Child's Nervous System (2019) 35:1925–2020
https://doi.org/10.1007/s00381-019-04316-8

ABSTRACTS

47th Annual Meeting of the International Society for Pediatric Neurosurgery

Birmingham, 20 - 24 October 2019
ISPN 2019 Meeting Chair: Guirish A Solanki
ISPN 2019 President: Wolfgang Wagner
ISPN 2019 Scientific Chair: Francesco Sala
ISPN 2019 Scientific Co-Chair: Abhaya Kulkarni

Platform Abstracts

Craniofacial Session I
Hall A, Monday, 21st October 2019, 08:15 - 09:55

PF-002

Spring-assisted Posterior Vault Expansion: The GOSH experience

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OBJECTIVE:Spring-assisted Posterior Vault Expansion (PVE) is another technique for calvarial vault expansion. Advantages include its less invasive technique and reduced morbidity, with potential drawbacks due to the need for a second procedure for spring removal and the lack of available long-term follow-up data. Since 2008, at Great Ormond Street Hospital, London (GOSH) the majority of patients requiring vault have been treated with PVE.
MATERIAL-METHODS:Data from all patients treated with PVE at GOSH were collected for analysis on: diagnosis, gender, indication for PVE, previous craniofacial procedures, CSF and ICP bolt procedures, age at surgery, operation and anesthetic time, hospital stay, blood transfusion requirements, time of springs in situ, number of springs used, additional (cranio)facial procedures, and complications.
RESULTS:Since 2008, a total of 177 cases underwent PVE (158 patients, 94M:64F). 139 patients underwent a single PVE at a mean age of 24.6 months; of these, 15 had a previous craniofacial procedure and 19 required additional (esthetic) procedures. In 13 patients, PVE was repeated at an average age of 35.8 months old - 1 had a previous craniofacial procedure and 1 needed an additional rigid expansion. PVE was indicated in 80% for raised intracranial pressure (RICP), in 3% for prevention of RICP and in 17% for esthetic reasons. Average operation time was 143 minutes for a first PVE and 188 for a redo. Blood transfusion was needed in 65% of patients when springs were inserted and in 21% at time of spring removal. For the latter group, 32 patients underwent Fronto-Orbital Remodelling and 78% needed a blood transfusion. Average hospital stay was 3 nights (range 0-203). Complications occurred in 23 patients: 1 death, 3 cases with Oxford Grade 4, and the rest Grade 1 to 3.
CONCLUSION:Based on our experience, PVE with springs remains our procedure of choice for a select patient group.

Keywords: posterior vault expansion, cranioplasty, vault, spring assisted surgery, craniofacial surgery, PVE

PF-003

Cranial-orbital changes in infants with anterior synostotic plagiocephaly

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OBJECTIVE:The effects of premature fusion of one coronal suture cause skull and orbital alterations in term of side-to-side asymmetry. This study aims at assessing the cranio-orbital complex changes related to the severity of skull-base dysmorphology in patients with unicoronal synostosis.
MATERIAL-METHODS:24 infants affected by unicoronal synostosis were subdivided in three subgroups according to the severity of skull-base deformity and their high-resolution CT images were quantitatively analyzed (groups IIa,IIb, III). Dimensions of cranial fossae, intracranial volume (ICV), ICV synostotic and ICV non synostotic side, whole brain volume (WBV), orbital volumes (OV), ICV/WBV, ICVsynostotic /ICVnon-synostotic and OVsynostotic/OVnon-synostotic were evaluated.
RESULTS:Asymmetry and reduction in the growth of the anterior and middle fossae were found in all groups while asymmetry of the posterior cranial fossa was found only in IIb and III groups. In all groups ICV, WBV, ICV/WBV were not significantly different while ICVsynostotic/ICVnon-synostotic and OVsynostotic/OVnon-synostotic resulted significantly different ($p<0.05$). ICVsynostotic side resulted reduced only in group III. OV on the synostotic side was not significantly reduced although a trend in progressively reducing volumes was noted according to the severity of the group.
CONCLUSION:Skull and orbital changes revealed a side-to-side asymmetry but the effects of the premature synostosis were more severe in group III suggesting an earlier timing of premature unicoronal synostosis in group III respect the other groups. The assessment of the skull base deformity might be an indirect parameter of severity of skull-orbital changes and it might be useful for the surgical planning

Keywords: anterior plagiocephaly, coronal suture

PF-004

Ten years review of « H craniectomy » technique for sagittal synostosis in 436 patients – evaluation of surgical aspects, aesthetic and cognitive outcome

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OBJECTIVE:"H craniectomy" – open approach with partial craniectomy- represents one of the principal surgical techniques for

scaphocephaly treatment. Several variations and mini invasive approaches have been proposed in the last years. This is the largest long-term retrospective outcome study aiming to evaluate this technique.
MATERIAL-METHODS:Between 2008 and 2018, 567 patients underwent H craniectomy for sagittal synostosis correction in a single center (Necker Hospital, Paris). 476 patients were included. Several parameters were analyzed: removal of coronal sutures, cranial index (preoperative and late post-operative), associated closure of metopic suture at surgery, late postoperative fusion of coronal sutures and presence of copper-beaten appearance in imaging. The aesthetic outcome was evaluated using a Whitaker scale by one single surgeon. The presence of cognitive problems was recorded.
RESULTS:64% patients were operated before 6 months of age, 30.5% were operated between 6 months and 1 year of age, and 5.5% were operated after 1 year of age. Mean follow-up was 5.6 years (range 0.2 – 10.4). Mean cranial index was 70 preoperatively and 73 postoperatively. 58.4% presented radiologic fusion of the coronal sutures at late follow-up and imaging showed 17.3% with copper-beaten appearance on late follow-up imaging. 19% presented an insufficient aesthetic result (Whitaker III or IV). 2.1% had papillary oedema at some point during their follow-up. 27.7% reported headaches at some point of their follow-up. 75% had no reported cognitive problems and 5.4% presented a cognitive or language impairment needing professional assistance. 7 (1.5%) patients had surgical revision.The comparison between the classic technique and the surgical variant where coronal sutures were removed did not show any statistically significant differences in cognitive (p=0.633), aesthetic (p=0.782) or radiologic (p=0.461) outcomes.
CONCLUSION:H craniectomy is a safe and effective procedure. Removal of coronal sutures did not change the incidence of secondary coronal fusion, aesthetic and functional outcomes.

Keywords: H craniectomy, scaphocephaly, cognitive outcome, aesthetique outcome

PF-005

Separation of Craniopagus twins – philosophy, techniques and innovation; lessons learnt from the GOSH experience of 3 sets of twins

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OBJECTIVE:Craniopagus twins are rare entities with approximately 10 pairs surviving the neonatal period per annum, globally. The GOSH team has till date separated 3 sets of twins. We present here our cumulative experience of the 3 sets with particular emphasis on the 'lessons learnt' in planning and execution of the separation.
MATERIAL-METHODS:Three sets of craniopagus twins underwent separation at GOSH. All 3 sets were of the O'Connell Total Vertical configuration. The 2006 case (CPT 1) was a Type 1, the 2011 case (CPT 2) a Type 3 and the 2019 set (CPT 3) a Type 2 configuration. Staged separation was undertaken in all 3 cases spanning some 6 months for each case. Neurovascular separation was undertaken first and once completed, tissue expanders were inserted and the final separation undertaken. For planning the separation cross-sectional imaging, MR flow studies, Digital subtraction angiograms, 3D photogrammetry, finite element modelling, rapid prototyping, 3 D modelling, computer simulations and virtual reality holograms were utilized.
RESULTS:The 6 twins survived the separation process.From CPT 1 both girls are diagnosed on the ADHD spectrum and require extra support at school. One twin has a mild weakness on one side; she is ambulant and able to use her affected arm for gross motor skills.From CPT 2 one twin is on the ASD spectrum.From CPT 3, one twin suffered a venous infarct resulting in a weakness in her left arm and leg. Follow up is short to comment on final recovery and cognitive outcome.All 3 sets presented with Cardiac and Renal compromise which deteriorated during the separation process and settled upon final separation.
CONCLUSION:Staged separation has a lower morbidity and mortality profile for Craniopagus twins of the total vertical classification. This does require stringent, multidisciplinary planning and execution. The venous anatomy and its separation is key.

Keywords: Craniopagus, Conjoint, 3D modelling, innovation

PF-006

A multistaged surgical separation in a total vertex craniopagus with crossed venous drainage: The Ribeirao Preto-Brazil experience

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OBJECTIVE:Craniopagus twins is the rarest anomaly seen in conjoined twins. Craniopagus can be classified into complete or partial, depending on whether or not they have shared dural venous sinuses and into angular or total depending on the alignment of the inter-twin longitudinal axis. The separation of craniopagus is a very rare and complex challenge needing detailed evaluation and planning., A multi-disciplinary approach is mandatory. We present the first latin american craniopagus case sucessfully separated in Brazil.
MATERIAL-METHODS:A 2-year-old female craniopagus twins who underwent a staged separation of their craniums in 2018. They were classified as a total craniophagus vertical type III. Initial radiology work-up was directed towards determining the potential connection between the twins' brains. An MRI and CT study showed that the brains abutted vertex to vertex. Twin A possessed the primary venous outflow pattern with the major sagittal sinuses. A medical 3D-model reconstructed from the CT venous angiogram showed the anomalous venous patterns. Neuronavigation was also used.
RESULTS:A total of 4 multistaged neurosurgeries and one for use of skin expanders were performed. Four major stages for 8 months led to their successful separation. After surgery number 1 and 3 the Twin B developed seizures in postoperative period. There has been no CSF leak or meningitis.
CONCLUSION:Successful separation of viable conjoined twins has been historically a great rarity. The multistaged surgery reduced complications improving venous drainage, prevent increased venous pressure, diminish cerebral edema. Success clearly requires an understanding of the complex interrelationship between the "separation" and the "reconstruction" and that decisions made for one aspect of the surgery will have a profound

impact on another aspect of the surgery. Successful separation of twins where both have come out of surgery without any neurological deficit remains a rare occurrence and in our mind the ultimate goal.

Keywords: craniofacial surgery, craniopagus, conjoint twins,

PF-007

Un-operated Craniosynostosis - A Review of the Decision Making Process and Patient Outcomes

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OBJECTIVE:Review of un-operated craniosynostosis (CS) patients to explore the decision making process and evaluate patient satisfaction and neurodevelopmental outcomes.
MATERIAL-METHODS:Patients with un-operated CS were identified (N=102, 74.5% Male), average age of 17 months at initialpresentation (Range 2-133months). Clinical information, including decision-making and speech and language data were collated. Satisfaction questionnaires were distributed. A range of open-ended and scaled fixed-response questions were included.Of those identified as un-operated, 56% had a metopic diagnosis (N=57), 37% sagittal (N=38), 4% unicoronal (N=4) and 3%lambdoid synostosis (N=3). The craniofacial MDT categorised patients based on severity, 83% classified mild (N=73), 17% moderate(N=15) and 1% severe (N=1). Inter-rater reliability was monitored across the categorisation process.
RESULTS:On review, decision not to operate was made by the craniofacial team in conjunction with parents (79%) or parental choice where the MDT offered surgical and non-surgical options (21%). We reviewed neurodevelopmental outcomes and receptive and/or expressive language skills. No patients had ophthalmological or radiological concerns of raised ICP. One patient had some features that may represent clinical concern. This patient proceeded to ICP monitoring that was normal. Qualitative comments collated through parent satisfaction surveys (N=38; 44%) revealed key themes. Several parents reported great improvement in head shape (N=10), with others commenting that head shape had worsened over time (N=10). Parents of mild sagittal patients reported significant differences in noticeability and impact of head shape ($P<.05$).
CONCLUSION:It is appropriate to consider a non-operative surveillance strategy in patients with mild CS or with complex medical needs. Appropriate clinical, ophthalmological and radiological assessment should be performed. Satisfaction data highlights the differing needs and concerns amongst un-operated patients. Consideration to the ways in which these families can be further supported is required.

Keywords: Craniosynostosis, Un-operated, Decision Making,

Craniofacial Session II

Hall A, Monday, 21st October 2019, 11:00 - 12:50

PF-008

Characterization of calvarial stem cells toward the optimization of cranioplastic strategies

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OBJECTIVE:Background and aims. Mesenchymal stromal cells (MSC) are well-known bone progenitors within the bone marrow niche. This has been widely characterized in long bones developing through endochondral ossification, while fewer data are available on the biology of the skull bone osteogenic niche. Craniofacial sutures provide a unique niche for MSCs for craniofacial bone homeostasis and repair. Since surgical cranial remodelling is often associated with morbidities of variable degrees, the aim of this study was to characterize the calvarial MSC niche in human bone specimens, in order to identify suitable tool to implement and ameliorate the cranial reconstruction strategies.
MATERIAL-METHODS:Methods. Calvarial tissues were collected from surgical waste of patients undergoing cranial remodelling and served for MSC isolation. MSC isolated from bone marrow served as controls. MSC's immunophenotype was confirmed by flow cytometry. The following lineage-specific markers were analysed in MSC, under growth and osteoinductive conditions, by immunofluorescence and qPCR: THY1 (skeletal stemness-marker), GLI1 (putative calvarial stemness-marker), AXIN2 (mesenchymal cell fate determinant), TEK and ENPEP (bone marrow stem cells differentiation markers). MSC were also grown on a novel 3D-printed PMMA based support in order to study cellular viability and cytotoxicity (by MTT test).
RESULTS:Results. All calvarial MSC homogeneously expressed the THY1+/GLI1+/AXIN2+/ITGAV+/TIE2-/ENPEP- phenotype, indicating that explant cultures allow selecting comparable cell populations, regardless of the patient phenotype. Upon in vitro osteogenic induction, the expression of THY1 and GLI1 decreased, whereas AXIN2 levels increased, in calvarial-derived cells. MTT test highlighted a higher level of biocompatibility of the 3D-printed biomaterial. Indeed, the mortality of MSC cultured on the biomaterial was about 9% after 72 hours.
CONCLUSION:Conclusion. MSCs isolated from calvarial sutures expressed a specific marker profile. In particular, THY1+/GLI1+ representing the stem cells within the human calvarial niche. MSC could implement the efficacy of osteo-biomaterial for innovative therapeutic strategies exploitable for craniofacial bone remodeling.

Keywords: mesenchymal stromal cells, suture niche, craniofacial bone reconstruction, craniofacial surgery, bone regeneration

PF-009

A detailed investigation into the microarchitecture of the calvarial bones in Crouzon syndrome

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OBJECTIVE:Crouzon patients' main feature is a brachycephalic skull, due to the premature fusion of the coronal sutures. This condition is associated with mutations in the FGFR2 gene. Previous studies have suggested that the effect of this mutation may be dependent on the cell origin of the bone. The

neural-crest cells form the frontal bone, while the parietal bone has a mesodermal origin. This study attempts to investigate the impact of FGFR2 mutation on the micro-architecture of the calvarial bones.
MATERIAL-METHODS:Micro-Computed Tomography was used to perform imaging of the dissected calvarial bones of the FGFR2C342Y/+ mouse model (mimicking Crouzon syndrome). Postnatal Control and FGFR2C342Y/+ mice at the postnatal age of seven (P7) and fourteen (P14) days were scanned at a resolution of 2.75 um. After selection of a reproducible region of interest, binarization was used to highlight the bone for analysis. Bone Volume (BV), Bone Volume/Total Volume (BV/TV) Bone Thickness (Th) and Bone Mineralization Density (BMD using a phantom model) parameters were analysed using CTAn (Bruker).
RESULTS:A total of 40 mice were used. Bone morphometric results revealed that the BV, BV/TV, Th and BMD were significantly lower in the FGFR2C342Y/+ mice ($P<0.01$ for all of them). Consistently, the bone morphometric results of the P14 FGFR2C342Y/+ frontal bone also demonstrated a significantly lower BV, BV/TV, Th and BMD in the FGFR2C342Y/+ mice ($P<0.05$ for all of them). Although the parietal bone showed no significant differences, the mutants appeared to have a greater number of homogeneous distributed holes.
CONCLUSION:These results suggest that the neural-crest cells, which form the frontal bone, are considerably more affected during osteogenesis compared to the mesodermal cells, which form the parietal bone. These results expand the knowledge about the Crouzon syndrome and provide clinicians with information that may be essential throughout the (surgical) treatments of a Crouzon patient.

Keywords: craniofacial, crouzon, craniosynostosis, microarchitecture, tomography

PF-010

Fronto – Orbital Remodeling in Coronal Synostosis Treatment: Review of a Series of 55 Children, Investigating Respective Role of Surgical Technique and Molecular Diagnosis on Long Term Results

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OBJECTIVE:The aim of fronto-orbital advancement (FOA) is to prevent or treat functional problems and to obtain a better craniofacial shape in terms of symmetry and proportion, without interfering with normal growth. Evidence suggests that also molecular diagnosis can influence the surgical outcome.
MATERIAL-METHODS:To investigate the respective influence of surgical technique and genetic pattern on cosmetic results, we reviewed a sample of 55 children affected by coronal synostosis, unilateral in 32, bilateral in 16 patients, 7 multiple with a prevalent coronal expression, surgically treated at FINCB. The mean age was 8 months (range 5- 26) and all children were treated by FOA, the majority with rigid and a few with absorbable plate fixation.All children underwent molecular studies. FGFR3, FGFR2, FGFR1, TWIST1 and TCF12 genes were screened. The pre and post-surgical evaluations included clinical assessment, photographic studies, CT images with 3D reconstructions and brain MRI.
RESULTS:There were no major complications, neither lack of ossification or large deformities.A molecular diagnosis was obtained in one third of the series (18/55); the identified patterns were: p.Pro250Arg mutation in FGFR3 gene, mutations in the TWIST1 and TCF12 genes.Cosmetic and functional surgical results were analysed in relation with molecular results, grading the surgical long term results on the basis of photographic measurements and need for further corrective surgeries.
CONCLUSION:The reported surgical technique allowed an accurate bone remodelling. The rigid fixation was effective for long term stabilization. Overcorrection of the defect partially compensated the recurrence due to the phenotype. Despite this, syndromic children had worse results.

Keywords: craniosynostosis, coranal suture, cranioplasty, frontorbital advancement

PF-011

Towards a Radiation Free Numerical Model for Spring Assisted Cranioplasty Surgical Planning

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OBJECTIVE:Spring-Assisted Cranioplasty (SAC) is an established method for treating scaphocephaly in young children at Great Ormond Street Hospital. Our group showed that surgical outcomes can be predicted using a numerical model. However, it relies on the availability of CT scans, which is not routinely performed. We hereby investigated a method for creating a simplified model for predicting the SAC outcomes, which only relies on the availability of head surface details, retrievable from radiation-free 3D scans.
MATERIAL-METHODS:Eight SAC Patients with preoperative CT scans were retrospectively recruited (male, age=5.1±0.4 months). Information on osteotomy locations, spring model and post-operative spring opening were recorded in theatre. Three models were created for each patient: two simplified models, where a constant thickness calvarial model was created from the head shape, and a third, where the skull and sutures were directly segmented from CT (PS). In the first simplified model, a patient specific average value of scalp and skull thickness were used (sPS). In the second, population averaged thickness values were used (sPA). Each model was imported into ANSYS for spring expansion numerical modelling. Anterior and posterior spring opening (OP) were retrieved and averaged for each model, and compared with on-table measurements (OPM).
RESULTS:The average recorded spring opening OPM was 35.0±2.6 mm. The PS model yielded a prediction error of 4.2%±1.8% of the maximum spring size; the sPS and sPA model yielded higher but comparable values (9.6%±3.9% and 9.3%±4.6%).
CONCLUSION:Finite element modelling is a suitable technique for predicting the outcome of SAC. This work shows that a simplified model created from the head surface shape using averaged skull and scalp thickness yields an outcome prediction error within 6mm of the measured values. Further modelling refinements will allow the use of this predictive tool during preoperative planning

Keywords: scaphocephaly, spring cranioplasty, finite element modelling

PF-012

Cerebellar tonsillar position and skull base deformities in syndromic craniosynostosis

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OBJECTIVE:Several brain anomalies have been described in syndromic craniosynostosis, including tonsillar herniation (TH) and Chiari I malformations (CM-I). However, the pathogenesis is unclear, and TH/CM-I is frequently asymptomatic. The purpose of this study was to assess the extent of the skull base deformation in syndromic craniosynostosis, compared to controls. Moreover, its association with tonsillar position (TP) was evaluated.
MATERIAL-METHODS:All patients with syndromic craniosynostosis, who underwent MRI-scanning, were included. Skull base angle (SBA), clivus length (CL), foramen magnum area (FMA) and TP were measured in a 3D platform. Linear mixed models were developed to clarify the differences between syndromic craniosynostosis and controls, corrected for age. All syndromes were evaluated separately.
RESULTS:: 284 Scans in 147 patients (Apert n=62, Crouzon n=150, Muenke n=38, Saethre-Chotzen (SCS) n=40), and 149 controls were included. TH and CM-I prevalence differed amongst the syndromes (Apert 18% and 15%, Crouzon 16% and 47%, Muenke 20% and 10%, and SCS 11% and 4%, respectively). In the control group 13% showed TH, and 2% had a CM-I. CL (mm) and SBA (degrees) were significantly smaller in all syndromes versus controls (p-values ranging from <0.001 to 0.03, for all syndromes independently). FMA (mm^2) was significantly smaller in Apert, Crouzon and SCS ($p<0.001$). TP was significantly lower in Crouzon and Muenke ($p<0.001$). In controls, a smaller CL and larger FMA were significantly associated with a lower TP. In syndromic craniosynostosis, the sample size was adequate to develop a model with TP as the outcome in Crouzon only. In these patients, a larger FMA was significantly associated with a lower TP ($p=0.008$).
CONCLUSION:Skull base measures are significantly different in all craniosynostosis syndromes versus controls. In Crouzon syndrome, the FMA is smaller compared to controls. However, a larger FMA compared to other Crouzon patients, is significantly associated with a lower TP.

Keywords: Tonsillar herniation, Chiari-I malformation, skull base configuration, syndromic craniosynostosis

PF-013

Safety and efficacy of independent allied healthcare professionals in the assessment and management of plagiocephaly patients

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OBJECTIVE:To determine the efficiency of the BCCH Plagiocephaly Clinic which is supervised by an occupational therapist in the management of positional plagiocephaly patients, and to investigate the clinic's ability to appropriately identify and refer patients with craniosynostosis to Pediatric Neurosurgeons for further assessment.
MATERIAL-METHODS:A retrospective chart review was conducted to identify patients who were assessed and managed at the BCCH Plagiocephaly Clinic between 2008 and 2014. Data on patient demographics, head shape measurements, and treatment were collected, and the BC Children's neurosurgical database was cross-referenced to identify craniosynostosis cases missed by the Plagiocephaly Clinic. A descriptive analysis of the average wait times, severity of patients' plagiocephaly, and interventions was conducted. In addition, the sensitivity and specificity of the clinic's ability to appropriately refer craniosynostosis patients to Pediatric Neurosurgery were calculated.
RESULTS:1752 patients were assessed, 66% of patients received counseling about repositioning, 34% were referred for head banding, 19% were referred to physiotherapy for torticollis and 1.4% were referred to the BC Children's Pediatric Neurosurgery Clinic for suspicion of craniosynostosis. The mean time from referral to first assessment by the Plagiocephaly Clinic was 41 days, and time from referral by the Plagiocephaly Clinic to diagnosis of craniosynostosis by a pediatric neurosurgeon was 8 days. Pediatric neurosurgeons requested imaging for 6 of the referred patients (25%). The sensitivity and specificity of the Plagiocephaly Clinic for referral of craniosynostosis patients to the Pediatric Neurosurgery Clinic were 100 and 99 percent, respectively.
CONCLUSION:The BC Children's Plagiocephaly Clinic is efficient and safe for the initial evaluation and treatment of patients with positional plagiocephaly. The clinic's model decreases wait times, appropriately manages patients with positional plagiocephaly, screens for craniosynostosis with high sensitivity and specificity and takes pressure off outpatient neurosurgical clinics. This model for assessment of plagiocephaly could be considered in other medical centers.

Keywords: plagiocephaly clinic, positional plagiocephaly, craniosynostosis, outpatient management

PF-014

Abnormal venous drainage in complex craniosynostosis may cause ventriculomegaly

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OBJECTIVE:The management of complex forms of craniosynostosis depends on several interdependent factors. Abnormal venous drainage has been reported in these patients, but its anatomical description and evolution is not well described, in particular the risk for ventriculomegaly. The aim of this study was to identify the pattern of the collateral venous network in faciocraniosynostosis and to correlate its evolution with the surgical strategy.
MATERIAL-METHODS:Between 2000 and 2018, among 248 patients managed for complex craniosynostosis managed at Necker - Enfants Malades Hospital, a preliminary group of 21 patients underwent a sequential MRI with 3D T2 acquisitions and venous imaging, including 2D TOF imaging, Inhance©(GE, Texas, USA) imaging or 3D gadolinium enhanced T1 imaging. The patients were analyzed according their syndrome (Crouzon, Pfeiffer, Apert). For each patient, the effect of surgery on venous development and ventriculomegaly were assessed.
RESULTS:33% of the patients carried bilateral bony stenosis of the jugular foramina. The left jugular bulb was never visualized, and the right jugular bulb was visualized in 17% of the patients. The collateral venous network developed based on three anatomical venous cranial base systems: the anterior system (ethmoidal-frontal-ophtalmic veins, 83%), the

middle system (pterygoid plexus, 92%) and the posterior system (torcular-mastoid-condylar emissary veins). A generalized logistic regression model suggested that ventriculomegaly correlated with bilateral bony stenosis (p=0.03) and the absence of the right jugular bulb (p=0.05). The analysis of venous network distribution in each syndrome and the result and impact of surgery on venous system is currently in progress.
CONCLUSION:Patients with complex craniosynostosis present bilateral stenosis of the jugular bulbs with subsequent development of a collateral venous network. This network runs through three anatomical cranial base systems. Our data suggest that ventriculomegaly develops in case of true bilateral obstruction of the jugular bulbs.

Keywords: faciocraniosynostosis, venous collateral network, hydrocephalus, surgical strategy, venous anatomy

PF-015

Cerebral perfusion in simple craniosynostosis using arterial spin labelling MRI

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OBJECTIVE:Isolated craniosynostosis is often thought to be a benign condition with mainly aesthetic repercussions but psychomotor delay has been reported. A few studies have assessed the impact of this condition on cerebral perfusion using SPECT. We hypothesized that craniosynostosis can influence the cerebral blood flow (CBF) by constricting or deforming the brain. Arterial-spin-labelling MRI (ASL) is a validated technique to assess the CBF. The aim of this study was to measure the perfusion of various areas of the brain using ASL in patients with craniosynostosis.
MATERIAL-METHODS:We included 110 patients, 60 with scaphocephaly, 20 with plagiocephaly and 30 controls. None of the patients had other brain conditions or known mutations. ASL measurements were performed on pre-operative MRI by the same operator for all the patients using 100 mm2 ROI for each of the following areas on both sides: frontal, parietal, temporal, occipital, insula, brainstem, and cerebellum.
RESULTS:In the group of 60 patients with sagittal craniosynostosis, a lower cerebral perfusion was observed in the occipital and parietal areas compared to the control group in both sides ($p<0.05$). In the group of 50 patients with scaphocephaly less than 1 year old, a lower occipital cerebral perfusion was observed compared to the frontal area ($p<0,001$). This difference was not found in the group of 10 patients older than 1 year.In patients with plagiocephaly, no difference of cerebral perfusion was shown between the side of the coronal fusion and the other side.
CONCLUSION:Premature fusion of skull sutures influences brain perfusion. Sagittal synostosis seems to lower the posterior perfusion of the brain. The impact of unilateral coronal synostosis needs further investigations because of the physiological difference of ASL between the right and the left hemisphere due to normal maturation. A pre/post-operative study is furthermore needed to assess the benefits of surgery.

Keywords: Craniosynostosis, perfusion MRI

Session on Infections

Hall B, Monday, 21st October 2019, 14:25 - 15:00

PF-016

Brain abscess in children, a two centre audit - outcomes and controversies

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OBJECTIVE:The aims of this study were to better characterize clinical presentation, management and outcome in infants and children with brain abscesses and to highlight ongoing controversies surrounding the treatment of this condition.
MATERIAL-METHODS:The authors conducted a retrospective multicenter study over a 25 years period (1992-2017). During this period, 116 children and 28 infants (age< 1 year) with brain abscess were treated in 2 national reference centers.
RESULTS:Mean age at diagnosis was 102.3 +/- 54 months in children and 2.5 +/- 2.4 months in infants. Significant differences were observed between children and infants. The most common predisposing factor was meningitis in infants (64% of cases versus 3% in children) while it was otolaryngology-related sepsis in children (31% of cases versus 3.6% in infants). Infants presented more frequently with fever and meningism compared with children. 115 patients were treated with aspiration, 11 with excision. Re-operation was required in 29 children versus 1 infant. The overall mortality rate was 4% (3.4% for children, 7.1% for infants). At 3 months follow-up, the outcome was favorable in 86% of children versus in 68% of infants.
CONCLUSION:There is a clear dichotomy between children and infants in terms of predisposing factors, causative organisms and outcome. Despite surgical drainage and directed antibiotic therapy 20% of patients with brain abscess require additional surgery. Mortality is improved compared with historical series however long-term morbidity is significant particularly in the infant population.

Keywords: brain abscess; children; magnetic resonance imaging; pediatric neurosurgery

PF-017

Pattern and risk factor analyses for re-operations in the management of subdural empyema – eleven-year single centre review

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OBJECTIVE:Intracranial subdural empyema (SDE) is a serious condition and successful treatment often requires multiple surgeries. This 11-year review reports the contemporary demographics, clinical features, causative organisms, re-operation pattern, risk factors for re-operations and outcome in this patient group.
MATERIAL-METHODS:This was an 11-year (2006-2017) retrospective review of all SDE cases in a regional paediatric neurosurgical unit. Logistic regression analysis was performed to identify significant risk factors predisposing re-operation.
RESULTS:Forty-seven patients were treated for SDE. Twenty-seven (57%) were male. The mean age was 11.9 years (2.5-16.0). The commonest presenting clinical features were headache (79%), fever (72%), focal deficit (47%), vomiting (43%), seizure (28%) and meningism (21%). The primary source of infection was sinusitis in 45 patients (96%). Forty-five patients (96%) had supratentorial disease; eight of them had bilateral collections. For the unilateral cases, the most common locations were convexity with interhemispheric collection (16 cases), and convexity (12). Forty-three patients (91%) underwent surgical evacuation. The mean number of operations per patient was 1.5; 4 (9%), 23 (49%), 15 (32%), 4 (9%) and 1 (2%) patients had 0, 1, 2, 3 and 4 operations, respectively. In re-operation cases, the mean time interval between the 1st and 2nd surgeries was 11 days. Forty-one patients (87%) underwent sinus surgery. In 31 patients (66%), Streptococcus anginosus group was the main causative organism. Mean antibiotic treatment duration was 9.5 weeks. The probability of requiring second surgery after the first was 47%; 3rd after 2nd 25%; and 4th after 3rd 20%. On regression analysis, absence of seizure at presentation and number of lobes covered by SDE were associated with increased risk of repeat operations. All patients had a favourable outcome.
CONCLUSION:In this large contemporary series, sequential re-operation rates and risk factors for re-operations were determined. Such information is useful for prognosis, planning interval scans and counselling patients and families.

Keywords: Subdural empyema, re-operation, risk factors

Session on Special Topics: Hindbrain Hernia & Syringomyelia II

Hall A, Monday, 21st October 2019, 16:45 - 17:32

PF-019

Fourth ventricle stent placement for Chiari type 1 malformation and cranio-vertebral junction anomalies: institutional experience

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OBJECTIVE:Surgery for Chiari malformation type 1 (CM1) and cranio-vertebral junction anomalies (CVJA) involves different techniques, essentially bone sub-occipital decompression and C-1 laminectomy eventually associated to duroplasty and tonsillar coagulation.Stent placement from the fourth ventricle to the cervical subarachnoid spaces has been proposed to promote CSF circulation at the level of cranio-vertebral junction (CVJ).The aim of this study was to review our experience in order to precise surgical technique and indications and to evaluate results and surgical complications.
MATERIAL-METHODS: The Necker surgical database was reviewed to identify all patients who underwent stent placement for CM1 and CVJA. The clinical and radiological data as well as the operative reports, post-operative complications and follow-up recordings were analysed.
RESULTS:Between 2008 and 2019, 40 among 311 CM1 and CVJA operated patients underwent a fourth ventricle stent placement. Thirty-five patients presented primary CM1, while in 5 cases cerebellar tonsil herniation was associated to other conditions.Stent placement was performed in 17 cases as first surgery in case of deficit of CSF outflow controlled by ultrasound at the CVJ after bony decompression and dural opening and in 23 as re-exploration for persistent syringomyelia or unremitting symptomatology. The mean follow-up period was 35 months. Complications including re-operation and stent replacement were observed in 4 cases, 2 due to infection, one to malposition, one for stent migration. Follow-up MRI showed a reduction in all but two of the 34 patients who presented preoperative syringomyelia. Among 11 patients with preoperative central sleep apneas, resolution was observed in 6 cases, amelioration in 3, while 2 patients were no further investigated.
CONCLUSION:Fourth ventricle stent placement associated to posterior cranio-vertebral decompression can be an effective and safe adjuvant technique for CM1 and CVJA, for either severe syringomyelia associated to CVJA or operated CM1 with persistent symptoms.

Keywords: Chiari malformation type 1, stent, syringomielia, cranio-vertebral junction anomalies

PF-020

Acquired Hindbrain Herniation after Shunting of Intracranial Arachnoid Cysts

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OBJECTIVE:Hindbrain herniation (HH; cerebellar tonsillar herniation, CTH; Chiari I malformation, CIM) has been reported as an acquired condition following cerebrospinal fluid (CSF) shunt placement. This has been reported after intracranial as well as lumbar CSF shunts. Specifically, hindbrain herniation has been reported after shunting intracranial arachnoid cysts. The incidence and predictive variables of this unusual complication have not been determined.
MATERIAL-METHODS:We reviewed the medical records of 64 patients who underwent shunting procedures for intracranial arachnoid cysts to determine if HH developed post-operatively. Measured variables included patient age, cyst size and location, shunt valve pressure, intracranial catheter location (within the cyst vrs subdural) and degree of cyst reduction.
RESULTS: Of 64 patients who underwent shunt procedures for arachnoid cysts, 49 had the proximal catheter placed within the cyst (cysto-peritoneal shunt, CPS), 13 had the proximal catheter placed in the subdural space (subduro-peritoneal shunt, SDS), and 2 patients had ventriculo-peritoneal shunts (VPS) placed. The patients who received SDS all had pre-operative subdural fluid collections either from spontaneous rupture of the arachnoid cyst (11) or as a result of prior operative fenestration (2). None of the patients undergoing SDS developed HH. Sixteen (33%) of the patients who received CPS developed hindbrain herniation. Hindbrain herniation was generally apparent by one year post-operatively. The development of HH correlated with the percentage of post-shunt cyst reduction and younger patient age. Additionally, the degree of post-shunt cyst reduction was influenced by the shunt valve pressure. Interestingly in 3 patients, reduction in HH was observed in cases of CPS occlusion.
CONCLUSION:Hindbrain herniation (acquired Chiari I malformation) may occur more frequently than previously appreciated after cysto-peritoneal shunt placement. CSF overdrainage likely plays a significant role in the pathogenesis of this condition.

Keywords: Acquired hindbrain herniation, cysts-peritoneal shunt

PF-021

How to nail a Devil: simple tips for the instrumentation in complex Cranio-Vertebral Junction anomalies without using fluoroscopy in Pediatric patients

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OBJECTIVE:This prospective study attempt to evaluate the clinical accuracy of Knock and Drill technique for the screw placement in complex CVJ (Cranio-vertebral junction) anomalies with various articular mass asymmetry, vascular anomalies with rotational component (Devil).
MATERIAL-METHODS:Total 76 consecutive patients were included in the study that fulfilled the criteria of Complex CVJ (the Devil). A-complete/partial overcapitalized C1; B-at least one articular mass was Hypo-plastic(C1/C2); C-rotational component; D-variation in third part of VA (vertebral artery).Preoperative detail CT study of CVJ was done with 3D reconstruction. Total of 210 screws was placed using Knock and Drill technique,where we see and feel the articular details intra-operatively and score it without using X-ray. Follow up CT with saggital and axial cut in the direction of bone where the screws were placed was done between 5th -7th Postoperative day in all the included patients. The CT criteria of screws Breach was similar to Lumbar screw breach criteria. Follow up of 6 months was done.
RESULTS:total of 80 screws were placed in C1 lateral mass, no bony breach was encounter in any case. 54 C2 pedicle screws were placed where the breach was encountered in 2cases (0.95%). 76 C2 pars screw was placed and bony breach along with vertebral artery injury was encounter with 1screw (0.95%) and only bony breach was encountered in 1 case(0.95%).Total screw breach were 1.9%.
CONCLUSION:Existence of complex variable bony and VA anomaly at CVJ in complex CVJ anomalies [devils] demands individualized instrumentation policy and placing screws in each bone requires strategic preoperative planning and intraoperative skills. This simple technique enabled us to avoid X-Ray exposure to the patients as well as to the surgical team with fair amount of accuracy.

Keywords: Complex cranio-vertebral anomalies, Knock and drill technique, rotational component,Vertebral artery anomalies.

PF-024

Overcoming challenges in pediatric congenital craniovertebral junction instability

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OBJECTIVE:Surgeons face different kind of challenges while managing pediatric congenital atlantoaxial dislocation as compared to their adult counterpart. Softer bones, deformed joints and the concern of fusing multiple segments in growing age are few of them. The answer to these problems, to achieve good multiplanar realignment and fusion (short segment) of C1-2 joints through a direct posterior approach are described here.
MATERIAL-METHODS:64 pediatric patients with CAAD were operated through a direct posterior approach in the last 4.5 years. The joints were drilled and manipulated to achieve multiplanar realignment. C1-2 joints were fused (short segment). The pre and post operative clinic-radiological data was compared.
RESULTS:Atlanto-axial dislocation was irreducible in 40 and reducible in 24 patients. 51 patients were partially or totally dependent. The joints in the irreducible groups were oblique and deformed. Ten patients had lateral angular dislocation, 3 had C1-2 spondyloptosis and 5 had significant vertical dislocation. The bones were soft and partly cartilaginous. Techniques were modified to achieve optimal bony purchase subsequent to drilling the relatively small bones and prevent screw pull-outs during intraoperative manipulation for the problems we had faced in our initial cases. Despite the challenges in initial cases, realignment could be achieved in all. There was a significant improvement in follow up modified JOA score and 30 patients were independent at 4-month follow up. Two patients had partial redislocation at 4-month follow up.
CONCLUSION:Relatively deformed and oblique joints make complete spondyloptosis, severe vertical dislocation and lateral tilt common in this age group. Though pediatric bones are soft and small, it is possible to achieve multiplanar realignment by modifying the technique of drilling and manipulation of C1-2 joints. The realignment and short segment C1-2 fusion in these patients has a good radiological and clinical outcome.

Keywords: Challenges; Congenital atlantoaxial dislocation; Manipulation; Multiplanar realignment; Outcome; Pediatric

Session on Spine I

Hall A, Monday, 21st October 2019, 17:32 – 18:20

PF-025

Experience in 172 operated cases of tuberculosis of the pediatric spine

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OBJECTIVE:Spinal tuberculosis is complicated by presence of neural structures in the vicinity, additional factors like cartilaginous nature of bones, relative rapid destruction and the effect of growth modulation. This is a review of 172 cases of tuberculosis of pediatric spine operated on by the author.
MATERIAL-METHODS:In our series of 172 operated cases, surgical treatment was typically reserved for rapid onset dense neurological deficit and neurological deficit not improving with conservative treatment(78/172), significant deformity at presentation(36/172), panvertebral involvement (disease of both anterior and posterior column)(20/172). Significant mechanical instability/potential for future deformity(18/172),presence of large paraspinal abscesses causing mass effect(10/172), persistent pain not improving with chemotherapy(5/172) and need for definitive diagnosis(5/172) were also indications for surgical intervention.
RESULTS:Of the 78 patients with significant neurodeficit, 68 improved after surgery. Deformity was successfully corrected in all 36 patients and only one had a persisent neurodeficit. In children with panvertebral involvement, neurological recovery was seen in 16/20patients, and where prophylactic surgery was done, there was no worsening of neurological status in any (0/18). All 10 children that had aspirations of cold abscess had this done in the cervical spine and this reduced pain and torticollis.
CONCLUSION:There are a number of indications of surgical intervention in pediatric caries spine, although the majority of children (78%) still need only medical management. This figure is however based on children attending our outpatients service and has referral bias.

Keywords: tuberculosis spine, deformity

PF-027

Surgical decision making in congenital cervical scoliosis based on radiographic parameters

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OBJECTIVE:Indications for thoracolumbar congenital scoliosis surgery have been well described, however there is a paucity of literature exploring the threshold for surgical treatment of osseous cervical congenital scoliosis (CCS) in children. We explored radiographic differences between patients selected for surgery or observation to delineate factors in surgeon decision making.
MATERIAL-METHODS:Medical records were retrospectively reviewed for 38 pediatric patients treated by 3 differing surgeons from a single institution with CCS and a minimum of 2 years of follow-up. Patients were then divided into two cohorts: 1) operative (n=19) and 2) non-operative (n=19). Radiographic measures were compared between cohorts using Student-t tests.
RESULTS:38 patients were included (16 female: 22 male) with a mean age at presentation of 5.6 ± 4.1 years. The majority of curve apices (63%) were localized to C5 or C6. 50% of CCS patients underwent surgery a mean of 1.2 ± 1.3 months after presentation. The non-operative cohort had a mean follow-up of 4.4 ± 3.2 years with 7.2 ± 5.3° of cervical curve progression after presentation. At presentation, C7-CSVL was larger in the operative cohort (34.3 ± 21.4 mm) than the non-operative group (0.4 ± 28.9mm, p=0.012). T1 tilt was also smaller in operative patients (23.8 ± 7.8°) than non-operative patients (31.4 ± 13.3˚, p=0.048). Age, cervical, thoracic and lumbar curve magnitudes, other radiographic measures of translation, and cervical measures were not significantly different between groups.
CONCLUSION:50% of osseous congenital cervical scoliosis patients underwent cervical fusions and had less T1 tilt and greater C7 CSVL translation than patients recommended for observation. These radiographic parameters may influence surgeon decision making.

Keywords: Congenital Scoliosis, Cervical Deformity

Session on Epilepsy

Hall A, Tuesday, 22nd October 2019, 08:00 – 10:15

PF-028

Stereoelectroencephalography in Children: Lessons from the GOSH Experience

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OBJECTIVE:To report a large single centre experience of stereoelectoencephalography (SEEG) in children.
MATERIAL-METHODS:Retrospective cohort study of all SEEG cases undertaken at Great Ormond Street Hospital for Children between November 2014 and March 2019.
RESULTS:Seventy-five consecutive SEEG cases were identified in 72 patients with age range 3-19 (median 10.8) years. Indications for SEEG included lesion negative MRI (32.0%), patients in whom there was a lesion but non-concordant non-invasive investigations (18.7%) or the borders of the lesion were not defined (17.3%), patients with multiple lesions (14.7%) and those who had experienced recurrence following prior surgical treatment (17.3%). Between 5-19 (median 12) electrodes were placed per procedure and 19 (25.3%) were bilateral implantations. Complications included single electrode dysfunction in 4 cases (5.3%), haemorrhage in 2 cases (2.7%, one requiring emergency craniotomy for evacuation and both of whom recovered fully in 3 months) and a non-compliant patient pulling out the majority of electrodes prior to recording (1.3%). The seizure onset zone (SOZ) was identified in 54 patients and either resection or radiofrequency thermocoagulation (posterior insular SOZ) was offered in 51 (in 2, a peri-rolandic focus was found and resection was declined by the carers based on risk and in 1, insular thermocoagulation was declined by the carers due to improvement in seizure control). To date, 47 of these patients have undergone 50 treatments, including 41 tailored resections, 8 thermocoagulation procedures and one laser ablation. In resective specimens, histology was non-diagnostic (36.6%), focal cortical dysplasia (31.7%), tuberous sclerosis (19.5%) or other (12.2%). At 1 year follow-up following resective surgery, 56.5% were seizure-free (Engel Class 1).
CONCLUSION:SEEG in children is a safe technique. With careful selection, high rates of seizure freedom can be attained even in children with difficult-to-localise focal epilepsy.

Keywords: SEEG, epilepsy, focal epilepsy, stereoelectroencephalography

PF-029

Multimodal image guided frameless robot-assisted stereoelectroencephalography in pediatric refractory epilepsy: technical aspects and primary results

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OBJECTIVE:Stereoelectroencephalography (SEEG) is a popular technique for localization of epileptogenic zone (EZ) in children with drug-resistant epilepsy. The study herein described the multimodal image guided frameless robot-assisted SEEG technique and reported the preliminary outcomes in pediatric refractory epilepsy patients.
MATERIAL-METHODS:We retrospectively evaluated 17 children with drug-resistant epilepsy who were consecutively explored with SEEG, followed by individually tailored resective surgery or radiofrequency thermocoagulation (RF-TC) in all cases. A detailed anatomo-electro-clinical analysis of non-invasive EEG and SEEG data was performed. The primary results included seizure-freedom rates and complication rates.
RESULTS:Multimodal imaging was successfully used to guide stereotactic intracranial electrode implantation in MR negative refractory epilepsy and younger patients. The mean age at implantation was 7.10±3.69 years, with a range of 1.5–13 years. In total, 152 electrodes were implanted for an average of 9 electrodes per implantation. Fourteen implantations were unilateral (5 left and 9 right) and 3 implantations were bilateral. The average OR time was 5h. No patient demonstrated obvious hemorrhages. Electrode displacement was observed in 1 patient; and pneumocephalus in 2 patients. Seizure outcomes were analyzed for all children for at least 1 year of clinical follow-up. Twelve children underwent resection, and 5 underwent SEEG guided RF-TC. Of the 12 children who underwent resection, 10 had Engel class I, 1 had class II, and 1 had class IV outcomes. The 5 patients who underwent RF-TC were seizure-freedom.
CONCLUSION:Multimodal image fusion in pediatric refractory epilepsy patients improved the detection of EZ, and visualized the cerebral cortex and intracranial blood vessels three-dimensionally. The implantation of SEEG electrodes guided by multimodal image is safe and efficient, and is worthy of application in children with refractory epilepsy.

Keywords: Multimodal image; stereoelectroencephalography; refractory epilepsy; surgery

PF-030

The role of SEEG and FDG-PET in the pre-surgical evaluation of MRI negative epilepsy in children

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OBJECTIVE:The use of stereoelectroencephalography (SEEG) and FDG-PET in the pre-surgical evaluation of epilepsy is increasing. Their utility in MRI negative epilepsy in children is not widely reported.
MATERIAL-METHODS:We reviewed 8 children who underwent pre-surgical evaluation for MRI negative epilepsy at King's College Hospital from 2016 to 2018.
RESULTS:The median age at time of SEEG was 16 (range 9-17). The median age at epilepsy onset was 5 years (range 4-12) and duration of epilepsy was 9 years (4-13). In all patients, concordance between semiology, video telemetry and FDG-PET established a focal region of interest. The regions of interest were right frontal/central (1), right frontal/temporal (1), left frontal (1), left parietal (2), left temporal (1), left temporal/parietal (1), left perisylvian/insula/operculum (1). The mean number of electrodes was 11 (range 8-15). All implantations targeted the PET abnormality and adjacent areas to distinguish onset versus spread of seizures, map function, and delineate surgical resection. Surgical resection was offered to 6 patients (75%) in whom SEEG identified a focal onset. Resections consisted of frontal (2), parietal (1), frontal operculum (1) and temporal lobectomy (2). Intraoperative electrocorticography was used in 5 patients. The median follow-up is 4 months (range 4-18). The outcomes were Engel 1 (4), Engel 3a (2). Histology showed FCD type 2 in one patient and non-specific changes in all others.
CONCLUSION:SEEG facilitates surgical resection in selected children with MRI negative epilepsy. FDG-PET was essential in enabling and guiding electrode implantation. Notwithstanding the short follow-up, the improvement in seizures despite negative histology pose further questions regarding the structure of epileptogenic networks.

Keywords: epilepsy surgery, SEEG, MRI negative, PET

PF-032

Surgical Interventions in drug resistant epilepsy as a sequel to neonatal hypoglycaemia and hypoxia

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OBJECTIVE:To study epilepsy surgery outcomes in pharmaco-resistant epilepsy as a sequel to perinatal hypoglycemia and hypoxic ischemic encephalopathy in children <18 years.
MATERIAL-METHODS:Thoroughly worked up cases of pharmaco-resistant epilepsy, who underwent epilepsy surgery and have documented perinatal hypoglycemia, hypoxia and/or characteristic radiological findings were analyzed.
RESULTS: Of Total 183 pediatric epilepsy surgeries performed from July 2015 to February 2019, 39 patients qualified for present analysis. Cohort has mean age of 10.4 ± 4.9 years, majority (35) were males. Onset of epilepsy varied from 6 months to 8 years. Seizure frequency varied from once a month to multiple events daily. Electroclinically 28 patients had Lennox Gastaut syndrome. Patients were on multiple AEDs (mean of 3.3). Bilateral parieto-occipital gliosis was noted in 35 patients and unilateral in 4 patients. Surgeries with curative intent were done in 20 patients, while 19 offered palliative surgery (complete callosotomy). Temporo-parieto-occipital (TPO) disconnection was done in 10 patients, while parieto-occipital resection (POR) in 10 patients. Focal unilateral ictal onset in all the recorded seizures, ipsilateral inter-ictal discharges and predominant ipsilateral radiological affection were prerequisites for surgeries with curative intent. Ipsilateral Involvement of hippocampus favored TPO against PO resection in curative group. Formal visual field analysis was inconclusive in all patients. Visual disability reserve was judged by occipital lobe radiology and bedside visual field testing before offering curative surgery. Mean follow up was 15±10 (range 6-40) months. In curative group, 16 of 20 (80%) patients had engel grade 1 outcome (1a-13), 3 had grade 2. Seven patients complained worsening of visual disability without affection of daily routine. In palliative group, 2 patients are seizure free (1a), while 17 report no drop attacks with 60-70% decrease in seizures.
CONCLUSION:Curative surgeries offers excellent seizure outcomes in selected cases. Post-operative visual disabilities are well tolerated. Long term studies needed to substantiate claims.

Keywords: Epilepsy surgery, Hypoxic ischemic encephalopathy, Drug resistant Epilepsy, TPO disconnection, neonatal hypoglycaemia

PF-033

Risk Factors and Results of Hemisferotomy Reoperations

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OBJECTIVE:Evaluate preoperative factors that may result in failure of hemispherotomies and the outcome of reoperations.
MATERIAL-METHODS:Review of medical records of 15 consecutive cases submitted to hemispherotomy reoperation at a dedicated epilepsy surgery center between 2003 and 2018, with emphasis on the following data: age, etiology of epilepsy, surgical technique, surgical findings in reoperation, magnetic resonance imaging findings, Engel's classification and postoperative complications.
RESULTS:Out of 150 cases of hemispherotomy, 15 underwent reoperation due to recurrence of seizures. Rasmussen encephalitis, with 7 cases (47%), was the most frequent etiology, followed by hemimegalencephaly, with 6 cases (40%), porencephaly, 1 case (6.5%) and Sturge-Weber syndrome, 1 case (6.5%). The technique used was the peri-insular hemispherotomy without temporal lobectomy in 13 cases, with lobectomy in 1 case and parasagittal hemispherotomy in another case. In eleven patients there was radiological evidence of incomplete disconnection, of which 8 were in the splenium of the corpus callosum, 4 were in some other portion of the corpus callosum, and 2 had a remaining frontobasal connection, confirmed intraoperatively. In cases without MRI diagnosis, the surgical finding was: 2 with incomplete frontobasal disconnection, 2 with remaining splenium, and 1 was complemented with temporal lobectomy. Seizures improved in all patients after reoperation, with 8 Engel 1A and 7 Engel 3. There were three complications (20%): one surgical wound infection and two cases of hydrocephalus requiring shunt.
CONCLUSION:Peri-insular hemispherotomy is a safe and effective technique, whose greatest challenge is disconnecting the splenium of the corpus callosum. Children with hemimegalencephaly due to anatomical distortion and Rasmussen's encephalitis, in whom the brain parenchyma is indurated and the ventricular size is reduced, are more likely to be incompletely disconnected. Reoperation is safe and able to achieve good results after a thorough redo of clinical and radiological assessments.

Keywords: Epilepsy, Hemispherotomy, Reoperation.

PF-034

GABAergic transmission underlies interictal epileptogenicity in pediatric FCD

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OBJECTIVE:Dysregulation of GABAergic transmission has been reported in lesional acquired epilepsies (gliomas, hippocampal sclerosis). We investigated its involvement in a developmental disorder, human Focal Cortical Dysplasia, focusing on chloride regulation driving GABAergic signals.
MATERIAL-METHODS:In vitro recordings of 47 human cortical acute slices from 11 pediatric patients operated from a Focal Cortical Dysplasia were performed on Multi Electrode Arrays. GABAergic receptors and chloride regulators were pharmacologically modulated. Immunostaining for chloride co-transporter KCC2 and interneurons were performed on recorded slices to correlate electrophysiology and expression patterns.
RESULTS:Focal Cortical Dysplasia slices retain intrinsic epileptogenicity. 36/47 slices displayed spontaneous interictal discharges, along with a pattern specific to the histological subtypes. Ictal discharges were induced in pro-epileptic conditions in 6/8 slices in the areas generating spontaneous interictal discharges, with a transition to seizure involving the emergence of preictal discharges. Interictal discharges were sustained by GABAergic signaling as a GABAA receptors blocker stopped them in 2/3 slices. Blockade of NKCC1 Cl- co-transporters further controlled interictal discharges in 9/12 cases, revealing a Cl- dysregulation affecting actions of GABA. Immunohistochemistry highlighted decreased expression and changes in KCC2 sub-cellular localization and a decrease in the number of GAD67-positive interneurons in regions generating interictal discharges.
CONCLUSION:Altered chloride cotransporters expression and changes in interneuron density in FCD may lead to paradoxical depolarization of pyramidal cells. Spontaneous interictal discharges are consequently mediated by GABAergic signals and targeting chloride regulation in neurons may be considered for the development of new antiepileptic drugs

Keywords: Focal cortical dysplasia. Epilepsy. GABA. Chloride

PF-035

Successful Highly Realistic Simulation to increase safety of Hypothalamic Hamartoma Real time MRI-guided Laser Instertitial Thermal Therapy (LITT) in a Pediatric patient

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OBJECTIVE:Real time MRI-guided Laser Instertitial Thermal Therapy (LITT) is a challenging procedure due to its technical complexity, as well as the need for efficient multidisciplinary teamwork and transfer of an anesthetized patient between operating room (OR) and magnetic resonance (MR). A highly realistic simulation was developed to design the safest process before being applied to real patients.The specific objectives were:1) Establish roles and location of participants during all the procedure: OR, transfers, elevator and MR. 2) Ensure availability and access to equipment and medications. 3) Define the appropriate position of the patient on the MR stretcher. 4) Evaluate the risk of displacement of the optical fiber in the transfer from OR to MR. 5) Establish elements for good communication and team interaction. 6) Evaluate safety elements for management of complications.
MATERIAL-METHODS:The entire anesthetic, image planning and surgical process was performed on a modified pediatric simulation mannequin with a brain made of medical grade silicone including a hypothalamic hamartoma. Preoperative CT and MRI were acquired. Stereotactic insertion of the optical fiber was performed with the Neuromate® robot and laser ablation with the Medtronic Visualase™ MRI-Guided System in a 3T Phillips Ingenia® MRI scanner. All the stages of the process, participants and equipment were the same as planned for a real surgery.
RESULTS:No critical errors were found in the process design that prevented the procedure from being performed with adequate safety. Specific proposals for people positioning and team interaction in patient transfers and in MR were validated. Some specific elements that could even increase process safety were identified.
CONCLUSION:Highly realistic simulation is a useful tool for safely planning LITT. It could potentially improve the preparation of other complex neurosurgical procedures, as it allows processes to be designed closer to "work as done" than to "work as imagined".

Keywords: simulation, laser interstitial thermal therapy, LITT, visualase, robotic arm, hypothalamic hamartoma

Early Riser Session: Functional Neurosurgery
Hall B, Tuesday, 22nd October 2019, 07:00 – 07:50

PF-036

Neuromate® Robot Accuracy in Paediatric DBS electrode implantation

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OBJECTIVE:Deep brain stimulation (DBS) is an established treatment for paediatric dystonia. Accuracy of electrode implantation is multifactorial and remains a challenge in young patients due to smaller anatomical targets and a less substantial evidence base in the literature, compared to adults. Our aim was to assess the accuracy of DBS implantation in a series of paediatric patients with dystonia.
MATERIAL-METHODS:A consecutive series of paediatric (≤18y) DBS procedures for dystonia since May 2017 was analysed retrospectively. Procedures were planned on neuroinspire™ software and implanted using the Renishaw neuromate® robot and Renishaw guiding tubes under

general anaesthetic. Electrodes were secured to the skull with dog-bone plate. Post-implantation CT performed with the intra-operative O-arm was fused to preoperative imaging using neuroinspire™ software. Coordinates of the planned electrode target and actual electrode tip were used to calculate radial error, depth error, absolute and directional errors in X, Y and Z axes and Euclidean distance.
RESULTS:27 patients were identified (median age 11, 6-18y; male:female 13:14). Targets for implantation were bilateral GPi. All implanted systems were manufactured by Medtronic. The first fifteen patients have been analysed thus far. Median Euclidean distance from target to electrode tip was 2.13mm (range, 0.71-4.85; p<0.001 compared to zero). Absolute errors in X, Y and Z axes were 1.25mm (range, 0.10-4.10), 0.80mm (0-2.70) and 1.45mm (0-3.90), respectively. There was overall anterior displacement of leads (median 0.55±0.85mm, p=0.001) but no significant directional error in X (p=0.219) or Z (p=0.077) axes.
CONCLUSION:The demonstrated discrepancy between planned and actual lead locations is comparable to previously published series using the Leksell Frame in a similar cohort. Compounding factors include localisation error, accuracy of frame registration, mechanical inaccuracy of the robotic arm, deformation of guiding tubes and inaccuracy of the neuroinspire™ software. Overall, the neuromate® robot is a reliable and accurate alternative to the Leksell Frame.

Keywords: Dystonia, deep brain stimulation, stereotaxy

Session on Neuroendoscopy

Hall B, Tuesday, 22nd October 2019, 08:00 – 09:10

PF-037

Endoscopic Transnasal Skull Base Surgery in Pediatric Patients

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OBJECTIVE:In pediatric patients, endoscopic transnasal surgery (ETNS) poses challenges because of the small size of the developing skull and narrow endonasal corridors. This study aimed to evaluate the efficacy of ETNS in children by assessing our experience of endoscopic skull base surgery.
MATERIAL-METHODS:All pediatric patients (n = 54) who were eligible for surgery using only the endonasal endoscopic approach at our tertiary center between 2012 and 2018 were included in this study. The surgeries were performed simultaneously by an endoscopic skull base team of neurosurgeons and otolaryngologists. Hormonal analyses were conducted before and after surgery in all patients with sellar/parasellar lesions. Patients older than 8 years underwent smell and visual testing.
RESULTS:In the 54 patients aged 1–17 years who underwent surgery, craniopharyngioma was the most common pathology (29.6%), followed by pituitary adenoma (22.2%). Gross total resection was achieved in 33 (76.7%) of 41 patients who underwent surgery because of the presence of tumors. All visual deficits improved, although one patient sustained olfactory deterioration. Sixteen (29.6%) patients presented with complications such as transient diabetes insipidus and temporary visual loss.
CONCLUSION:Despite anatomy-related challenges in children, adequate results can be achieved with high rates of success, and the functional and anatomical integrity of the developing skull and nose of children can be preserved. In pediatric patients, ETNS is a safe and effective option for addressing various lesions along the skull base.

Keywords: Endoscopic, pediatric, skull base, surgery, endonasal, transsphenoidal

PF-038

Endonasal endoscopic skullbase surgery in children - a retrospective case series

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OBJECTIVE:The role of endonasal endoscopic approach for pathologies in the pediatric population is evolving and has still not been accepted as standard of care in neurosurgery. It represents a challenge in terms of narrow access, instrument manipulation and adequate reconstruction of defects. We have described our experience in 49 cases from a single neurosurgical unit in pediatric skull base surgeries through this approach over the last 12 years.
MATERIAL-METHODS:A case series of 59 pediatric skull base surgeries in 49 children through endoscopic endonasal route over the last 12 years is presented. The age ranges from 4 months to 18 years. Out of 49 cases, 22 cases were of craniopharyngiomas, 8 cases of pituitary adenomas, 5 cases with CSF rhinorrhea, 5 cases with meningoencephalocele, 3 cases of Rathke's cleft cysts, 2 cases of odontoidectomy and 4 miscellaneous cases viz. mucocele, hypothalamic glioma, esthesioneuroblastoma and epidermoid. CSF leaks were repaired with free graft in the initial years and by vascularized flap more recently.
RESULTS:The goal of surgery was achieved in all but two cases in whom the tumor excision was unsatisfactory due to failure of the cyst wall to collapse after decompression. Extent of tumor excision was not compromised by the choice of this approach. Revision surgery for CSF leak was required in 3 patients. Local vascularized nasoseptal flap has been possible even in very young patients and has now become the standard for reconstruction.
CONCLUSION:In spite of the challenges posed by small nostrils and ill developed sinuses in the pediatric age group, surgery from endoscopic endonasal corridor is possible to be carried out successfully in selected cases.

Keywords: Endonasal, Endoscopy, Pediatric, Skullbase

PF-039

Sylvian Arachnoidal Cysts-Endoscopic fenestration.Personal experience with 100 cases

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OBJECTIVE:To present and analyze our serie of 100 arachnoidal sylvian cysts. Surgical neuroendoscopic technique,indications,complications and outcome are discussed.
MATERIAL-METHODS:100 consecutive cases observed and treated by the author at the Pediatric Neurosuregery Service of the Asenjo'o Neurosurgical Institute from 1998 to 2016.Review of the clinical charts, surgical protocols and videos,preop and post op neuroimages and follow up of the patients were performed for the 100 cases.
RESULTS:After an average of 5 years follow up 93 % of the patients are considered to be better either because of cyst size reduction or headaches frequency significant lowering and 7 % of them needed other procedure - open cystectomy or shunt. Regarding neuroimages only 10 % achieved complete reduction, 65 % partial decrease and without any change in 25 %. According to clinical outcome based in the headache as the cardinal symptom 75 % showed a clear improvement and 25 % had no change.Main complications were CFS leak (12%) Hygroma (4%) Wound local infection (4)Ventriculitis (3%) and Third nerve palsy (3%).

CONCLUSION:Endoscopic fenestration for Sylvian Arachnoidal cysts is an advisable technique to achieve control of headache being this the main surgical indication although the cysts size is only reduced in 75 % of the cases.Low rate of complications and most of them are transient. Failure of the procedure in our serie was only 10 % on a 3-10 years period of follow up.

Keywords: Arachnoidal cyst, neuroendoscopy, fenestration, headache

PF-040

Temporal arachnoid cysts and neurocognition. Seek and you will find

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OBJECTIVE:The purpose of this study is to describe and evaluate if children with temporal arachnoid cysts (AC) have cognitive symptoms attributed to the AC and if a microneurosurgical fenestrations improves the symptoms.
MATERIAL-METHODS:This is a prospective case study including 14 consecutive patients aged 5-15 years with temporal AC evaluated at the Astrid Lindgren's Childrens' Hospital, Karolinska University Hospital, Stockholm (Sweden). The patients underwent a three Tesla MRI, a neuroopthalmologic evaluation and standard EEG. Specifically for this study the children were then evaluated by a pediatric neuropsychologist who performed a standardized evaluation consisting of WISC IV (cognitive abilities), FAS (verbal fluency), Boston Naming Test for visual naming ability and NEPSY for verbal memory.
RESULTS:Fourteen children were evaluated according to our protocol and ten children underwent microneurosurgical fenestration. The children were re-evaluated six months later according to our protocol. In the neuropsychological assessment we could se a statistically significant improvement in Full Scale IQ and Verbal Index according to the WISC intelligence test. One patient needed reoperation with a cystoperitoneal shunt. No other complications were recorded.
CONCLUSION:ACs are a rather common finding in a pediatric neurosurgical setting. We suggest a standardized setting of evaluations by neurosurgeon, pediatric neurologist neuropsychologist and ophthalmologist to thoroughly assess any symptoms. Standardised and validated scales should be used. In our material microneurosurgical fenestration resulted in statistically significant increase in full scale IQ and verbal performance.

Keywords: arachnoid cyst, neuropsychology, fenestration, cognition

Special Session: Publishing in Pediatric Neurosurgery: The perspective of Child's Nervous System

Hall A, Tuesday, 22nd October 2019, 10:40 – 12:20

PF-041

Predicting Cerebellar Mutism Syndrome Risk Pre-Operatively: Consensus from mixed methods international multi-disciplinary workshops

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[8]on behalf of the Nottingham, Denver and Reykjavik CMS Workshops

OBJECTIVE:To evaluate applicability of the Nottingham Liverpool cerebellar mutism syndrome predictive scoring system (NLCMS Score) using imaging characteristics in pre-operative scans.
MATERIAL-METHODS:Three workshops involved: W1 a multi-centre validation of the NLCMS score using 247 datasets from 11 centres (Nottingham May 2017); W2 a surgical consensus discussion at the ISPNO (Denver May 2018, n=16); W3 a multi-disciplinary consensus meeting considered ethical, consent and clinical implications of low (0%) and high (>50%) predicted CMS risk cases (Reykjavik Aug 2019, n=25).
RESULTS:W1: Surgical consensus advocated cautious use of ultrasonic aspirator/settings, avoidance of retraction/ disturbance to cerebellar peduncles, surgical care around floor of fourth ventricle, acceptance of tumour residuum in medulloblastoma, including pre-operative assessment of mutism risk in consent and clinical discussion. The cohort's overall mutism rate was 16%, centre rates ranged 8-29% (all tumour types) and 11-42% (medulloblastoma). CMS rates were <1% (82/83), 20% (17/86) and 31% (22/72) in low, intermediate and high risk group, respectively. Inter-rater agreement of predictors ranged from 0.33-0.60. W2: Surgeons reported personalizing CMS risk for patients during consent, quoting 10-30% (mode: 11-20%). Involvement of cerebellar peduncles, dentate nucleus, imaging predictive of medulloblastoma and large invading 4th ventricular tumours were high risk features. W3: Discussion of low risk (0%) case achieved consensus for primary surgery / ICP management, justified by low CMS risk prediction. Discussion of high risk (>50%) recorded a majority view (11/23) for biopsy, ICP management and molecular sub typing prior to primary drug treatment and second look surgery, justified by poorer survival prognosis and higher risk of mutism.
CONCLUSION:The NLCMS Score is applicable across centres with training, NLCMS risk-adapted rates offer a metric for clinical audit. Predictive risk scoring places a value on risk of brain injury against maximizing primary surgical resection for survival.

Keywords: Cerebellar Mutism Syndrome; Posterior Fossa Syndrome

PF-042

Cerebello-cortical evoked potentials (cCEP) for intraoperative neurophysiological monitoring of cerebellar mutism – a pilot study

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OBJECTIVE:Cerebellar mutism (CM) remarkably impairs the quality of life of children undergoing surgery for cerebellar tumors. A well-established hypothesis based on clinical and neuroimaging data attributes the pathophysiology of CM to injury to the dentato-thalamo-cortical (DTC) pathway, though this has never been investigated with intraoperative neurophysiology. We assessed the putative function of the DTC pathway, by modulating primary motor cortex (M1) output through

cerebellar cortical stimulation. If cerebellar-M1 and DTC pathways partially overlap, it may be possible to monitor, intra-operatively, the DTC pathway, ultimately predicting, and possibly preventing, the onset of CM.
MATERIAL-METHODS:We looked for modulations of corticospinal tract (CST) excitability by prior stimulation of the cerebellum using a canonical "conditioning-test stimulus" paradigm, which we applied to three patients undergoing surgery for a cerebellar tumor. CST stimulation was performed through transcranial motor evoked potentials (tcMEPs) in trains of 2 to 5 stimuli at 250 Hz. TcMEPs were recorded from distal upper limb muscles following motor cortex stimulation alone (test stimuli) or preceded by direct stimulation of the contralateral cerebellar cortex (conditioning stimuli). The inter-stimulus interval (ISI) between M1 and cerebellar stimulation varied between 8 and 14 ms.
RESULTS:CST stimulation produced stable tcMEPs. Direct stimulation of the cerebellum alone did not produce MEPs in any site. Conditioning cerebellar stimuli at 14 ms ISI systematically reduced tcMEP amplitudes, while at 8 ms it produced a significant increase of tcMEP amplitudes when applied to the anterior cerebellar lobe, and a decrease when applied to more posterior regions.
CONCLUSION:These preliminary data suggest that cerebellar modulation of CST activity can be monitored intraoperatively, warranting further investigation to ultimately define a monitoring paradigm for the DTC pathways.

Keywords: cCEP

PF-043

Selective dorsal rhizotomy for GMFCS II and III: results of a national multicentre study

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OBJECTIVE:Selective Dorsal Rhizotomy (SDR) is an irreversible surgical procedure involving the division of selected sensory nerve roots. The procedure aims to reduce spasticity in the lower limbs with the effect of improving mobility and quality of life. There is limited evidence relating to SDR from three randomised controlled trials conducted over 20 years ago.
MATERIAL-METHODS:Five paediatric neurosurgery units were commissioned in England to perform SDR followed by intensive physiotherapy on children aged 3-9 years with spastic diplegic cerebral palsy and Gross Motor Function Classification Scores (GMFCS) II or III over a period of 20-months to provide evidence on safety and outcomes.
RESULTS:One hundred and thirty-seven children underwent SDR during the commissioning period with a mean age of 6.0 years. Mean Gross Motor Function Measure score (GMFM-66) and Quality of Life measures (CP QoL) increased and reported pain decreased following SDR at a follow-up of 2 years. Results for GMFM-66 and most CP QoL measures were statistically significant. Complication rate was 12% with no severe morbidity. More outcome measures have been collected and will be discussed.
CONCLUSION:This national prospective data collection confirms selective dorsal rhizotomy followed by intensive physiotherapy to be effective and safe in eligible children with cerebral palsy with GMFCS levels II and III.

Keywords: selective dorsal rhizotomy, cerebral palsy, spastic diplegia, physiotherapy, outcome measures

PF-044

Upper Extremity Performance Changes in Children with Spastic Cerebral Palsy following Lumbo-sacral Selective Dorsal Rhizotomy

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OBJECTIVE:In children with spastic cerebral palsy, lumbo-sacral selective dorsal rhizotomy (SDR) is done primarily to improve lower limb spasticity. However, improvement in upper extremity function has also been noted after SDR, at least in short follow up. The goal of this study was to determine if the improvements in the upper extremity are sustained in the longer term.
MATERIAL-METHODS:This was a retrospective review of prospectively collected data on children operated with SDR since 1987 at a single centre. Quality of Upper Extremities Skill Test (QUEST) scores were compared for individual patients at three time points: preoperatively, early post-operatively (<5years) and late post=operatively (>10 years).
RESULTS:Out of more than 200 patients with SDR at our centre, 53 had a follow-up at 10 years or more. Of these 53 patients, 37 had a QUEST assessment done preoperatively, as the remainder had been operated on before QUEST was done routinely. Repeated measures ANOVA demonstrated a statistically significant difference in scores between the three time points. Subsequent pairwise comparisons showed that the scores significantly improved from baseline to early post-operatively, and that this improvement from baseline was generally maintained at the late post-operative assessment. There was no significant change in scores between early and late post-operative assessments.
CONCLUSION:In addition to other demonstrated long term functional improvements following SDR, this study suggests that early postoperative improvements in upper extremity function are sustained in the long term.

Keywords: treatment of spastic cerebral palsy, upper extremities, suprasegmental effects, long term outcome, rhizotomy

PF-045

The Role Intra-operative Neurophysiological Monitoring Plays in Single-level Approach Selective Dorsal Rhizotomy

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OBJECTIVE:Single-level approach SDR 100% relies on the interpretation of results from the intra-operative neurophysiological monitoring. The current study is to investigate the role our modified rhizotomy protocol plays during SL-SDR procedure with regard to nerve rootlets selection for sectioning.
MATERIAL-METHODS:A retrospective study was conducted in the pediatric patients with spastic CP undergone our modified

protocol guided SL-SDR since Jan. 2016 to Feb. 2019. The study focused on interpretation of our intra-operative neuromonitoring data.
RESULTS:Clinical and intra-operative neurophysiological monitoring data of 318 consecutive cases were reviewed (231 boys, 87 girls with 32 hemiplegias, 161 diplegias, and 125 quadriplegias). Age at SL-SDR in was 5.8±1.9 yrs. Pre-op GMFCS level was 2.7±1.0. GMFM-66 Scores pre-op were 55.7±13.4. Number of targeted muscle was 2-8/case (muscle in lower limbs with its muscle tone ≥ 2 Grade). Among 20,774 nerve rootlets tested (65.3±8.2/case), 5384 (25.9%) were discovered sphincter involved. In the rest of 15,390 (48.4±7.8/case) nerve rootlets associated with lower limbs, 10943 were taken as the dorsal ones (34.4±7.5/case). A total of 3370 (10.6±4.7/case) rootlets matched our rhizotomy criteria with 3067 (9.6±4.1/case) sectioned 50% and 303 (1.0±1.0/case) cut 75%. Sectioning rate (transected/all dorsal ones) was 16.3%, 23.0%, 34.2%, 40.6%, and 34.4% across cases with their pro-op GMFCS level from I-V, respectively. Rootlets required 75% cut had a tendency to increase with their pro-op GMFCS level from I-V, comprising 1.4%, 4.8%, 8.4%, 13.5%, and 15.3% of all rootlets transected, respectively. Muscle tone of 2070 targeted muscles at the time of 3-week post-op significantly decreased when compared to pre-op (2.1±0.9 vs. 2.7±1.0).
CONCLUSION:Intra-operative neurophysiological monitoring is critical when SDR is performed via single-level approach. SL-SDR when guided by our modified rhizotomy protocol is an effective treatment to improve spasticity in lower extremities of those CP children.

Keywords: spastic cerebral palsy, single-level SDR, spasticity, intra-operative neurophysiological monitoring

PF-046

Intra-operative electrophysiology during single-level selective dorsal rhizotomy: technique, stimulation threshold and response data in a series of 145 patients

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OBJECTIVE:Selective dorsal rhizotomy (SDR) is effective at permanently reducing spasticity in children with spastic cerebral palsy. The value of intra-operative neurophysiological monitoring in this procedure remains controversial. This study describes our institutional electrophysiological technique based on the one described by Park, intra-operative findings and its value to the procedure.
MATERIAL-METHODS:Demographic, functional and electrophysiological data of all children who underwent SDR at our centre, between September 2013 and February 2019 were collected. SDR is performed through a single-level laminotomy at the conus. Bilateral selective transection of ~60% of L2 to S2 afferent rootlets (guided by intraoperative electrophysiology) is carried out, with non-selective transection of 50% of L1 roots.
RESULTS:145 patients underwent SDR (63% male, mean age 6y7m, range 2y9m-14y10m). Dorsal roots were distinguished from ventral roots anatomically and electrophysiologically, by assessing responses on free-running EMG and determining stimulation thresholds. Root level was determined anatomically and electrophysiologically, by assessing EMG response to stimulation. Median stimulation threshold was lower in sacral vs. lumbar roots, and was similar on both sides within patients; thresholds were stable between patients, with no association with age, gender or functional status. Similarly, responses to tetanic stimulation were consistent; 87% were graded 3+ or 4+, were similar between sides in individual patients, and were not associated with age, gender or functional status. A median of 61% of rootlets (range 50-67%), based on response to tetanic stimulation at threshold amplitude, were divided.
CONCLUSION:This electrophysiological technique is robust and reproducible. It allows reliable identification of afferent nerve roots and definition of root levels, and guides rootlet division. Further work is needed to determine whether electrophysiology maximises the long-term benefit of SDR.

Keywords: Selective dorsal rhizotomy, Electrophysiology, Cerebral palsy, Spasticity

Session on Antenatal diagnosis and treatment

Hall A, Wednesday, 23rd October 2019, 08:00 – 10:10

PF-048

Skin healing after fetal myelomeningocele repair: an evaluation of our surgical experience

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OBJECTIVE:Following the results of the MOMS trial, maternal-fetal surgery for myelomeningocele (MMC) repair is being offered to pregnant women in an increasing number of centers. While most attention is given to neurological outcome (motor function of the lower limbs, reversal of hindbrain herniation, shunting of hydrocephalus), skin healing is considered a less important aspect. We aimed to assess the quality of skin closure after fetal MMC repair, at the moment of repair and at birth.
MATERIAL-METHODS:We have retrospectively reviewed the first 44 cases of fetal MMC repair we performed (i.e. the children who are born at the moment). Primary outcome was the quality of skin healing at birth, secondary outcome the type of fetal repair that was performed. As most children were not born in our Center but in their respective referring centers in other countries, we obtained photographs of the skin healing from the parents or from neurosurgeons/plastic surgeons caring for the child at birth.
RESULTS:In 34 cases it was possible to obtain a linear closure using the technique developed in the MOMS trial. The scar in all these cases was normal or slightly irregular at birth and no additional measures were needed. In 10 cases the circular MMC skin defect could not be closed primarily and a patch (Integra 2-layer Dermal Regeneration Template) was used. At birth, 9 of these needed minor wound care. In a single case more complex plastic surgery was done.
CONCLUSION:Open fetal MMC repair, either linear anatomical closure or closure using a commercially available patch (after dura and fascia

repair) leads to adequate skin healing. Future research will have to correlate these results to the functional outcome.

Keywords: fetal surgery, myelomeningocele, skin healing

PF-049

Long term outcome of prenatally diagnosed myelomeningocele and consideration problems for fetal surgery

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OBJECTIVE:Fetal myelomeningocele repair is about to start in Japan, as the efficacy of fetal surgery has been proven by MOMS Trial. However, the prognosis of the myelomeningocele patients diagnosed fetal in Japan is largely unknown In order to introduce fetal surgery in the future, we investigated the present state of the patients who were diagnosed prenatally in our institute.
MATERIAL-METHODS:We investigated all patients diagnosed as myelomeningocele prenatally in our institute and associated institutes between March 1994 and March 2019. We analyzed timing of initial diagnosis, association of hydrocephalus and/or symptomatic chiari malformation, and prognosis (ADL,intellectual outcome) of all patients.
RESULTS:34 patients were diagnosed prenatally were enrolled, and one patient was excluded because the patient was diagnosed as lipomyelomeningocele after birth. Average of the timing of initial diagnosis is 28.2 weeks. There were 13 cases diagnosed less than 26 weeks which were objects of the fetal surgery, and only 5 cases (38%) were born and remaining 8 cases were aborted. All the born cases were performed surgical closure within 48 hours after birth. The average period of follow-up was 11.0 years (0-25.0 years). Symptomatic Chiari malformation type II occurred in 4(16.0%) and one case was diagnosed in less than 26 weeks. Hydrocephalus was associated in all cases. VP shunt were placed in 32 cases, and endoscopic third ventriculostomy and choroid plexus cauterization was performed in one case. 11 cases (44%) can walk alone or with canes. 2 cases died during the follow-up and cause of the death of both cases were Chiari malformation type II.
CONCLUSION:Only 13 cases were diagnosed less than 26 weeks, accounting for only 39% of the total. In Japan, improvement of diagnosis rate before 26 weeks and reduction of abortion rate are thought to be issues to introduce fetal myelomeningocele repair.

Keywords: myelomeningocele, fetal myelomeningocele repair, prenatal diagnosis

PF-050

Prenatal closure of myelomeningocele reduces Chiari associated brainstem dysfunction

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OBJECTIVE:Prenatal closure of myelomeningoceles reduces the anatomic severity of Chiari II malformations versus postnatal closure. Translating anatomic change into functional outcome, however, has not been shown. Symptom frequency ascribed to the brainstem has not been thought to differ between groups. Severity of these symptoms between groups however, has not been addressed.
MATERIAL-METHODS:We reviewed imaging and records for Chiari malformation anatomic and functional severity, ventricular size, myelomeningocele level, and clinical course of neonates repaired either prenatally (n=13) or postnatally (n=45) over four years.
RESULTS:Twelve neonates (27%) in the postnatal group had significant functional Chiari symptoms within the first month of life, as defined by: neurogenic dysphagia requiring gastrostomy, airway protection and respiratory insufficiency requiring tracheostomy, vocal cord surgery, or repeated admissions with intubation. Anatomically, two had “mild”, six had “moderate”, and four had “severe” Chiari malformations. No child with significant Chiari symptoms had absence of Chiari malformation on imaging. Two underwent Chiari decompressions without improvement. None with prenatal closure experienced significant “Chiari symptoms”, or anatomically had moderate or severe Chiari malformations. Shunts were placed in 64% and 8% of the postnatal and prenatal groups, respectively. Endoscopic techniques were employed in four infants, two in each group. Ventricular sizes at birth were a median of 16mm and 19 mm for prenatally and postnatally closed neonates, respectively. Median gestational ages were 36.6 and 38 weeks, for prenatal and postnatal closures, respectively. Median and mean functional myelomeningocele levels were nearly identical for both groups at L4.
CONCLUSION:Despite historical autopsy findings of disorganized brainstem nuclei in this population and more recent publications that broadly address any apnea ascribed to the Chiari malformation as not influenced by timing of repair, we found prenatal repair is associated with marked reduction in significant physiological dysfunction traditionally ascribed to the Chiari malformation and brainstem in these neonates.

Keywords: Antenatal, Prenatal, Myelomeningocele, Chiari, Brainstem

PF-051

Skull Base in Chiari Type II - Comparison Between Pre and Postnatal Repair

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OBJECTIVE:To analyze and compare the skull base anatomy of patients who underwent intrauterine or postnatal myelomeningocele repair.
MATERIAL-METHODS:This was a retrospective cross-sectional study that analyzed three groups: the Postnatal group, 68 patients who underwent myelomeningocele repair up to 48 h after birth, the Fetal group, 70 patients who underwent myelomeningocele repair in the period between 19 and 27 weeks and 6 days of gestation, and a normal Control group (65). We compared the rate of hydrocephalus treatment, clivus-supraocciput angle (an indirect measure of posterior fossa volume), Welcher angle, and head circumference fitted for gestational age at birth up to the age of 2 years.
RESULTS:The mean clivus-supraocciput angle in the Fetal group was 87.6°, and the Postnatal group was significantly different at 77.7° ($p < 0.0001$). The Control group (89.1°) was significantly different from the Postnatal group, but it was not different from the Fetal group. The mean Welcher angle was not significantly different between the groups. There was a 8.5% of ventriculoperitoneal shunting placement or endoscopic third ventriculostomy in the Fetal group, compared to 76.4% in the Postnatal group.

CONCLUSION:The changes in the skull base of patients who underwent fetal surgery for myelomeningocele correction were related to an increase in the clivus-supraocciput angle that represents the increased posterior fossa amplitude and may explain a decrease in the prevalence of hydrocephalus in this condition.

Keywords: fetal surgery, myelomeningocele, open spinal dysraphism, skull base, spina bifida

PF-052

Identifying lesion mediators in MMC-placodes during the prenatal developmental time-course in rats – a prerequisite for developing adjuvant therapy strategies for open spinal dysraphism

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OBJECTIVE:Surgical reconstruction of spinal defects and symptomatic therapy of long-term sequelae remain the mainstays of myelomeningocele (MMC) management. New therapies aim i.a. for optimising surgical outcomes by tissue engineering or neuroprotective approaches. A prerequisite for such approaches is a detailed understanding of cellular and molecular lesion cascades in the fetal placode and its microenvironment.
MATERIAL-METHODS:A retinoic acid (RA) mmc model was established. Time dated female Sprague-Dawley rats were gavage-fed with RA acid (60 mg/kg) at day E10. Controls received olive oil. Fetuses were obtained via caesarean section at E16, E18, E22. Placodes and associated findings were photo documented. Spinal cords were dissected in toto and transferred into PFA or snap frozen. Serial sections were prepared for staining with neuroepithelieal and progenitor cell markers (e.g., GFAP, NeuN, BLBP, Nestin, 2CB2) and inflammatory markers. Tissues were screened by real-time RT-PCR for diverse cytokines and chemokines, known to play a role in central nervous lesion cascades. As such pro-inflammatory cytokines like TNFalpha, IL-1beta, and their receptors were analysed also by immunohistochemistry (IHC). Normal fetal sc of the respective time points served as controls.
RESULTS:Placodes exhibited typical cellular profiles with strong expression of neural precursor markers (as expected in the fetal course). Glial and progenitor marker expression changed over time. Proinflammatory cytokines were induced in the placodes, compared to normal fetal sc on mRNA level. Detailed semiquantitatively IHC evaluation is still going on and will be reported. The time course of the respective cytokines like TNFa and IL1a plus their main receptors and neuroprotective cytokines like EPO/EPOR will be presented along with their cellular relationships.
CONCLUSION: The presented mmc model is an adequate tool to investigate cellular and molecular characteristics of fetal mmc placodes and its microenvironment during fetal development. It thus may support the development of functional cellular scaffolds in tissue engineering.

Keywords: myelomeningocele, retinoid acid model, molecular lesion cascades, fetal development

PF-053

Morphological changes during junctional neurulation in chick embryos: cross-talk between normal and anomaly

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OBJECTIVE:Recent reports have shown congenital anomalies in which there seemed to be a functional disconnection between the primary and secondary neural tube. Such cases were named 'junctional neural tube defect' (JNTD) under the hypothesis that they may be result from an error during junctional neurulation. This study aimed to elucidate the junctional neurulation process in chick embryos.
MATERIAL-METHODS:Chick embryos of Hamburger and Hamilton stages (HH) 14, 16, 18, 20, 24, 28 were harvested. Hematoxylin-Eosin staining and immunofluorescent staining were performed in the axial and sagittal sections.
RESULTS:In HH14, the primary neural tube and its lumen started to decrease in size. At the junctional zone the proportion of primary neural tube decreased in the more caudal region. In HH16, the caudal cell mass increased in relative size and seem to 'invade' the primary neural tube. Cavitation of secondary neural tube started to appear. By HH18, evidence of the fusion between the primary neural tube lumen and one of the multiple cavities of secondary neural tube is seen. In HH24, the tapered end of the primary neural tube lumen looks very small, where it is connected to one of the multiple cavities. In sagittal sections, the lumen has the shape of an hourglass. In HH28, as the coalescence of the multiple cavities is near completion, the primary neural tube lumen and the secondary neural tube lumen is fused completely.
CONCLUSION:The results suggest that the junctional neurulation is a process in which the tapering primary neural tube lumen eventually fuses with the secondary neural tube lumen. The primary and secondary neural tube lumen temporarily shows an hourglass-like configuration. The arrest of junctional neurulation at the time of the 'hourglass' shape may lead to JNTD.

Keywords: junctional neurulation, morphology, chick embryo, development

PF-054

Junctional neurulation: an experimental approach in the chick embryo

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OBJECTIVE:Neural tube defects (NTDs) are common developmental malformations in human that affect the nervous system with a marked prevalence for the lower spinal cord. Despite progress, their causal factors remain largely ignored. Elucidating which developmental processes operate during neural tube morphogenesis is therefore pivotal to unravel etiology of NTDs.
MATERIAL-METHODS:We planned to study the region at the interface between primary and secondary neurulations in the chick embryo. We marked chick cells in order to follow their fate in the developing embryo. Then, we perturb the expression of Prickle-1 a gene of planar cell polarity. At last, we compared the phenotype obtained by these experimental conditions with that observed in a human case of spina bifida.
RESULTS:We show that the spinal cord region located precisely at this interface corresponds to a discrete neural tube portion elaborated by a specific developmental program that involves a succession of concerted cellular movements of ingression, intercalation and accretion. This

process ensures the topological continuity between the primary and secondary neural tubes while supplying all neural progenitors of both the junctional and secondary neural tubes. Since this developmental program is different from the others known to occur during neurulation, we term this junctional neurulation. Moreover, misexpression of Prickle-1, a member of the planar-cell-polarity pathway, causes neural tube anomalies in bird which phenocopy some lower spine open NTDs in humans.
CONCLUSION:Our study provides a molecular and cellular basis for understanding the causality of some thoraco-lumbar NTD in humans and ascribes to Prickle-1 a critical role in lower spinal cord formation.

Keywords: neurulation, spina bifida

Session on Spinal dysraphisms

Hall A, Wednesday, 23rd October 2019, 10:45 – 13:00

PF-050

External validation of a new classification of spinal lipomas based on embryonic stage

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OBJECTIVE:Contention exists within the neurosurgical community regarding the appropriate classification and management of spinal lipomas (SL). Several systems have been formulated, however due to the heterogeneity of SL, omissions or overlap between surgically incomparable groups exists. A recent classification proposed by Morota et al. (J Neurosurg Pediatr 19:428–439, 2017) delineates SL based on their embryological pathogenesis and resultant impact on operative difficulty. Our aim was to validate this system by applying it to a retrospective cohort of patients with SL operated on at our institution.
MATERIAL-METHODS:All children with SL who underwent surgical resection between 2014 and 2018 were retrospectively examined. Pre-operative and post-operative MRI scans were independently assessed by two adjudicators. Baseline patients' characteristics, co-existing associated anomaly, preoperative Necker Enfants Malades (NEM) score, operative notes and postoperative complications were extracted from electronic healthcare notes. Baseline characteristics were compared for each sub-group. Exploratory data analyses were undertaken.
RESULTS:Thirty-six children underwent surgical untethering for SL. Twenty patients (56%) were male with a median age of 3 years (range 1-15). MRI scans revealed: Type 1 in 5 patients (17%), Type 2 in 14, patients (36%), Type 3 in 4 patients (11%) and Type 4 in 13 patients (36%). All patient radiological classifications were agreed on first assignment by both adjudicators. Co-existing associated anomalies were identified in none of SL type 1, 23% type 2, 67% type 3 and 57% type 4. Radical/near radical SL resection was always possible in type 1 and 4, never achieved in type 2 and 3.
CONCLUSION:The New Classification of Spinal Lipomas was a logical and reproducible system to apply within our population. Widespread establishment of a commonly adopted and clinically-useful classification system will enable clinicians to improve patient selection for operative management and discussion with patient representatives during the decision-making process.

Keywords: Spinal Lipomas, Dysraphisms, Classification, External Validation

PF-056

Lipomyelomeningoceles: how much should we resect? A single centre experience with 86 patients

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OBJECTIVE:Lipomyelomeningoceles are a complex and rare type of Occult Spinal Dysraphism (OSD). Their natural history and optimal treatment are still debated. We analized our surgical experience to asses our results and to critically compare our treatment strategy with the pertinent medical literature, both the non interventional and the interventional approach.
MATERIAL-METHODS:Electronic database of pediatric neurosurgical patients was investigated with pertinent queries. We excluded patients with incomplete medical information and only included patients with at least two years of follow up. Between 2000 and 2017 86 patients were operated on for lipomyelomeningoceles, accounting for 17.5% of all OSD who underwent surgery during those years.
RESULTS:On admission, 1 out of 10 patients was referred for neurology but on examination 67.4% had already one or more focality. All received surgery consisting in complete release of the tethering, partial resection of the lipoma and duraplasty with artificial substitute. Short term (30 days) complications were mainly CSF leak (10), that drastically dropped since we started to keep the patients in Trendelemburg position for 3 days after surgery; and 3 cases of transient neurological deficit. Among symptomatic patients at surgery (58), at last follow up 77.6% were improved or had a complete remission and 6 had worsened; among asymptomatic (28), 2 had developed symptoms.
CONCLUSION:In our experience the complete untethering with partial resection of the lipoma resulted in good control of symptoms in symtpomatic patients and a low incidence of developing symptoms in asymptomatic patients, with an acceptable low risk of surgical related complications. Compared to results in the medical literaure, we had better outcome than with non surgical strategies, and similar results to untethering with total resection of lipomas.

Keywords: lipomyelomeningocele, dysraphism

PF-057

Early post-operative outcomes and intraoperative electrophysiology results following adoption of a radical resection technique for complex spinal lipomas in children

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OBJECTIVE:The management of spinal lipomas remains controversial. Improved neurologic outcomes have been reported by Pang et al. using a technique of radical resection with expansile duroplasty. However, many institutions are reluctant to adopt this technique due to concerns of causing new neurologic deficits. In 2012, the technique of radical resection was adopted at Great Ormond Street Hospital. The objective of this study was to review intraoperative electrophysiology results and early post-operative outcomes.
MATERIAL-METHODS:We undertook a retrospective review of the prospectively maintained database of all lipoma cases performed using a radical

resection technique. Demographic data were recorded. Pre-operative neurologic deficits were recorded. We analyzed intraoperative electrophysiology results, complications and early post-operative outcomes.
RESULTS:Between November 2012 and November 2018, 88 cases were analyzed. 39% of patients were asymptomatic at the time of surgery. Electrophysiology data were available in 69 cases. In 86% of cases, there was no change in motor evoked potentials (MEPs) or sphincter responses (SRs) at the end of surgery compared to baseline. There was a 31% complication rate. The majority (87%) were wound healing complications. Only one patient exhibited worsening of motor function immediately post-operatively. At 3 months post-operatively, 85% of patients had stable motor function, 9% improved, and 5% worsened. For post-operative urologic function, 59% remained stable, 20% improved, and 20% worsened. 98% of patients with normal motor function remained neurologically intact and 81% of patients with normal bladder function pre-operatively retained normal bladder function.
CONCLUSION:Radical resection of spinal lipomas can be accomplished with most cases exhibiting stable electrophysiology during surgery. Immediate post-operative neurologic worsening was rare. There was a relatively high rate of wound healing complications. The vast majority of patients with normal motor function pre-operatively maintain normal function at early post-operative follow-up. Likewise, most patients with normal bladder function pre-operatively maintain normal bladder function post-operatively.

Keywords: complex spinal lipoma, radical resection, pang technique

PF-058

Global Pediatric Neurosurgery

Can intraoperative neuromonitoring (IONM) predict and prevent post-operative neurological deficit during complex paediatric spinal surgery?

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OBJECTIVE:To assess the ability of intraoperative neuromonitoring (IONM) in predicting and preventing neurological injury.
MATERIAL-METHODS:Retrospective review of paediatric complex brainstem/spinal procedures in which IONM was used to predict and prevent neurological injury. Surgeons were alerted to >50% decrease in cortical somatosensory evoked potential (SSEP) amplitude and >80% decrease in motor evoked potential (MEP) amplitude. Such drop in evoked potentials (or 'alert criteria breach') resulted in a surgical pause, review of any direct surgical causes; anaesthetic review and optimisation of sedation level and physiological status, aiming to improve the IONM indices. Hypertensive therapy was used to increase the arterial blood pressure if necessary. Thirty day post-operative outcome was assessed by review of patient notes and categorised as no deficit, transient deficit (good outcome), or sustained neurological deficit (poor outcome). IONM accuracy was calculated via a contingency table.
RESULTS:102 patients (median age 7yr, IQR: 3-13yr; 42M:58F) had IONM during brainstem/spinal cord lesion excision (n=19), fixation +/- decompression (n= 27), and complex cord detethering (n=56) surgery. Twenty-five (24%) had alert criteria breached, of which 19 (76%) were reversed. Of the 25 patients with an IONM alert, a positive 'test' result was defined as a reversal of the alert and a negative result as irreversible alert. The presence of 'disease' was defined as good outcome and absence as poor outcome. Nineteen of twenty patients with good outcome had a reversed IONM alert (sensitivity 95%). All 5 patients with poor outcome had irreversible IONM alert criteria (specificity: 100%). All 77 (75%) patients without an IONM alert had good outcome.
CONCLUSION:IONM can detect intra-operative neurological injury with a high degree of accuracy and changed surgical and anaesthetic management in 25% of cases. When there was no IONM alert, it was safe for the surgeons to continue with surgery.

Keywords: Intraoperative neuromonitoring, Somatosensory and Motor evoked potential, Neurological injury, Prognosis

PF-059

Evidenced Based Protocols to Guide Transition from Pediatric to Adult Spina Bifida Care

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OBJECTIVE:OBJECTIVE: In October of 2010 Children's of Alabama (COA) partnered with the University of Alabama at Birmingham to develop a transition/adult spina bifida clinic. During the initial phase of development the clinic was modeled after the existing pediatric multidisciplinary clinic but we quickly determined that there were areas of deficiency in the adult clinic and opportunities to improve the outcomes of adult patients.
MATERIAL-METHODS:METHODS: After our anecdotal observation that the transitioning population was growing in depression and loss of motivation, we designed multiple studies to determine key areas of importance for adults with spina bifida. In addition, we began to systematically study transition readiness with a validated measure.
RESULTS: We found that there are 4 areas that have great impact on young adults in our clinic; lack of employment (57% indentify as permanently disabled), bowel management (49% have accidents monthly or greater), obesity (55% >30 BMI), and skin breakdown (30% reported skin breakdown either active or within the previous 12 months of their visit). As the individual with spina bifida ages into the adult program, their neurosurgical need for intervention decreases and the issue around bowel continence, depression/anxiety, and urinary tract infections become more of their focus. Finally, our readiness assessment scores showed that to improve transition readiness, transition teaching needed to begin earlier than age 19.
CONCLUSIONS: Based on these results, we have reduced the age of transition teaching from age 19 to age 14. We created evidenced based transition protocols and developed guidelines for baseline testing intervals. Neurosurgical needs decrease in adulthood. Future studies are needed in depression/anxiety and sexuality in this population.

Keywords: spina bifida, transition, adult care, spina bifida clinic

Session on Hydrocephalus

Hall A, Wednesday, 23rd October 2019, 14:00 – 15:30

PF-060

Which children with big ventricles need a shunt? CSF infusion studies in shunt-naïve children

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OBJECTIVE:Decision making for children with suspected hydrocephalus can be difficult often requiring extended observation and/or overnight ICP monitoring. We report our experience of using CSF-infusion studies to aid decision making where hydrocephalus or failed endoscopic third ventriculostomy (ETV) is suspected.
MATERIAL-METHODS:Infusion studies are performed via lumbar needle or ventricular reservoir. Young children receive sedation during the study. Baseline ICP recording is established and then a constant rate infusion is started until an ICP plateau (ICPpl) is reached. The resistance to CSF outflow (Rout) is calculated.
RESULTS:48 children (21F, 27M) aged 0.3 to 16 yrs (mean 6.7 yrs) underwent 53 infusion studies between 2003 and 2017. Underlying diagnoses included aqueductal stenosis (8), congenital ventriculomegaly (7), tumour (9), post-haemorrhagic (6), post-infectious (3) and other diagnoses (13). 18 children underwent infusion study after ETV. 26 (54%) were shunted including 10 children who'd previously undergone ETV. Decision to shunt was based on clinical, radiological and infusion study data. Baseline ICP was 10.0±4.4 mm Hg in children that did not require a shunt and 13.0±5.1 mm Hg (p=0.04) in those that were shunted. ICPpl was significantly lower in children that did not need a shunt compared to those that did (20.3±5.5 vs. 30.7±9.1 mm Hg; p<0.01). Similarly, Rout was significantly lower in children that did not need a shunt compared to those that did (7.2±3.1 vs. 17.2±11.9 mm Hg/min/ml; p<0.01).
CONCLUSION:CSF infusion study is a safe and reliable method for evaluating children with suspected hydrocephalus and for assessing ETV efficacy. Infusion studies avoid the uncertainties and hospital stay of observation and ICP monitoring. Elevated ICPpl and Rout are good indicators of disturbed CSF dynamics and can be used to determine the need for a shunt.

Keywords: Hydrocephalus, endoscopic third ventriculostomy, CSF infusion study, shunt

PF-061

Comparative Study between ETV and VP shunt on Cognitive and Quality of Life Scores

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OBJECTIVE:Endoscopic Third Ventriculostomy is increasingly being accepted as the treatment of choice in place of Ventriculo-Peritoneal (VP) Shunt for hydrocephalus. However, differences between them on cognitive and Quality of Life (QOL) scores have not been studied much.
MATERIAL-METHODS:Patients of hydrocephalus (not due to tumor) treated with VP shunt or/and ETV underwent cognitive assessment (using modified child MMSE standardized as per the age group), and QOL (using PedsQL as per the age group in Physical, Emotional, Social & School Functioning domains) in addition to the primary outcome assessment of not requiring additional surgical intervention.
RESULTS:Out of a total 139 patients, there were 29 infants and 40 children 1-14 years. Among these children, ETV was done as the primary intervention in 45, and VP shunt in 24 depending on various factors, and could be studied for a mean follow-up of 1.7 years. Though ETV fared better beyond infancy, there was no significant difference in failure rates between ETV and VP shunt (26% vs 20% in infants, 19% vs 29% among other children). Among those who had only either ETV or VP shunt, subnormal cognitive scores were noted in 25% and 45% respectively with no statistically significant difference. Among the different domains of QOL, the child reported scores in social domain were significantly better after ETV as compared to VP shunt, while the differences in other domains were not significant.
CONCLUSION:ETV has significantly better child reported QOL scores in social domain, while failure rate and other parameters did not show significant difference, in comparison with VP shunt.

Keywords: ETV, VP shunt, QOL, Cognitive Score, Domains, Failure rate

PF-064

Time to Ventricular Subgaleal Shunt impacts on shunt survival at one year following Neonatal Intraventricular Haemorrhage

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OBJECTIVE:The management of neonatal post haemorrhagic hydrocephalus (PHH) remains challenging. Little data exists to guide management, with treatment based primarily on the preference of the surgeon and institution. The use of a temporising device (ventricular access device (VAD) or ventricular subgaleal shunt (VSGS)) is widely accepted as initial management. Our objective was to review our experience with VSGS to determine if we could identify factors affecting outcome.
MATERIAL-METHODS:A retrospective review of electronic records of all neonates with PHH who underwent insertion of a VSGS at our centre between September 2012 and April 2018 was carried out.
RESULTS:49 neonates underwent VSGS between 2012 and 2018. Overall VSGS to VPS conversion rate at 180 days was 77%, and one-year VPS survival was 66%. VSGS to VPS conversion rate and one-year VPS survival rate were 65% and 81% respectively for neonates undergoing VSGS insertion before 30 days of age, but 90% and 43% respectively for neonates who underwent VSGS insertion after 30 days (p=0.07 and 0.013 respectively). Low gestational age at birth (<26 weeks), high ventricular index at VSGS insertion, and VSGS complications all showed non-significant association with higher VSGS to VPS conversion and lower one-year VPS survival.
CONCLUSION:We postulate that prolonged exposure to xanthochromic CSF under raised pressure may carry an adverse impact on outcome. This highlights the need to expediently identify and treat those neonates who are at the highest risk of progressing to PHH.

Keywords: Neonatal Intraventricular Haemorrhage Post-Haemorrhagic Hydrocephalus

PF-065

CSF Reservoir Placement for Preterm Neonate with Post-Hemorrhagic Hydrocephalus: Rate of Shunt placement and Complications

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OBJECTIVE:Management of post-hemorrhagic hydrocephalus (PHH) in preterm neonate remains a challenging problem because compromised immune system and associated diseases. Ventriculo-peritoneal shunt seems more risky than full-term baby. Outcome after CSF reservoir placement for PHH in preterm neonate were analyzed to evaluate and verify the efficacy of CSF reservoir placement and intermittent CSF drainage.
MATERIAL-METHODS:From 2002 to 2017, 30 preterm infants underwent CSF reservoir (PS medical Co) placement to address PHH. Average gestational age and birth weight were 27 weeks, 864 gram respectively. All patients had grade III or IV of intraventricular hemorrhage

grade. Mean time of CSF reservoir placement was 51days after birth. CSF was drained by amount of 10cc per kilogram of body weight depending on increment of head size and fontanelle via CSF reservoir. Finally, ventriculo-peritoneal (VP) shunt was placed in case of refractory hydrocephalus despite repeated CSF drainage.
RESULTS:Out of 30 patients, 2 were expired due to systemic complication. Among 28 patients followed by repeated CSF drainage, 18 (64%) needed VP shunt average 131 days after CSF reservoir insertion. Eight patients (29%) were treated with 3rd ventriculostomy (ETV). Two among 8 patients treated with ETV needed VP shunt finally. During CSF reservoir placement period, head circumstance increased on average 0.65cm/ week and there was no infection of CSF reservoir reported. Two patients were expired after V-P shunt.
CONCLUSION:CSF reservoir placement for PHH in preterm neonate can be effective to defer VP shunt placement by about 3 months without significant complications. Furthermore, some patients (29%) can avoid permanent VP shunt placement by temporary CSF drainage.

Keywords: post-hemorrhagic hydrocephalus, preterm infant, CSF reservoir, ETV, outcome

PF-066

Predictors for the development of hydrocephalus following traumatic brain injury in the paediatric age group

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OBJECTIVE:Predictive factors for post-traumatic hydrocephalus (PTH) in adults have been elucidated but remain uncertain for children. We aimed to ascertain the prevalence of PTH in children and identify clinical/radiological factors that may predict paediatric PTH.
MATERIAL-METHODS:This was a retrospective study of all patients <16yrs old admitted to our unit with traumatic brain injury (TBI) between March 2013-June 2018. A total of 108 patients were recruited to the study. Patients were classified as mild, (13-15) moderate, (9-12) or severe (3-8) TBI based on admission GCS. Clinical and imaging data were collected from case notes by three independent reviewers. CT scans were reviewed for PTH using Evan's index to identify hydrocephalus. Two-tailed Fischer exact tests with a p-value <0.05 were considered statistically significant.
RESULTS:The median age of patient was 7 years; 65% of patients were males (n=70). No PTH was seen in mild or moderate TBI (n=79).Of 29 cases with severe TBI, 3 developed PTH requiring ventriculoperitoneal shunting (10%; p=0.02). Radiological features in the PTH group were intraventricular haemorrhage, (p=0.05) and subarachnoid haemorrhage (p=0.03). There were trends towards statistical significance for subdural haematoma (p=0.07) and skull fractures, (p=0.2) which were identified in all 3 patients who developed PTH (Supplementary Table). The need for other neurosurgical procedures such as fracture elevation or craniotomy did not reach statistical significance (p=0.08).
CONCLUSION:The prevalence of PTH in our study is 2.7%. Factors which may be associated with PTH include: IVH; SAH; severity of TBI; subdural haematoma, and skull fracture. We propose a national prospective multi-centre study of paediatric PTH looking at prevalence, presentation, risk factors and management. The study will determine the contemporary management and outcomes of children with PTH.

Keywords: Post-traumatic hydrocephalus TBI imaging

PF-067

Non-invasive first-line and follow-up diagnostic of patients with idiopathic intracranial hypertension (IIH)

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OBJECTIVE:Idiopathic intracranial hypertension (IIH) is a disease associated with increased intracranial pressure (ICP) under absence of hydrocephalus or space-occupying lesion. For initial diagnosis and follow-up during/after medical, interventional or surgical treatment, repetitive invasive lumbar punctures are often necessary to evaluate therapy success. Combined ultrasound-based measurement of optic nerve sheath diameter (ONSD) and third ventricle diameter (TVD) are an ideal first-line tool, to diagnose possible ICP increases and exclude hydrocephalus. After treatment, repetitive ONSD determination can be used for control of therapy success.
MATERIAL-METHODS:17 children (16 boys, 1 girl, age-range 4-17) and 12 adults (11 women, 1 man, age-range 22-49) diagnosed with IIH were investigated. Ultrasound-based transorbital ONSD and transtemporal TVD measurements were performed initially and during the course of the disease repetitively. Individual ONSD values were compared to invasively measured ICP values to create individual ONSD-ICP-correlation-curves and calculate ICP values according to ONSD.
RESULTS:Initial ONSD mean value was 5.95 ± 0.34mm in the pediatric (normal values < 5.3mm) and 6.15± 0.41mm in adult (normal value < 5.5mm) patients. TVD values were always below 5mm in children and adults, excluding hydrocephalus. After any kind of therapy mean ONSD decreased quickly and significantly ($p< 0.01$) in the entire cohort and increased again with rising ICP. Intra-individual correlations of ONSD and ICP were outstandingly linear ($r= 0.66- 0.99$, $p < 0.01$).
CONCLUSION:Combined ultrasound-based ONSD and TVD measurement is an optimal first-line screening tool for IIH in pediatric and adult patients. ONSD can detect ICP increase, TVD can exclude hydrocephalus as underlying reason. Repeated ONSD measurements during IIH therapy can be used for control of therapy effectiveness as ONSD values quickly decrease after therapy and increase in case of therapy failure. Thus, repeated lumbar punctures can be avoided.

Keywords: IIH, idiopathic intracranial hypertension, non-invasive diagnostic, ONSD

Session on Global Pediatric Neurosurgery

Hall B, Wednesday, 23rd October 2019, 14:00 – 15:30

PF-068

Gender disparities in Neurosurgery: A Real Pipeline? -Part two, Survey results and Analysis

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OBJECTIVE:To collect and analyze the data about the experiences of women in academic and non-academic neurosurgery around the world and better understand the factors that have impacted women's ability to advance in their neurosurgical careers.
MATERIAL-METHODS:A survey was designed to collect data on Demographics (age, marital status, children, ethnicity, higher degree,

country and continent of practice, number of female residents and attending neurosurgeon in your department, academic rank, fellowship trained, subspecialty, years in practice, type of practice), Workload (Hours work/week, OR days/month, Clinic days/week, Academic days/week, time for completing paperwork from work at home), Research Productivity (Life-time perreviewed publications, factors that determine your ability to publish, applied for a grant), Career Satisfaction (Career decisions, rate of career progression, best aspects of being a neurosurgeon, worst aspects of being a neurosurgeon, what changes would attract more female to neurosurgery),Work/Personal Life Balance (Hours of sleep, partner cooperation with housekeeping, colleagues and family support in personal situations, interaction with colleagues, pregnancy), Opportunities (professional interactions, salary gap, opportunities and promotion), Mentorship (having a mentor, being trained as a mentor). Leadership (participation in organized neurosurgery). The survey was shared via Google Drive and was responded annonimously.
RESULTS:Over 150 replies have been recibed so far, The Statistics will be presented and discussed.
CONCLUSION:The survey allows to obtain concrete responses about the different aspects of gender disparity in Neurosurgery and will help creating proposals that could be applied locally and internationally to improve the gender-related gap and pipelines.

Keywords: Gender disparity, Neurosurgery practice, glass ceiling, gap, pipeline.

Session on Neuro-oncology I

Hall A, Thursday, 24th October 2019, 08:00 - 10:45

PF-069

Molecular and Clinical Characterisation of Midline Gliomas: Correlation With Programmed death ligand 1 Expression and Tumor-infiltrating lymphocytes

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OBJECTIVE:Diffuse midline gliomas (DMGs) are rare and devastating tumours with limited therapeutic options. Programmed death-ligand 1 (PDL1) expression represents a potential predictive biomarker of immune checkpoint blockade response. PDL1 expression and T-cell infiltration in different genetic cohorts of pediatric and adult midline gliomas (MGs) was analysed and correlated with currently known genetic markers of diagnostic and prognostic relevance.
MATERIAL-METHODS:126 MGs were assessed for immune [PDL1, tumor infiltrating lymphocytes (TILs)- CD3, CD8] and genetic profile (H3K27M, ATRX, IDH1 and p53) by immunohistochemistry. Sanger sequencing was done for H3K27M and IDH1 mutation.
RESULTS:There were 89 adult and 37 pediatric cases. Thalamus was commonest site and majority were grade IV (85.7%). H3K27M mutation was more frequent in children (p=0.0001). PDL1 expression was observed in all age groups, with higher frequency in elderly (>50 years) compared to adults (19-50 years) and paediatric cases (≤18 years) (p=0.002). There was a trend of increased PDL1 expression with tumour grade (II<III<IV; p<0.23).On univariate analysis, there was no direct correlation of PDL1 with any genetic alteration. However, PDL1 expression was highest in H3K27M non-mutant IDH1 wildtype and IDH1 mutant adult GBMs. Frequency of CD3 positive T-cell infiltration was similar in both age groups while CD8 expression was more in adults (P<0.05). Positive PDL1 expression was strongly associated with high TIL count and poor median overall survival. H3K27M IHC had 95% concordance with sequencing.
CONCLUSION:This is first comprehensive analysis highlighting heterogeneous molecular profile and immune microenvironment of MGs across various age groups. These results provide a strong basis for an integrated approach employing clinical, radiological, molecular and immune features for stratifying MGs to develop effective immunotherapies. Thus, data from studies on adult GBMs cannot be translated to paediatric tumors.Further, studies on adult DMGs are needed to better elucidate their molecular profile.

Keywords: PDL1, T cell, midline, GBM, pediatric

PF-070

Brainstem biopsy in pediatric diffuse intrinsic pontine glioma in the era of precision medicine: the INFORM study experience

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OBJECTIVE:Diffuse intrinsic pontine glioma (DIPG) is a highly aggressive pediatric brain tumor with fatal outcome. The INFORM registry offers comprehensive molecular profiling of high-risk tumors in order to identify target alterations for potential precision therapy. We analyzed molecular characteristics and clinical information after brainstem biopsy of all enrolled newly diagnosed DIPGs for risk-benefit assessment.
MATERIAL-METHODS:From 02/2015 - 02/2018, 21 subsequent primary DIPG cases were enrolled in the nation-wide multi-center INFORM registry study following brainstem biopsy. Whole-genome, whole-exome sequencing and DNA methylation analysis were performed, and RNA-sequencing was added in case of sufficient material. Standardized questionnaires and the INFORM electronic case report form retrieved clinical data.
RESULTS:Tumor material obtained from brainstem biopsy was sufficient for DNA analysis in all cases and RNA analysis in 16/21 cases. In 16/21 cases (76%) potential targetable alterations were identified including an EZH2 alteration not previously described in DIPG. In 5/21 cases molecular information was used for initiation of targeted treatment. The majority of patients (19/21) presented with neurological deficits at diagnosis. Newly arising or worsening of neurological deficits post-biopsy occurred in nine patients. Symptoms were reversible or improved notably in eight cases.
CONCLUSION:In this multi-center study setting, brainstem biopsy of DIPG was feasible and yielded sufficient material for comprehensive molecular profiling. Relevant molecular targets were identified impacting clinical management in a substantial subset. Death or severe bleeding occurred in none of the cases. 1/20 patients experienced unilateral paresthesia possibly related to biopsy.

Keywords: diffuse intrinsic pontine glioma, brainstem biopsy, molecular profiling, targeted therapy

PF-071

Retrospective analysis of 94 consecutive DIPGs patients to investigate the clinico-radiological factors eventually predictive of hydrocephalus development and the impact of its treatment on clinical status and survival

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OBJECTIVE:Hydrocephalus can occur in DIPGs for acqueduct obstruction. The incidence varies among series, there are few data about its correlation with neuroradiological features and there is no consensus about its treatment and impact on disease clinical course. A series of DIPG patients were retrospectively reviewed to address these issues.
MATERIAL-METHODS:After approval of independent ethical committee clinico-radiological data of patients treated over 10 years were reviewed and analyzed.
RESULTS:94 patients were enrolled, mean age 6,29 +/- 3,4 years, 57% females and 43% males. 7% underwent a biopsy. 34% of patients developed hydrocephalus. Mean interval of hydrocephalus onset from the diagnosis was 5,24 months. Mean tumor diameter was 14 +/- 5.6 cm2, mean volume was 23 +/-14 cm3. Patients who did not developed hydrocephalus showed tumor diameters significantly greater than the others (respectively 6.5 cm2 vs 16.45 cm2, p< 0.005). Tumor margins were unsharped in 72% of cases, edema was present in 9%, necrosis in 63%, intralesional hemorrhage in 18%. None of these features correlated with hydrocephalus onset. No major change in MRI was observed at the time of hydrocephalus onset compared to previous MRI. 87% of hydrocephalus was treated with VPS shunt, 13% with ETV. Shunt malfunction occurred in 3,6% of patients. ETV showed no complications. Mean overall survival was of 16,6 months. There was no significant difference between the two groups (16.72 months patients without hydrocephalus, 15,95 patients with, p-value 0.8).
CONCLUSION:Hydrocephalus occurred frequently. No radiological feature correlated to the development of hydrocephalus, apart a statistically unexpected higher incidence of hydrocephalus in smaller tumors. This result may be explained with the relatively small cohort of patients but should suggest not to underestimate the risk of hydrocephalus in smaller DIPGs. ETV should be considered in treating hydrocephalus. Hydrocephalus treatment provides clinical improvement but do not affect prognosis.

Keywords: DIPG, Hydrocephalus, MRI features, VP shunt, ETV, clinical course

PF-072

Prognostic stratification of posterior fossa ependymomas using H3K27me3 immunohistochemistry and fluorescence in-situ hybridization for chromosome 1q21

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OBJECTIVE:Ependymomas (EPNs) are relatively rare gliomas with poorly defined prognostic criteria. Gene expression and DNA methylation studies have identified 2 distinct clinicopathological subgroups among the WHO Grade II/III posterior fossa (PF) EPNs, of which the PF-A molecular subgroup associates with poor outcome. We aimed to analyse the utility of H3K27me3 immunohistochemistry and chromosome 1q21 locus gain in the molecular subgrouping of PF EPNs.
MATERIAL-METHODS:All PF Grade II/III EPNs were retrieved (2009-2018). Diagnosis was reconfirmed and graded as per WHO 2016. Immunohistochemistry for H3K27me3 and *H3.3* K27M mutation-specific antibody, and fluorescence in-situ hybridisation for 1q21 locus was performed.
RESULTS:A total of 64 PF EPNs (Grade III n=34; Grade II n=30) were included. Loss of H3K27me3 expression was seen in 66% (42/64) of cases. Tumors with H3K27me3 loss occurred at a median age of 4.5 years (range 1-53) with a strong male preponderance (M;F-4:1), and showed predominantly grade III histology (Grade III:II – 1.6:1). All infantile PF EPNs showed H3K27me3 loss. On the contrary, PF EPNs with retained H3K27me3 expression (34%, 22/64) occurred predominantly in adults (median age:20 years; range 4-62) with a slight female predilection (M:F-1:1.4) and were more commonly of Grade II histology (Grade III:II – 1:1.75). 1q21 gain seen in 12.5% (8/64) ependymomas, all of which also showed H3K27me3 loss. Patients harbouring tumors with H3K27me3 loss suffered significantly more frequent recurrences and shorter progression free survival. 1q gain did not correlate with outcome. The demographic and clinicopathological patterns of the H3K27me3-based subgroups in our cohort matched with published cohorts of PF-A and PF-B EPNs subgrouped by gene expression or DNA methylation profiles.
CONCLUSION:H3K27me3 immunohistochemistry is a reliable marker for molecular subgrouping of PF EPNs in routine neuropathology practice. 1q gain appears to identify a smaller subgroup within PF-A EPNs, and its independent prognostic significance needs elucidation in larger cohorts.

Keywords: ependymoma, posterior fossa, H3K27me3, 1q gain, PF-A, PF-B

PF-073

The Cytokine Secretion Response of Normal Human Epithelial Cells Under the Influence of Adamantinomatous Craniopharyngioma Cyst Fluid

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OBJECTIVE:Pediatric Adamantinomatous Craniopharyngioma (ACP) is well known for its association with poor quality of life in young patients. Biologically guided therapies are currently unavailable. ACP is histologically heterogeneous, including whorls of epithelial cells that harbor the upregulating β-catenin mutation and are suspected to drive tumor growth through a paracrine mechanism, likely cytokine mediated. ACP is further characterized by a unique cyst fluid, known to be enriched with pro-inflammatory cytokines. Understanding of the cellular source of these cytokines and the effects of cyst fluid on normal cells may facilitate the development of targeted therapies.
MATERIAL-METHODS:Cyst fluid was collected intraoperatively from pediatric ACP patients. Normal human epithelial cells were cultured and left untreated (control) or treated with ACP cyst fluid diluted at 10% in growth media with or without the IL-6R inhibitors, Tocilizumab or IL-6 neutralizing antibody (i.e. Siltuximab). Supernatants were collected and the concentrations of 41 cytokines were determined using a highly sensitive multiplexed magnetic bead-based cytokine assay.RESULTS:In response to CF treatment, epithelial cells significantly overexpressed several cytokines. Notably, IL-6 secretion was increased by 7.8-fold ($p<0.001$) with CF treatment but with CF plus Tocilizumab, this stimulated effect was diminished by 25% ($p<0.05$). IL-8 secretion was increased by 9.6-fold ($p<0.0001$), TGF-α by 34-fold ($p<0.005$) and GM-CSF by 6-fold ($p<0.05$). IFN-γ was increased by 3.7-fold ($p<0.005$) with CF treatment but with CF plus IL-6 neutralizing antibody, this stimulated effect was diminished by 73% ($p<0.001$). While CF treatment alone had no effect on IL-1α, CF plus Tocilizumab decreased IL-1α levels by 62% ($p<0.05$).
CONCLUSION:ACP cyst fluid is capable of driving pro-inflammatory cytokine secretion from normal epithelial cells. The IL-6R inhibitors, Tocilizumab and Siltuximab may blunt this response. These data regarding inflammatory signaling in ACP are guiding both preclinical and clinical studies of novel targeted therapies.

Keywords: Craniopharyngioma, Cyst Fluid, Cytokines, Tocilizumab, Interleukin-6, Interleukin-8

PF-076

Surgical Outcomes with Respect to Extent of Resection for Paediatric Atypical Teratoid Rhabdoid Tumours

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OBJECTIVE:Atypical Teratoid Rhabdoid tumours (ATRTs) are rare, embryonal CNS tumours with a poor prognosis, found largely in infants but may present in older children and adults. The objective of this study is to evaluate survival for ATRTs in relation to the extent of surgical resection.
MATERIAL-METHODS:The neurosurgical tumour databases from three UK paediatric neurosurgical centres (University Hospital of Wales, Alder Hey and Royal Manchester Children's hospital) were analysed and patients with a diagnosis of ATRT were identified between 2000-2018. Data was collected regarding demographics, extent of surgical resection, complications and overall survival. Our findings were compared with the previously published literature.
RESULTS:Twenty-four patients diagnosed with ATRT underwent thirty-eight operations in total. The age range was from 20 days to 147 months (mean age 29 months). The most common location for the tumour was the posterior fossa which included nine patients (37.5%). Six patients (25%) underwent a complete total resection (CTR), seven (29%) underwent a near total resection (NTR), eight (33.3%) underwent a subtotal resection (STR) and three patients (12.5%) had biopsy only. 66.6% of patients who underwent CTR are still alive, as of March 2019, in comparison to 29% in the NTR and 12.5% in the STR groups. Out of the thirty-eight operations, there was a total of twenty-two complications, of which the most common was pseudomeningocele (27%). Eight patients (33.3%) required a ventriculo-peritoneal shunt for hydrocephalus.
CONCLUSION:Although these patients are a highly vulnerable group, with a poor prognosis, maximal resection is recommended, where possible, for the best chance of long-term survival. However, near total resections are likely beneficial when compared with sub-total resections and biopsy alone. Maximal surgical resection should be combined with adjuvant therapies for the best long-term outcomes.

Keywords: ATYPICAL, TERATOID, RHABDOID, TUMOUR, NEUROSURGERY, PAEDIATRICS

PF-095

Thalamic tumors in children: surgical results of a series of 140 cases and literature review
Session on Trauma

Stephanie Puget[1], Kevin Beccaria[1], Thomas Blauwblomme[1], Giovanna Paternoster[1], Anais Chivet[1], Sandro Benichi[1], Timothe De St Denis[1], Syril James[1], Pascale Varlet[2], Nathalie Boddaert[3], Michel Zerah[1], Christian Sainte Rose[1]
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OBJECTIVE:Pediatric thalamic tumours are rare and challenging having been considered inoperable for a long time. A better understanding of their nature, location and accessibility may help to better rationalize their management.
MATERIAL-METHODS:We reviewed the results of a series of 140 children treated in our institution and reviewed the corresponding literature.
RESULTS:Three entities were identified according to their extension: thalamic (n=90), bithalamic (n=20) and thalamopeduncular (n=30). Progressive spastic hemiparesis and signs of raised ICP related to hydrocephalus were the most frequent clinical signs at presentation. No specific image could predict their type or grade. At first, a global treatment strategy must be carefully planned, taking into account the better option for the hydrodynamic disorders and the tumour itself. There are multiple surgical options, from biopsies to microscopic/endoscopic resection in one or several stages that can be applied. We will describe the different surgical approaches, depending on their location and extension. Many thalamic tumors could be resected with low mortality and morbidity.
In our series theses lesions were benign (the majority) or malignant. Since the 2016 WHO classification, high-grade glioma of this region belong to the "Diffuse Midline Glioma" H3K27m (DMG) and have the same dismal prognosis as DIPG. However we have shown that H3K27M/BRAF V600E midline ganglioglioma have a less agressive behaviour than DMG.

Hall B, Thursday, 24th October 2019, 08:00 – 09:05

PF-077

Utility of Serum Osteopontin to Differentiate Abusive Head Trauma From Other Causes of TBI in Children; A Pilot Study

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OBJECTIVE:Abusive head trauma (AHT) is a frequent cause of pediatric traumatic brain injury (TBI). Significant morbidity is commonplace among survivors. The diagnosis of AHT is often elusive at initial patient encounter(s). Studies to identify biomarkers that can differentiate AHT from other causes of TBI have been unsuccessful. AHT is especially unfortunate if the child is inadvertently returned to the offensive environment. This pilot study evaluates the utility of a recently described putative TBI blood biomarker, osteopontin (OPN) to identify AHT in a cohort of children who sustained TBI.
MATERIAL-METHODS:Twenty-three patients were identified, nine diagnosed with AHT and 14 with TBI of other mechanisms (e.g., falls, motor vehicle accidents). Serial blood samples were collected at admission, 24, 48, and 72 hours. Levels of OPN were compared between children with AHT versus other TBI mechanisms. Independent samples t-test was used to conduct statistical analysis.
RESULTS:No differences were found in Glasgow Coma Score (GCS) between AHT and the other TBI mechanism group (mean GCS 5.21 vs. 5.0). Independent samples t-test revealed that at admission, OPN level was significantly higher in children who sustained AHT compared to other TBI etiologies (mean AHT = 585.37 ng/ml vs. mean TBI = 353.30 ng/ml; $t(21) = -2.35$, $p = .029$). Furthermore, the mean levels of OPN was significantly higher for AHT compared to TBI ($t(21) = -2.780$, $p = .011$) across all subsequent time points.
CONCLUSION: OPN shows promise as a neuroinflammation-based diagnostic and prognostic biomarker in pediatric TBI and may potentially provide information about mechanism of injury. We speculate that the pathophysiologic basis is the enhanced inflammatory response associated with repeated brain injuries, as usually occurs with AHT. Studies with a larger cohort are needed to validate the sensitivity and specificity of OPN to identify children who are victims of AHT.

Keywords: abusive head trauma, non accidental trauma, biomarker, osteopontin, traumatic brain injury, children

PF-078

Pediatric mild brain trauma: What is the real yield of repeat imaging?

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OBJECTIVE:Pediatric traumatic brain injury is the leading cause of death among children and is a significant cause for morbidity.The majority of the injuries are mild (GCS 13-15) without any need for neurosurgical intervention and clinical significant neurological decline is rarely seen. Whereas the question for repeat imaging within the first 24 hours was

discussed in the past, the yeild of short term follow up imaging was never thoroghly described.
MATERIAL-METHODS:A retrospective review of patients with pediatric brain trauma (TBI) admitted to our institution was conducted. Patients with mild TBI (mTBI) were identified. Their presentation, hospital course, imaging results of acute, immediate (<48h), and short term follow up (<8 weeks) were reviewed. We included pediatric patients with mTBI that had repeated imaging in clinic and had no procedure during their initial admission (only conservative treatment). Each case was assessed to weather the follow up imaging changed the follow up course.
RESULTS:Between 2010 and 2015, 725 patients were admitted to our hospital with TBI. We reviewed each case and found 173 with mTBI that were treated with conservative treatment without any procedure and were seen in clinic within 8 weeks after the trauma for evaluation and repeat MRI. For thirty-two patients (18.5%) it was decided after imaging to continue neurosurgical follow up, which is a change from our paradigm after mTBI. Yet, none of the cases needed for either admission nor intervention. Most of the patients had either subdural hematoma, epidural hematoma or a combination (68.8%). Average age at admission was 7.7 years.
CONCLUSION:Children with mTBI are commonly followed in ambulatory clinic. We have high suspicion to believe that for children with mTBI that have normal clinical exam and no new complaints, there is no need for further ambulatory imaging, since the yield of imaging is relatively low.

Keywords: Traumatic brain injury, imaging, Pediatric, MRI, Follow up, cost effectiveness

PF-079

A machine-learning model to predict outcomes after traumatic brain injury using admission laboratory values

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OBJECTIVE:Admission laboratory blood results have been explored in adult studies for prognostication after traumatic brain injury (TBI) but the evidence in paediatric cohorts is scant. We aimed to identify which admission laboratory variables are correlated to 6-month outcomes after TBI in children and to explore prediction of outcomes, using both univariate and machine-learning analysis.
MATERIAL-METHODS:This was a retrospective cohort study of 94 children (mean age=7.3y) who were admitted to our centre with a severe TBI. Clinical records were examined for the data of laboratory blood tests taken on admission. Data for fourteen routine serum parameters were recorded. All patients had been followed up at 6-months and the Glasgow Outcome Score (GOS) recorded. The GOS for each patient was dichotomised as favourable (GOS 4-5) or unfavourable (GOS 1-3). Two models were trained using this data: logistic regression and a support vector machine (SVM). The models were evaluated using five-fold cross-validation.
RESULTS:pH, lactate, and glucose levels were identified as the most linearly correlated with bipartite outcome. A logistic regression model for these three variables predicts favourable outcome with a sensitivity=71% and specificity=99%. The SVM model for all fourteen parameters predicts favourable outcome with a sensitivity=63% and specificity=100%. A SVM model of the three most linear variables yields a sensitivity=80% and specificity=99%.
CONCLUSION:We identify admission levels of pH, lactate, and glucose as the most informative of 6-month outcomes after severe TBI in children. We have developed a supervised learning model that can prognosticate outcomes based on fourteen admission laboratory variables. Further work is warranted to validate and develop this model as a clinical tool.

Keywords: traumatic brain injury, machine-learning

PF-080

Rotterdam computed tomography score predicts 6 month favourable outcome after traumatic brain injury in children

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OBJECTIVE:Traumatic brain injury (TBI) is a devastating condition affecting 5-6 per 100,000 children annually in the UK. Early Computer Tomography (CT) features have been used for mortality prediction in children with TBI. However, it is not known whether they are useful for neurodevelopmental outcome prediction.
MATERIAL-METHODS:Single centre, pilot observational study (Nov 2016 to April 2018) of children (<16yrs) admitted to PICU following severe TBI. Rotterdam CT score (sum of component features on CT scan; see table) was calculated by a radiologist blinded to patient outcome. Existing Rotterdam CT score prediction model (Liesemer et al PCCM 2014) was validated using survival outcome and then a novel prediction model was derived for neurodevelopmental outcome. Model performance was compared with prediction based on injury severity score (ISS). We used a score of 1-3 of extended pediatric Glasgow Outcome Scale (1=upper good recovery, 8=death) at 6 months as favourable outcome.
RESULTS: 33 patients (median aged 9.2 years; IQR [6 to12.7]) were included. 56% were male, 42% were pedestrians injured by motor vehicle. Overall survival to 6 months was 30/33 (90.9%) with 26/33 (79%) favourable neurodevelopmental outcome. Published Rotterdam CT score mortality prediction model had a sensitivity (97%), specificity (50%), positive predictive value (97%) and negative predictive value (50%) for our cohort. In a novel derivation model, increasing Rotterdam CT score was statistically significantly associated with an unfavourable 6 month neurodevelopmental outcome; Odds ratio (OR) 4.2 (95%CI 1.3 to 13.4; p=0.017) and area under receiver operator curve (AUROC) (0.77; p=0.029). Increasing ISS was also associated with unfavourable outcome; OR 1.3 (95%CI 1.1 to 1.5; p=0.006), AUROC (0.96; p=0.001).
CONCLUSION:This pilot study demonstrated Rotterdam CT and ISS scores were associated with neurodevelopmental outcome at 6 months. A larger, multi-institute, study is required to validate findings and assess clinical utility in prognostication score.

Keywords: traumatic brain injury, paediatric, prognostication, neurocritical care, neuro-developmental outcome

PF-081

Decompressive craniectomy for traumatic intracranial hypertension in children

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OBJECTIVE:High ICP is the most frequent cause of death and disability after severe TBI. AIM: to determine, does, decompressive craniectomy improve clinical outcomesin children with severe TBI.
MATERIALS-METHODS: 287 patients (GCS 3-8) were admitted to our hospital from 2004 till 2018. Age of patients - from 1.5 to 18 years, 58% of them had combined trauma. Severity of concomitant injuries was evaluated using ISS. Intracranial injuries were classified using Marshall CT scale. ICP monitoring took place in 169 cases. High ICP was treated by general maneuvers (normothermia, sedation etc) and a set of first line therapeutic measures (hypertonic saline, etc). When these measures failed to control high ICP, second line therapies was started - barbiturates, moderate hypothermia. DC was final point of control of ICP for 69 patients. 8 patients had early DC without ICP control before surgery for clinical deterioration presenting with deteriorating rapidly to GCS ≤ 8. Refractory intracranial hypertension more than 20 mm Hg developed in 28% of patients. Mean value GCS was 5,8. All patients before DC demonstrated displacement of the brainstem, compression of the contralateral peduncle, and progressive obliteration of the parasellar and interpeduncular cisterns on CT scan. Indications for frontotemporoparietal DC was lateral dislocation (37 patients) and for bifrontal DC - axial dislocation (32 patients).
RESULTS:Good outcomes (GOS 4-5) - 40%; 31% had GOS 3; 29% - GOS 1-2. All surviving patients underwent early reconstruction of the skull defect (30-55 days). Six months later, 69% of survivors had good results. Statistical analysis demonstrated that patients with GCS < 5, wide pupil size without photoreaction, ICP > 40 mm Hg before DC have bad prognosis ($p<0,05$).
CONCLUSION:DC may be an effective method of control dislocation syndrome, but the effectiveness is doubtful for patients under the conditions of herniation

Keywords: severe brain injury, children, intracranial pressure, decompressive craniectomy, outcomes

Session on Vascular

Hall B, Thursday, 24th October 2019, 09:10 – 10:45

PF-082

Gene mutations related to pathogenesis and development of cerebral arteriovenous malformations in pediatric populations

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OBJECTIVE:Cerebral arteriovenous malformations (AVMs) are the most common cause of spontaneous intracranial hemorrhage in pediatric patients. Recurrence after complete surgical resection is a recognized risk that occurs primarily in children. While Pediatric Neurosurgery practices traditionally focus on clinical management, recent advances have found gene mutations to play a role in pathogenesis and development of AVMs. It is not known how many pediatric AVMs are sporadic versus arising from familial inheritance patterns. We aimed to see how identified genetic mutations are represented in our AVM patient population in Texas and the southern United States.
MATERIAL-METHODS:We developed a multidiscipinary pediatric neurovascular program at our institution. Patients and families were screened in their first-time and/or follow-up outpatient clinic encounters by our hematologist-oncologist and genetics counsellor from the Pediatric Vascular Anomalies program. Genetic testing recommendations and results were recorded in our IRB-approved ongoing prospective neurovascular database.
RESULTS:50 patients were screened in Vascular Anomalies program. Diagnoses ranged from arteriovenous malformations (n=20), cerebral cavernous malformations (n=13), non-NF/non-sickle-cell moyamoya (n=7), and other lesions such as cerebral proliferative angiopathy and megelencephaly-capillary malformation. Of the 50 patients, 30 underwent genetic testing. 7 had identified mutations. 3 patients with cavernous angiomas had Krit1 mutations. 2 patients with AVMs had Rasa1 mutations, and 2 patients with megenecephaly-capillary malformations had PIK3CA mutations.
CONCLUSION:These preliminary findings highlight the importance of thinking beyond neurosurgical intervention for pediatric neurovascular diseases. Genetic mutations have been found in 23% of patients screened thus far. Such findings provide insight into disease biology and may likely have clinical implications for risk assessment, family screening, and follow-up surveillance. Further work needs to be done to capture all our AVM population for genetic screening over time, while expanding our neurovascular program's study focus to encompass all neurovascular pathologies.

Keywords: Genetic screening; arteriovenous malformation; pediatric; vascular anomalies; genetic mutation; neurovascular pathology

PF-083

Incidence and predictive factors of hydrocephalus treatment after rupture of arteriovenous malformations in children

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OBJECTIVE:Hydrocephalus is a life threatening complication in patients with ruptured cerebral arteriovenous malformation (AVM) that may impact neurological outcome. 44% of adult patients with a ruptured AVM require a temporary external ventricular drain (EVD), and 18% a permanent ventriculo-peritoneal shunt.As these data were not reported in pediatric series, we conducted a study of children with ruptured AVM related hydrocephalus.
MATERIAL-METHODS:We retrospectively analysed clinical and imaging data from children treated for a ruptured AVM extracted from the prospectively maintained databank of pediatric intracerebral hematoma (PICH Database, Guedon et al 2018). We analysed incidence of temporary and permanent CSF diversion as well as predictive factors such as the modified Graeb score which evaluates the percentage of blood in each cerebral ventricle (Morgan et al 2013).
RESULTS:116 patients treated for a ruptured AVM between 2002 and 2018 were included. An EVD was inserted in 50 cases (43%): 11 children (10%) had a superficial supratentorial hemorrhage, 28 (24%) a deep supratentorial hemorrhage and 10 (9%) an infratentorial hemorrhage. Of these 48/50 had an intraventricular hemorrhage component with a median Graeb score of 8 (range 0-37). Four patients ultimately required a ventriculo-peritoneal shunt (3.4%). Multivariate linear regression revealed low initial Glascow Coma Scale ($p<0.001$), AVM associated aneurysms ($p=0.03$), high Graeb score ($p<0.001$), infratentorial AVM localisation ($p=0.04$) and increasing patients' age ($p=0.03$) to predict the need of temporary EVD.

CONCLUSION:We report that 43% of children treated for a ruptured AVM require a temporary EVD, and we identify risk factors that could be of clinical benefit for an early treatment. Whether ruptured AVM related hydrocephalus impairs cognitive development remains to be studied.

Keywords: Hydrocephalus, ventriculo-peritoneal shunt, arteriovenous malformation, intracerebral hematoma, aneurysm

PF-084

The effect of indirect revascularization and endothelial progenitor cells on the non-revascularized hemisphere in ischemic rat brains

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OBJECTIVE:To investigate the effect of encephalo-myo-synangiosis (EMS) and endothelial progenitor cells (EPCs) on the non-revascularized hemisphere in the ischemic rat brains.
MATERIAL-METHODS:Cerebral ischemia was induced by bilateral internal carotid artery ligation (BICAL) in rats, and EMS was performed 1 week thereafter on one hemisphere. The addition of EPCs, stromal cell-derived factor 1 (SDF-1), and AMD3100 to EMS was performed to investigate their effects on EMS to both hemispheres. Two weeks after EMS, another craniotomy was performed on the revascularized and non-revascularized hemispheres, respectively, for direct visualization of the cortical microcirculation and the measurement of the regional blood flow and the partial pressure of brain tissue oxygen (PbtO2).
RESULTS: The regional blood flow and PbtO2 on bilateral hemispheres decreased 1 week after BICAL. EMS improved the regional blood flow and PbtO2 induced by BICAL on the revascularized hemispheres. The regional blood flow was further increased by the addition of SDF-1 or decreased by the addition of AMD3100, an antagonist of SDF-1, respectively. The injection of EPCs into the temporalis muscle further increased the regional blood flow compared with the group of EMS. On the non-revascularized hemisphere, the changes were paralleled to that on the revascularized hemisphere though the improvement of PbtO2 was not as good as the regional blood flow in the groups of EMS and the group of EMS plus EPC injection.
CONCLUSION:EMS ameliorated the cerebral ischemic changes which include disturbance of microcirculation, regional blood flow and PbtO2. EMS also improved ischemic impairment on the non-revascularized hemisphere, especially the regional blood flow. This finding is compatible with moyamoya disease surgery that after indirect revascularization surgery on one hemisphere, the cerebral perfusion on the opposite side may improve for some degree. It suggests that EPCs may play a role in augmenting the effect of indirect revascularization on ischemic brain.

Keywords: EPC, microcirculation, EMS, angiogenesis

PF-085

Long-term outcomes after indirect bypass surgery for 629 children with moyamoya disease: cross-sectional and longitudinal analysis

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OBJECTIVE:Moyamoya disease (MMD) is the most common surgically treated paediatric cerebrovascular disease in East Asia. The rare incidence and variety of surgical techniques applied have limited the clinical research on MMD. In paediatric MMD, there are few reports on the efficacy of surgical intervention for stroke prevention. We evaluated the long-term outcomes of indirect bypass surgery on a relatively large number of children with MMD in a single centre.
MATERIAL-METHODS:From August 1988 to December 2012, 772 children with MMD underwent indirect bypass surgery. This study included 629 patients who were followed up for more than 5 years, excluding patients with moyamoya syndrome. The mean clinical follow-up duration was 10.3±4.7 years (range, 5–28 years). Cross-sectional analysis was performed to evaluate overall clinical outcomes and factors associated with unfavourable outcomes. To analyse the longitudinal effect of surgery, the annual risk of symptomatic infarction or haemorrhage after indirect bypass surgery was calculated with a person-year method, and the event-free survival rate was evaluated using the Kaplan–Meier method.
RESULTS:The overall clinical outcome was excellent in 55%, good in 38%, fair in 6%, and poor in 1% of the patients. Therefore, 92% of the patients had a favourable clinical outcome (excellent and good). The annual risks of symptomatic infarction and haemorrhage ipsilateral to the operated vascular territory were 0.06% and 0.04%, respectively. Furthermore, the 10-year event-free survival rates for symptomatic infarction and haemorrhage in the operated hemispheres were 99.4% and 99.6%, respectively.
CONCLUSION:Indirect bypass surgery resulted in satisfactory long-term improvement in overall clinical outcome and prevention of recurrent stroke in children with MMD.

Keywords: Moyamoya Disease; Bypass; Indirect; Stroke-free survival; Outcome

PF-086

Changes of surgical strategy for young patients with moyamoya disease

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OBJECTIVE:Young children with moyamoya disease (yMMD) frequently exhibit extensive cerebral infarction at the time of initial presentation, and even in the early postoperative period. We have changed the

surgical strategies for yMMD patients to reduce cerebral infarction. The clinical findings and radiological data were reviewed.
MATERIAL-METHODS:Between January 2004 and December 2013, 22 patients (39 hemispheres) with yMMD (<7 y.o), were surgically treated. The surgical strategy of 1st era was indirect bypass by Encephalo-galeo-myo-duro-synangiosis (EGMDS) (3 hemisphere), 2nd era was that by EGMDS and STA-MCA single anastomosis (32 hemispheres) and 3rd era was that by EGMDS and double STA-MCA anastomosis (4 hemispheres) for high risk patients. The surgery was performed more than one month after initial symptom at 1st era, while performed as early as possible at 2nd and 3rd era.
RESULTS:Mean age at surgery was 3.7±1.5 y.o. Cerebral infarction while waiting for surgery was seen in 5 patients. Postoperative cerebral infarctions were seen in 3 patients. Of them, 2 occurred in ipsilateral hemisphere and 1 in contralateral hemisphere. They were all seen in 2nd era. During follow-up period (mean 107±40.7m) TIA was disappeared in all cases but 5 who showed progression of PCA lesion.
CONCLUSION:Considering these results, direct bypass can provide prompt improvement in cerebral circulation of moyamoya disease that thought to be suitable for rapidly progressive yMMD. But the direct bypass is not completely safe in yMMD patients because it causes dynamic change in postoperative cerebral hemodynamics that we call watershed shift. To prevent these complications, we recently induced STA-MCA double bypass as an initial treatment for the patients with high risk of cerebral infarction that should be able to increase cerebral perfusion of both areas that upper and lower trunk of middle cerebral artery perfuse in a balanced manner. The result of the strategy seems to be favorable.

Keywords: moyamoya disease, surgical treatment, young children

Special Session on EBM

Hall A, Thursday, 24th October 2019, 11:15 – 12:35

PF-087

Association of Myelomeningocele Sac and Sac Size with Prenatal Function in Open Spinal Dysraphism: Evidence of Prenatal Stretch Induced Neurologic Injury

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OBJECTIVE:Analyze the correlation of the presence and size of a myelomeningocele sac size with fetal lower extremity function.
MATERIAL-METHODS:Retrospective data was obtained from 2013-2017 at the Children's Hospital of Philadelphia (CHOP). Myelomeningocele (MMC) or myeloschisis (MS) was established at the time of the prenatal evaluation based on the presence or absence of a sac and sac volume was calculated from ultrasound. The presence of talipes and lesion level were obtained from ultrasound reports. Data from the Management of Myelomeningocele Study (MOMS) randomized controlled trial was analyzed to correlate the presence of an MMC sac with prenatal talipes and impaired fetal leg movements.
RESULTS:A total of 283 MMC cases and 121 MS cases involving the lower thoracic and lumbar spine (T10-L5) were identified from a CHOP prenatal database. When comparing MMC to MS cases, a higher proportion of talipes was present in the MMC group (28.4% vs 16.5%, p=0.02). Mean sac volume was statistically higher in cases of MMC associated with talipes compared to those cases without talipes (4.7±4.2mL vs 3.0±2.6mL; p<0.01). There was a significant association between increasing sac volume and talipes (p <0.01). The predicted probabilities of talipes at sac volumes of 1mL, 7.5mL and 15mL were 20.6%, 41.7%, and 69.7%, respectively. A review of the MOMS data demonstrated similar findings. For cases with a sac, 40/142 (28.2%) had talipes versus 3/40 (7.5%) for those that had no sac (RR=3.76, 95% CI 1.23-11.5; p<0.01). This finding was significant even when adjusting for lesion level as a confounder.
CONCLUSION:The presence of an MMC sac is associated with prenatal talipes. In addition to direct physical trauma and chemical damage, these findings delineate a third acquired mechanism of injury to the exposed spinal tissue in these patients, mechanical stretching of the neural elements

Keywords: spina bifida, myelomeningocele, myeloschisis, talipes, prenatal, fetal

PF-088

Hemispherectomy Outcome Prediction Scale: Development and validation of a scale to predict seizure outcomes

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OBJECTIVE:To develop and validate a scale to predict the probability of seizure freedom in children undergoing a cerebral hemispherectomy for the treatment of drug-resistant epilepsy.
MATERIAL-METHODS:We analyzed 1267 hemispheric surgeries performed consecutively on children (<19 years of age) across 30 centers and 12 countries to identify predictors of seizure freedom at 6 months following the operation. A multivariate logistic regression model was developed on 70% of the dataset (training set) and validated on 30% of the dataset (validation set). Missing data was handled using multiple imputation techniques.
RESULTS:Overall, 817/1267 (64%) hemispherectomies led to seizure freedom. The regression model (containing age at seizure onset, presence of generalized seizures and age at surgery, etiology, MRI characteristics, age at surgery and previous non-hemispheric respective surgery) demonstrated were predictive of seizure freedom (Training set AUC 0.775, Testing set AUC 0.725). A simplified HOPS score was devised that closely approximates the predicted probability of hemispherectomy success.
CONCLUSION:Children most likely to benefit from a hemispherectomy can now be appropriately selected and counseled. Importantly, some children can be spared from the complications and deficits associated with this surgery who are unlikely to experience seizure control.

Keywords: HOPS, Hemispherectomy Prediction Model, Scale, Validation

PF-089

Comparative Analysis of Surgical Callosotomy and Laser Interstitial Thermal Therapy (LITT) in Children

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OBJECTIVE:Corpus callosotomy has been efficacious for patients with multifocal refractory epilepsy or secondarily generalizable seizures, and drop attacks (atonic or tonic). MR-guided Laser Interstitial Thermal Therapy is a minimally invasive surgical option for ablation of epileptogenic foci. To date, there is no comparative study; therefore authors report their results from open corpus callosotomy (OCC) and Laser Interstititual Thermal Therapy (LITT).
MATERIAL-METHODS:All patients operated with either open surgical callosotomy or LITT from Jan 2005 to Jun 2018 were reviewed at a single center. Patient' demographics, presurgical seizure burden, operative variables, postoperative outcome, complications, revision operation, need for steroid/duration of steroid, disposition to rehab facility or home, and overall recovery from seizure burden were recorded.
RESULTS:20 patients male to female ratio of 4:1 with mean age of 10 years *OCC versus LITT, (9.2 vs. 11.6)* were operated for medically refractory epilepsy. 6 (30%) patients underwent LITT procedure. When compared with OCC cohort, statistically significant decrease in EBL ($p<0.003$), and decreasing trend towards LOS ($p<0.149$) was observed in LITT cohort *mean±SEM, (50.71±8.40 vs. 7±3.41), and (6.07±0.44 vs. 4.50±1.18)*. Reported follow-up (in months) for OCC cohort was 87.64, and for LITT was 6.91. In OCC cohort 9 (64%) patients were transferred to inpatient rehab facility while, all LITT patients were discharged home postoperatively. Interestingly, 10 (71%) patients in OCC, and 5 (83%) in LITT cohort documented recovery from seizure burden.
CONCLUSION:The concept of treatment of multiple epileptogenic foci in children using LITT has been relatively recent. Corpus callosotomy using LITT is a novel alternative procedure to conventional open surgical approach with significant decrease in EBL, and LOS. When compared to OCC, LITT offers quicker recovery, almost complete cure from drop seizures, and final disposition to home.

Keywords: drop attacks; corpus callosotomy; laser interstitial thermal therapy

PF-090

Value of computerised shunt infusion studies for suspected shunt malfunction in paediatric hydrocephalus - a two centre observational study

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OBJECTIVE:Hydrocephalus shunt malfunction can occur insidiously without specific symptoms or changes in ventricular size. It therefore imposes a diagnostic challenge. Computerised shunt-infusion-studies (SIS) enable quantitative shunt assessment. We have previously reported the impact of SIS on patient management in a mixed adult and paediatric population. In this study, we have aimed to report the feasibility and accuracy of SIS in a cohort of paediatric hydrocephalus patients.
MATERIAL-METHODS:232 SIS (39 in Tubingen and 193 in Cambridge) were performed in 178 children. Based on follow-up and need for revision, we classified shunts as functioning, borderline and obstructed and calculated how accurately the infusion test could differentiate between a functioning and malfunctioning shunt, as well as the site of obstruction.
RESULTS:41 shunts (18.5%) were found distally obstructed, 23 proximally obstructed (10%), 26 (11.8%) had borderline characteristics and 142 (64.2 %) were functional. CSF outflow resistance and ICP plateau were significantly elevated ($n<0.001$) in distally obstructed shunts, with cut-off thresholds being 5.9 mmHg/ml/min and 21.07 mmHg, respectively. Absence of ICP waveform combined with steep increase of pressure during the occlusion manoeuvre accurately detected proximal obstruction in all cases. All obstructed shunts were revised. In about 50 % of cases the ventricular size decreased postoperatively, with 50% of patients showing an improvement on clinical investigation or according to parent's reports.
CONCLUSION:SIS is a feasible, radiation-free technique for quantitative diagnosis of shunt malfunction. Knowledge of shunt hydrodynamic characteristics and dedicated software containing those are necessary when investigating shunt function.

Keywords: hydrocephalus, infusion tests, shunt function

PF-092

Consensus guidelines for contemporary management of medulloblastoma in developing countries

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OBJECTIVE:The high success rate in the management medulloblastoma achieved in the western world is not exactly mirrored in developing countries including India. Socio-demographic differences, health-care disparity, and lack in uniformity of care with resultant widespread variations in the clinical practice are some of the reasons that may partly explain this difference in outcomes. Patients with medulloblastoma require a multi-disciplinary team approach involving but not limited to neuro-radiology, neurosurgery; neuropathology, molecular biology, radiation oncology, pediatric medical oncology and rehabilitative services for optimizing outcomes.
MATERIAL-METHODS:The Indian Society of Neuro-Oncology (ISNO) constituted an expert multi-disciplinary panel with adequate representation from all stakeholders to prepare national consensus guidelines for the contemporary management of medulloblastoma.
RESULTS:Minimum desirable, as well as preferable though optional recommendations (as appropriate), were developed and adopted for the pre-surgical work-up including neuroimaging; neurosurgical management including surgical principles, techniques, and complications; neuropathology reporting and molecular testing; contemporary

risk-stratification in the molecular era; appropriate adjuvant therapy (radiotherapy and chemotherapy); and follow-up schedule in medulloblastoma.
CONCLUSION:A broad consensus was reached amongst various stakeholders within the neuro-oncology community involved in the contemporary curative-intent management of children with medulloblastoma. It provides both general as well as specific guidelines and recommendations to be adopted by physicians and health care providers to achieve uniformity of care, improve disease-related outcomes, and compare results between institutions within the developing country.

Keywords: medulloblastoma, guidelines, developing country

Session on Innovation and Technology

Hall B, Thursday, 24th October 2019, 11:15 – 12:15

PF-093

Scalable Deep Learning Optimization Algorithms as a Framework for Computer-Aided Diagnosis from Radiographic Images of Rare Diseases with Limited Data Using Adamantinomatous Craniopharyngioma as an Example

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OBJECTIVE:Deep learning (DL) is an increasingly utilized mathematical modeling technique. DL is traditionally used when large volume of data (i.e. millions of datapoints) are available for model training. Therefore, novel techniques are required for the application of DL to uncommon medical conditions, such as pediatric brain tumors. As a proof of principle, we present a novel genetic algorithm (GA) that identifies optimal architecture hyperparameters for state-of-the-art image classification networks to identify the pediatric brain tumor, adamantinomatous craniopharyngioma (ACP).
MATERIAL-METHODS: We accumulated a multi-institutional dataset comprising representative preoperative CT and MRI images from 56 unique patients with pathologically-confirmed ACP. We gathered images from 63 unique patients with pathologically-confirmed diseases within the radiographic differential diagnosis of ACP (labelled "NOTACP"). Using Google's TensorFlow API with publicly-available image classification networks, we generated classifiers that were trained on a subset of images. To improve this classifier performance over 10 network features, we implemented a custom GA. The resultant models were compared against board-certified pediatric neuroradiologists on a test set comprising the images not used in model training. Model performance was evaluated using Receiver Operating Curve and Area Under the Curve metrics.
RESULTS:Our scalable GA searched 1,000 networks in parallel and yielded up to a 38% increase in performance over out-of-the-box classifier results. Our GA-optimized classifier achieved 85.3%, 83.3%, and 87.8% accuracy in CT, MRI, and combined CT-MRI contexts, respectively. Comparatively, neuroradiologists achieved an average of 89.4%, 83.3%, and 93.8%, respectively, on the same test dataset (p=0.39).
CONCLUSION:The proposed system serves as an easily implementable and scalable framework for developing non-invasive computer-aided diagnostic tools even for rare diseases, thereby establishing the potential for their application in myriad clinical contexts.

Keywords: Deep Learning, Machine Learning, Genetic Algorithm Optimization, Artificial Intelligence, Computer-Aided Diagnosis

PF-094

Initial experience with navigated TMS for pediatric neurosurgical interventions

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OBJECTIVE:In adults, navigated transcranial magnetic stimulation (nTMS) has been established as preoperative examination method for brain tumours in motor or speech eloquent location. The feasibility of

nTMS in children with brain tumours is yet unclear. We analysed our first experience for surgical-strategy planning and counselling the families with nTMS examination in children.
MATERIAL-METHODS:TMS examinations were performed in 10 children (6♂; mean age: 10.2±4.9yrs) with different brain lesions involving motor or language eloquent locations. A motor mapping was performed in 9 cases combined with cortical seed area definition to visualize the corticospinal tract. In 7 cases TMS language mapping was done to detect language-associated cortical areas in conjunction with DTI fiber tractography to visualize the individual language network. We analysed feasibility of TMS and nTMS influence on counselling and surgical strategy in a prospective analysis.
RESULTS:All motor mappings could be performed successfully. TMS induced speech error detection could be visualized in 5/7 cases. In a 7-year old boy with developmental retardation and in a 5-year old girl with a shunt system nTMS language mapping was not feasable. No surgical complications and no unexpected neurological deterioration were observed. In all cases, successful TMS counselling of the families was improved. In 5/8 patients the surgical strategy was adapted according to nTMS data and in 5/8 the extent of resection was redefined.
CONCLUSION:Navigated-TMS and DTI fiber tracking was feasible in the majoritry of patients as planned. We experienced to improve the presurgical counselling of the families and the surgical planning for approach and extent of resection by nTMS. Navigated TMS surgical procedure can be regarded as potential beneficial adjunct for neurosurgical procedures in eloquent areas in pediatric population.

Keywords: brain tumors, epilepsy, Neuronavigation, transcranial magnetic stimulation

Flash Abstracts

Craniofacial Flash Session I
Hall A, Monday, 21st October 2019, 09:55 - 10:30

FL-001

Parents Reported Outcome in Craniosynostosis

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OBJECTIVE:To report the cosmetic outcome of surgery for craniosynostosis as reported by parents.
MATERIAL-METHODS:A prospective observational study of children with craniosynostosis surgery who underwent surgery for correction of shape by a single surgeon. Following surgical procedures for specific suture involvement. Metopic and Unicoronal – bifrontal craniotomy and orbital advancement. Bicoronal – bifrontal craniotomy, orbital advancement, biparieto-occipital craniotomy, and height reduction under intracranial pressure monitoring. Sagittal – bifrontal, biparietal, and bioccipital craniotomy, anteroposterior length reduction and bilateral pi procedure. Multidutural – customized to the most severe deformity. Only thread was used for fixing the bone in most of the cases. Miniplates and screws biodegradable of metallic were rarely used. The outcome was reported by parent/s at time of follow-up. The outcome was classified as class 1 – satisfactory correction of shape, class 1 - satisfactory correction of shape, however, some irregularities felt but not bothersome, class 3 - satisfactory correction of shape, however, some irregularities seen but not bothersome, class 4 - satisfactory correction of shape, however, irregularities seen of felt and bothersome, class 5-dissatisfactory correction of shape, however, reoperation is not requested, 6 - dissatisfactory correction of shape, and reoperation is requested.
RESULTS:A total of 72 children underwent surgery for craniosynostosis. The distribution was as following: unicoronal (16), metopic (14), bicoronal (12), sagittal (9), pancraniosynostosis (10), and multisutural (11). Only VP shunt was done for 8 of them. Rest (66) underwent surgical procedures as described above. The follow-up was available for 44 children ranging from 3 – 81 months (mean 18.8 months) after surgery. The outcome was as following: class 1 (22), class 2 (10), class 3 (8), class 4 (3), and class 5 (1).
CONCLUSION:The cosmetic outcome of craniosynostosis was satisfactory in most cases. A simple technique of bone fixation with thread can also give good cosmetic results.

Keywords: Craniosynostosis

FL-002

Management of sagittal synostosis in the Synostosis Research Group (SynRG)

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OBJECTIVE:The role of imaging and approaches to management are variable for sagittal synostosis. The Synostosis Research Group (SynRG) has prospectively collected data on new cases of sagittal synostosis to identify areas for improvement in care.
MATERIAL-METHODS:All new cases of synostosis from 5 craniofacial centers were prospectively entered in the SynRGdatabase (2017/2018). For sagittal synostosis, we analyzed presentation, imaging, operative techniques and complications.
RESULTS:139 children had sagittal synostosis. Among 80 treated with strip craniectomy (mean age 100 days), 70% had pre-op imaging. Additional fused sutures on imaging included 5 coronal, 4 metopic, 2 lambdoid. Enlarged subarachnoid spaces found in 25%. Periop adjuncts were steroids 49%, arterial lines 30%, TXA 15%. Post op 10% went to PICU and 80% were helmetted. Surgical technique varied by center (4.8cm craniectomy with parietal wedges;2.5 cm craniectomy; 1.0 cm craniectomy with springs; 3.7 cm craniectomy with barrel staves). Intraoperative transfusions in 7.5%, 2% patients had dural openings. Narcotics prescribed at discharge in 73% of strips.Sagittal synostosis had cranial vault surgery in 59 cases (591 days old). 95% had imaging; additional fused sutures were 10 coronal, 12 metopic, 10 lambdoid, 14% enlarged subarachnoid spaces, 2 had copper beaten skull and 1 had Chiari. Periop adjuncts included TXA 85%, art line 85%, foley 83%, steroids 80%, doppler 34%, cell saver 12%, central line 7%. Intraop 73% transfused and durotomy occurred in 10%. Postop subdural blood on imaging in 4%. Narcotics prescribed at discharge in 83% of vaults.
CONCLUSION:Sagittal synostosis was more commonly treated by strip craniectomy than cranial vault. Preop imaging revealed additional fused sutures and impacted the clinical diagnosis. Craniectomy methods vary by site. Transfusions were less common with strip craniectomy. Narcotic prescription at discharge is common in both groups. Detailed prospective data collection allows identification of practice patterns and opportunities for improvement in care.

Keywords: sagittal synostosis, imaging, variation

FL-003

Changes in nasofrontal angle on 3D photocephalometry after sagittal craniectomy with biparietal morcellation for scaphocephaly

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OBJECTIVE:Parents often tell us shortly after surgery for scaphocephaly that forehead shape is improved even when we have not directly reshaped it. We wondered, is this real or illusion? To investigate, we measured nasofrontal angles using 3D photocephalometry in subjects with scaphocephaly and compared the preoperative-to-postoperative change in angle between subjects who underwent open surgery with various extents of forehead remodeling.
MATERIAL-METHODS: We included all subjects from 2013 onwards who underwent sagittal craniectomy with biparietal morcellation (SCBM) +/- variations addressing the frontal bones and who had preoperative and postoperative 3D photos within 2 months before and 3 months after surgery. We compared the average preoperative-to-postoperative change in nasofrontal angle between 4 surgical groups: SCBM only (SCBM), SCBM with morcellation anterior to the coronal suture (SCBMA), SCBMA with lateral frontal bone barrel stave cranioplasty (SCBMA+BS), and SCBMA with bifrontal craniotomy/cranioplasty (SCBMA+Crani).
RESULTS:126 subjects underwent surgery. 54 were excluded due to timing of preoperative/postoperative photos. 30 SCBM subjects had an average preoperative-to-postoperative nasofrontal angle decrease of 1.03 degrees, 27 SCBMA subjects had an average increase of 0.40 degrees, 9 SCBMA+BS subjects had an average decrease of 0.53 degrees, and 6 SCBMA+Crani subjects had an average decrease of 0.28 degrees (nonsignificant).
CONCLUSION:Nasofrontal angles change little shortly after sagittal craniectomy with biparietal morcellation for scaphocephaly, regardless of surgical variations addressing the frontal bones. It may be that changes in nasofrontal angle occur later after surgery or that the nasofrontal angle does not reflect changes in forehead contour after surgery. We are currently graphing all nasofrontal angles versus time from surgery, including sequential postoperative photos obtained after 3 months, and also measuring nasofrontal angles in the same subjects using the metopion instead of the glabella as the upper point of the angle. We are also comparing changes in nasofrontal angle after endoscopic versus open surgery.

Keywords: sagittal craniosynostosis, scaphocephaly, nasofrontal angle, 3D photocephalometery, sagittal craniectomy with biparietal morcellation

FL-004

evolution of coronal and lambdoid sutures following total vault remodelling for scaphocephaly

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OBJECTIVE:It is known that closure of coronal or lambdoid suture can be seen after surgical correction for scaphocephaly. However, its pattern was not studied in detail. The objective of this study was to evaluated if and when the coronal and lambdoid suture close after a complete vault remodeling for scaphocephaly.
MATERIAL-METHODS:Among all scaphocephalies operated in our pediatric neurosurgical service, twenty patients agreed to undergo a new CT scan for the purpose of this study. All patients were operated using the same surgical technique with a total vault remodeling. Both coronal and lambdoid sutures are removed with a gouge forcep.
RESULTS:Mean delay between the surgery and the CT scan was 5,5 years (min 1,3 years, max 11,4 years). Regarding the closure of the lambdoid sutures, we noted that, in all but one patient, the pattern of the suture was present on the post-operative control. Regarding the coronal sutures, half of the patient (n=10) had a closed suture. Closure could be seen as early as 1.3 years post op.
CONCLUSION:This series proves that coronal and lambdoid sutures can reappear with a normal pattern of growth after their surgical removal. This neoformation was observed mainly for lambdoid sutures that present a more physiological behavior. On the contrary coronal sutures more frequently close after the surgical removal. Questions remain to explain the reasons of such different evolution and the implication of the early coronal closure in relation with of neuropsychological evolution.

Keywords: craniosynostosis, neosuture, children

FL-005

Endoscopic correction of scaphocephaly: do helmets affect treatment outcome?

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OBJECTIVE:According to previous studies the endoscopic treatment of scaphocephaly is effective. However, some studies question the need for postoperative use of helmets. Therefore, the aim of this study was to evaluate the effect of cranial orthoses on the outcome of the endoscopic treatment of scaphocephaly in children.
MATERIAL-METHODS:From 2013 to 2018, 192 endoscopic correction of scaphocephaly operations were performed. In all cases helmets were used after surgery, with one to three helmets used for each patient during the treatment period. The study included 123 patients with scaphocephaly, for whom the results of 3D-photogrammetric imaging were available. The imaging was done before the operation, at different stages of helmet treatment and during follow-up. For all cases included in the study 3D-models of cranial orthoses were also available. A comparative analysis of shape of the head of patients with scaphocephaly and dimensions of the helmets was carried out, for this, the dynamics of the cranial index(CI) were studied.
RESULTS:The morphology of the head (CI) at follow-up correlates with the same parameters of the cranial orthosis (P=0.54). The greater the difference between the CI of the helmet and the head, the greater the difference between the initial CI of the head and the CI at the follow-up (P=0.7). There was no effect of the duration of the helmet therapy on the final result. The greatest changes occurred during the first 2 months after surgery. The biggest changes in CI were found in patients with initially low CI. The effect of treatment depends on the patient's age.
CONCLUSION:Cranial orthoses significantly influence the change in the shape of the skull after endoscopic treatment in patients with scaphocephaly. The shape of the first helmet is most important, since it is during this period of time that the greatest changes in the shape of the head occur.

Keywords: craniosynostosis, scaphocephaly, endoscopy, helmet

FL-007

Management of craniostenosis: about 413 cases

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OBJECTIVE:The purpose of the treatment of the craniosynostosis is correcting bone deformities to ensure harmonious development of the skull, the brain and the face and especially to prevent secondary complications to the premature synostosis of the cranial sutures, which are intracranial hypertension (ICH) in charge of blindness and retardation, and craniofacial dimorphism with disastrous psychosocial consequences. Surgical treatments are adapted to each type of craniosynostosis and every age.
MATERIAL-METHODS:We report a series of 413 cases of craniosynostosis treated in our department between 1994 and 2018. 53 are syndromic (20 Apert syndrome, 23 Crouzon syndrome, 7 cloverleaf skull and 3 other syndromes), and 360 non-syndromic (125 plagiocephaly, 33 oxycephaly, 143 scaphocephaly and 42 trigonocephaly, 7 lambdoides and 10 complex craniosynostosis).
RESULTS:The average age of the patients at the intervention is 20 months (40 days to 13 years) with a discret male predominance; the sex ratio is 1.3/1. All of our patients have benefited from an imaging assessment: Plain X ray and head scanner with three-dimensional reconstruction. An electroencephalography balance sheet and an ophthalmologic assessment were done for all patients. The realization of the bilateral parietal flaps (BPF) in 143 cases, craniofacial advancement unilateral or bilateral in the others cases. These techniques have allowed for very good functional and cosmetic results after an evolution of 8.4 years. Postoperative complications were observed: 4 deaths the first case was immediate post surgery secondary to a haemorrhage; the second to a complex heart malformation 2 cases after sever sepsis. Tow cases of recurrence, which have benefited from a surgical recovery with an excellent aesthetic result.
CONCLUSION:Surgical treatment of the craniosynostosis continues to grow, fronto-orbital advancement techniques and parietal flaps allowed us to get good functional and aesthetic results in the majority of cases.

Keywords: craniosynostosis, cranio-facial dimorphism, craniofacial surgery, fronto-orbital advancement, front floating.

FL-008

Use of resorbable material in the surgical correction of craniofaciosynostosis: 16 years of experience in lyon

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OBJECTIVE:Use of a fix and rigid system for surgical correction of craniosynostosis is mandatory. Resorbable plates and screws (poly L-lacticpolyglycolic copolymer) have proved to be effective. We present our experience with the use of resorbable plates in craniofaciosynostosis surgery in children.
MATERIAL-METHODS:Between January 2002 and October 2018, 302 patients with a craniosynostosis were operated using resorbable material: 106 scaphocephalies, 75 trigonocephalies, 83 plagiocephalies/brachycephalies and 38 complex craniofaciosynostosis. For each patient, at least 4 plates were used. For the correction of the orbital bandeau a plate of 10 holes was used on the inner part of the bone. The following events were evaluated: post-operative infections, fixation failure, local inflammatory reaction or inflammatory granuloma, a new procedure du to a failure of the fixation devices, cosmetic results and bone defect.
RESULTS:Mean follow-up time was 5.3 years (min 3 mths, max 15 yrs). No complication related to the material was reported. Three patients (1%) presented a scar infection but not next to the plates. No fixation failure was noted. Local inflammatory reaction due to the resorption of the plates and screws occurred but without inflammatory granuloma. A bump was evident in some patient but disappeared during the follow-up proof of the resorption of the plate. No redo surgeries were necessary. Bone defect were noted in 21 cases (7%). Cosmetic results were deemed satisfactory by the parents and the physician.
CONCLUSION:Our experience confirms that the use of resorbable pates and screws in craniofaciosynostosis surgery in children is well tolerated and effective in a rapid growing skull. The rate of complications is slow and, for us, this material represents the first choice for rigid bony fixation. The number of plates used does not interfere with intensity of the inflammatory process of the resorption.

Keywords: craniosynostosis, resorbable plates, children

FL-009

Posterior Cranial Vault Distraction Osteogenesis (PVDO) + Foramen Magnum decompression (FMD) for the treatment in Craniosynostosis with chronic tonsillar herniation. -A comparison with FMD for Chiari type 1 malformation

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OBJECTIVE:Posterior Cranial Vault Distraction Osteogenesis (PVDO) is now accepted as a common procedure for the treatment for craniosynostosis. In our institute we have applied PVDO in syndromic craniosynostosis and bilateral coronal suture synostosis cases which need an expansion of anterior-posterior diameter. If the patient had chronic tonsillar herniation, we additionally applied Foramen magnum decompression(FMD) at the same time when performing PVDO. We had compared these cases between typical cases of FMD with Chiari type 1 malformation(CM-1).
MATERIAL-METHODS:Cases which were treated from 2014-2018 were included in this retrospective chart and image analysis. 6 cases underwent PVDO+FMD and 5 cases underwent FMD. Since there were age difference in these two groups. A ratio of removed bone area / foramen magnum area was calculated.
RESULTS:The removed bone area / foramen magnum area ratio in PVDO + FMD group and FMD group were 0.87±0.49 and 0.59±0.36 respectively with no statistically significant difference. Also in MR images, improvement of tonsillar herniation was seen in all cases of PVDO + FMD cases.
CONCLUSION:The concept of our treatment in craniosynostosis which needs to expand the anterior-posterior diameter is to apply PVDO first to obtain intracranial volume as much as possible. Then a frontal orbital advancement or frontal orbital remodeling is performed to concentrate in aesthetic appearance when removing the distractors as a second surgery. In these cases, if the child had chronic tonsillar herniation, additional FMD was done at the same time during PVDO. The ratio between the removed bone area and foramen magnum area did not have statistically significant difference compared to typical FMD cases. Also the images had improved post operatively. This leads that an additional FMD with PVDO can play a similar role to release the tight foramen magnum as the typical FMD for CM-1.

Keywords: Craniosynostosis, Posterior Cranial Vault Distraction Osteogenesis, Foramen Magnum Decompression

FL-010

Preoperative EPO with intraoperative TXA reduces transfusion rates and volumes in cranial vault remodeling with fronto-orbital advancement

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OBJECTIVE:To assess the effect of a protocol of preoperative erythropoietin (EPO) and iron with intraoperative tranexamic acid (TXA) on transfusion rates in metopic and unilateral coronal craniosynostosis patients undergoing cranial vault remodeling (CVR) with fronto-orbital advancement (FOA).
MATERIAL-METHODS:A retrospective chart review of all patients undergoing CVR with FOA for unilateral coronal or metopic craniosynostosis from March 2010 until June 2018 was conducted. Prior to 2014, patients received no perioperative hematopoietic or anti-fibrinolytic drugs and received blood transfusion at the start of their case ("control group"). A protocol of preoperative EPO with iron and perioperative TXA, along with a shift away from automatic transfusion, was initiated in 2014 ("study group"). Perioperative hemoglobin levels, length of stay, and transfusion rates were compared between groups.
RESULTS:27 patients met inclusion criteria, of which 12 were male and 15 were female. 18 were in the control group, and 9 in the study group. There were no differences between groups in demographics or operative time. The study group had a significantly higher preoperative Hb (14.1 ±0.8 vs. 12.6±0.4, p=0.003) and a significantly lower intraoperative Hb nadir (6.9±1.4 vs. 9.0±0.5, p=0.007) than the control. The study group also had a significantly lower rate of transfusion (66.7% vs. 100%, p=0.029). Among those who were transfused, the study group had a lower percentage of estimated total blood volume transfused than the control (18.9±15.4% vs. 54.0±11.0%, p=0.0006). There were no differences between groups in estimated intraoperative blood loss, postoperative complications, length of PICU stay, or length of total hospital stay.
CONCLUSION:Combining preoperative EPO with iron combined with intraoperative TXA was associated with lower rates and volumes of transfusion without negatively affecting postoperative course in unilateral coronal and metopic craniosynostosis patients undergoing CVR with FOA.

Keywords: craniosynostosis, fronto-orbital advancement, transfusion

FL-011

Raised intracranial pressure and sleep disordered breathing in children with craniosynostosis

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OBJECTIVE:Sleep-disordered breathing (SDB), via hypercapnia-related vasodilatation, or raised intrathoracic pressure, can be a contributor to raised intracranial pressure (rICP). We report a single institution experience of pre-operative work-up with sleep study, ICP monitoring and ophthalmology evaluation for rICP in patients with craniosynostosis and sleep-disordered breathing.
MATERIAL-METHODS:Retrospective chart review of all children with craniosynostosis who underwent combined sleep study (SS) and intracranial pressure monitoring (ICP) from 2015-2018. Data included diagnosis, prior airway procedures, visual electrophysiology, ICP measurements, sleep studies and surgical outcomes.
RESULTS:27 consecutive patients were identified (19 males), with a mean age of 6 years (range 1-18). Diagnoses were Apert (8), sagittal (6), multisuture non-syndromic (5), Crouzon (5), Muenke (2) and Pfeiffer (1). Indications for undertaking ICP/SS were: ophthalmic examination findings (13), clinical symptoms e.g. headache (11) and deteriorating visual electrophysiology (7). 10 patients were found to have normal ICP, of which 8 had normal SS and 2 had mild OSA. 14 had rICP, of which 12 had normal SS and 2 had moderately severe OSA. 2 children had low ICP, both with normal SS, and 1 child had borderline ICP, and mild OSA. 10 patients had undergone previous airway interventions. In the high ICP group, physiological rises in pCO2 caused significant ICP spikes. All children with raised or borderline ICP and obstructive airway pathology (3) went on to have either continuous positive airway pressure or surgical airway management. All others with raised ICP (12) went on to have vault expansion. At last follow-up following surgical airway management, headaches had since resolved.
CONCLUSION:A proportion of children with OSA and raised intracranial pressure in patients with craniosynostosis may benefit from airway management rather than cranial vault expansion for treatment of raised ICP. Understanding this relationship may aid monitoring and decision making in these patients.

Keywords: craniosynostosis, craniofacial syndromes, intracranial pressure, sleep physiology, obstructive sleep apnoea

FL-012

The role of ICP overnight-monitoring (ONM) in children with suspected craniostenosis

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OBJECTIVE:Secondary Craniostenosis is a relevant problem paediatric neurosurgeons are confronted with and poses challenges regarding reliable diagnosis of raised intracranial pressure (ICP), especially in case of absent or questionable papilledema. How to identify children with elevated ICP is still controversial and diagnostics vary from department to department. We report on our experience with computerised ICP overnight monitoring (ONM) in relation to imaging derived parameters.
MATERIAL-METHODS:We report on a cohort of 34 children with primary or secondary craniostenosis and clinical suspicion of raised ICP. We compared clinical signs, history and radiographic assessment with the results of computerized ICP ONM.
RESULTS:Baseline ICP was significantly higher in patients with combined sagittal and further single suture synostosis. Those patients had a significantly higher rate of questionable papilledema. Mean RAP (correlation index of pressure and amplitude) at baseline was significantly elevated in patients with multi-suture synostosis, indicating poor intracranial compliance. Syndromal craniostenosis was associated with elevated ICP, more pronounced copper beaten skull, and RAP was significantly lower in this group, indicating a more pronounced derangement of intracranial pressure/volume coupling. Headaches correlated to lower ICP-and were not associated with

more severe X-ray abnormalities. Children with narrowed external CSF spaces in MRI had significantly higher ICP-levels during REM-sleep.
CONCLUSION:Skull X-rays can help to identify patients at risk for chronically elevated ICP. In MRI scans narrowed external CSF spaces seem to be associated to elevated ICP. However, only ICP monitoring clearly identifies raised intracranial pressure and low intracranial compliance or deranged pressure/volume coupling in case of exhausted reserve capacity. Thus, in cases with ambiguous imaging, ONM constitutes an effective tool to acquire objective data for identification of surgical candidates.

Keywords: craniostenosis, raised intracranial pressure, ICP monitoring, computerized analysis, skull X-rays,

FL-013

Shunt Algorithm and Cranial Reconstruction for Frontoethmoidal Encephalocele

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OBJECTIVE:To evaluate the demographic background, clinical manifestations, management with surgical consideration and post-surgical complications of frontoethmoidal encephalocele (FEE) patients in Neurosurgery Department, Dr. Soetomo Academic General Hospital, Surabaya, Indonesia.
MATERIAL-METHODS:A retrospective study was performed to obtain the data concerning its preoperative and postoperative demographic and outcome of the patients with FEE. Medical records in our institution from 2015 to 2019 were analysed. FEE patients with intracranial abnormalities were reviewed using Shunt Algorithm for Frontoethmoidal Encephalocele (SAFE) before underwent surgical procedures. Data were presented and discussed based on relevant findings in the literature.
RESULTS:Twenty nine patients underwent the procedure in a single institution. All the patients were subjected to repair of encephalocele. Computed tomography (CT) was performed in all patients, which showed bone defect and associated brain anomalies. It is further divided into three subtypes: nasofrontal (NF) (15/29, 52%), nasoethmoidal (NE) (13/29, 45%), and nasoorbital (NO) (1/29, 3%). Six patients (7/29, 25%) underwent shunt procedure. Most patients (24/29, 82%) had age less than 5 years old. Mean operative time varied between the patients due to their concomitant diagnosis. No more than 200 ml bleeding during surgery was recorded. There were no major complications (severe infection, reoperation, death) recorded. Cosmetic outcomes were acceptable for most patients.
CONCLUSION:Comprehensive surgical treatment of patients with FEE should be done as early as possible to prevent potential complications. SAFE method is effective to reduce unnecessary shunt placement in FEE with CSF-related intracranial abnormalities without compromising the neurological or clinical results.

Keywords: Frontoethmoidal encephalocele; Neural tube defect; Shunt; Cranial reconstruction

CCJ Flash I Session

Hall A, Monday, 21st October 2019, 15:00 - 15:30

FL-014

Decompressive surgery for Chiari I malformation in children without dural repair: A still effective and safe procedure?

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OBJECTIVE:There are numerous publications about the technical aspects of decompressive surgery for Chiari I malformation highlighting many variations of this procedure. Each approach has its followers. Bony decompression of the foramen magnum alone or with the removal of a portion of the posterior arch of C1, dural splitting with keeping arachnoid intact, and durotomy are described. Dural closure is done with various materials. We retrospectively reviewed foramen magnum decompression without dural repair following the technique used by Gardener and Williams as an option in pediatric patients with Chiari I malformation in terms of complication rate and clinical outcome.
MATERIAL-METHODS:The surgical database of our unit identified 65 consecutive children who underwent foramen magnum decompression without dural repair surgery for Chiari I malformation between 2009 and 2016. The retrospective assessment included patient demographics, clinical data, surgical technique, revision rate, complications, and clinical outcome.
RESULTS:Durotomy without repair was performed in 65 patients. Complications included CSF leaks in 6 children, aseptic meningitis and subdural hematoma respectively in 3 cases, and intradiploic CSF collections in 3 patients. Revision surgery was performed in 7 cases. None of the patients was identified with infection. There was no mortality and no long term surgical morbidity. In terms of clinical outcome 52 patients reported post-operative improvement, 10 were clinically unchanged, and 3 noticed worsening of symptoms.
CONCLUSION:Foramen magnum decompression without dural repair is still a viable treatment option for Chiari I malformation in children in terms of complication rate and clinical outcome.

Keywords: Chiari I malformation, foramen magnum decompression, durotomy, dural repair, cerebrospinal fluid

FL-015

Dural splitting in foramen magnum decompression for Chiari malformation. The Great Ormond Street Hospital experience

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OBJECTIVE:Surgical management for Chiari malformation is widely debated issue. A common surgical strategy is to perform foramen magnum decompression (FMD). There remains debate on variations of this procedure related to opening the dura or performing bone-only decompression. There is sufficient evidence that not opening the dura is less likely to help resolve the symptoms whereas opening the dura carries a higher risk of morbidity related to wound problems and CSF leak. An alternative approach involved performing dural splitting. This keeps the integrity of the dura intact but reduces the tension band, alleviating symptoms. We aim to review the cases within our institution that have had dural splitting for management of their Chiari malformation.
MATERIAL-METHODS:A retrospective case note review was performed of all patients who had undergone FMD at our institution and operative notes reviewed. Presence of a syrinx was recorded and whether this had improved on post operative imaging, as well post operative complications, specifically CSF leak, wound issues and hydrocephalus. Any improvement or worsening in clinical symptoms was also recorded.
RESULTS:Thirteen patients were identified who have undergone FMD with dural splitting. Seven (54%) had evidence of syringomyelia pre-operatively.

None of these patients displayed any worsening of the radiological appearances of the syrinx post-operatively and three patients (42%) improved on postoperative imaging. Assessment of subarachnoid spaces with ultrasound also showed increased space intra-operatively in all cases. Mean follow up was eight months, and clinical improvement was seen in 75% of cases. Importantly, there were no wound related problems associated with any of the patients that underwent this procedure.
CONCLUSION:Compared to previously published data and internal comparisons, dural splitting in foramen magnum decompressions for chiari malformation is a safer alternative to FMD with duraplasty and is as effective at improving symptoms.

Keywords: chiari, foramen magnum decompression, dural splitting

FL-016

Foramen Magnum Decompression with Outermembrenectomy for treating non-complicated Chirai malformation type 1

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[2]Department of Neurosurgery, Juntendo University

OBJECTIVE:The most common surgical treatment for Chiari malformation type 1 (CM-1) is foramen magnum decompression (FMD). There are several methods for the intervention to the dura matter such as dural plasty by sectioning the dura and increasing the intradural space by removing the outer membrane of the dura matter without intradural manipulation. We had compared retrospectively of our cases.
MATERIAL-METHODS:A retrospective analysis was conducted using patient charts and images. 26 patients who underwent surgery from 2010 to 2019 were included in this study. The age distribution was 1 to 55 years-old (mean: 16.4±11.3). The patients were divided into two groups Group A which underwent outermembrenectomy, Group B which underwent dural plasty. The determination of outcome was divided into 3 groups; improved, stable and worsened group.
RESULTS:There were 15 cases in group A and 11 cases in group B and in group B, tonsillectomy was performed in 5 cases out of the 11 cases. Symptoms had improved in 7 cases(47%) in group A and (45%) in group B. Improvement of the syrinx was seen in 14 cases (93%) of group A and 10 cases (90.9%) of group B. None of Complication cases were seen in group A, however, 3 complication cases was seen in Group B. The number of our cohort is not large enough to analize statistics but it seems outermenbrenectomy does not have a huge difference in terms of the results of surgery compared to cases with dural plasty. On the other hand it seems outermembrenectomy has a lower risk of complications.
CONCLUSION:Although, FMD with dural plasty is a feasible method for treating CM-1, FMD with outermembrenectomy without intradural manipulation may also play a similar role treating non-complicated CM-1 with a lower rate of complication.

Keywords: Chiari malformation type I, Foramen magnum decompression, Outermembrenectomy

FL-017

Prognosis Analysis of 110 Consecutive Cases of Chiari I Malformation Treated by Foramen Decompression with Duroplasty

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OBJECTIVE:Chiari I malformations (CMI) are hindbrain anomaly characterized by cerebellar tonsillar herniation. Treatment depends on symptoms and causes of CMI. Surgical methods are still in controversy. Prognosis of CMI is yet clearly documented in the literature. To evaluate and verify prognosis of CMI, authors analyzed clinical features, neuroimages, surgical methods and outcome of patients with CMI treated by surgery.
MATERIAL-METHODS:Total 110 patients with CMI underwent foramen magnum decompression(FMD) and duroplasty consecutively in a single institute for 20 years and they were analyzed retrospectively. Female were slightly more prevalent to male. Age was 28.2 (mean) and ranged 4 to 60 year. Outcome was analyzed statistically by quality of life (QOL) using Karnofsky performance status (KPS) scale with variables of age at diagnosis, gender, clinical features, duration of symptoms, descent of tonsil, syringomyelia, and surgical methods. KPS was assessed preoperatively and last follow-up at least 1 year after surgery.
RESULTS:Quality of life of 110 patients with CMI treated surgically were affected significantly by initial KPS score, duration of symptom, syringomyelia, and motor weakness/muscle atrophy, but not by age at diagnosis, extent of tonsillar descent, materials of duroplasty. Nine among 110 patients need reoperation due to inadequate bony decompression (5) or postoperative subarachnoid adhesion (3) and small duroplasty(1). Two of 9 reoperated patients needed syringopleural shunt for residual syringomyelia but they did not improved in KPS due to spinal cord malacia.
CONCLUSION:Predictors of favorable outcome after surgery of CMI are better preoperative KPS, shorter duration of symptom, absence of syrinx, and absence of motor weakness. Reoperation was related with inadequate decompression of foramen of magnum, arachnoid adhesion, or complicated cranial base anomaly. Long-term outcome analysis showed early postoperative results are stable in most cases without late deterioration or recurrence.

Keywords: Chiari malformation, surgery, outcome, prognosis

FL-018

Surgical Management of Type 1 Chiari Malformations in Children

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OBJECTIVE:Chiari 1 malformations are a group of congenital and acquired disorders characterised by cerebellar tonsillar herniation through the foramen magnum. Treatment options vary from conservative management to foramen magnum decompression (FMD) in isolation or FMD supplemented by dural opening, duroplasty, tonsillar mobilisation or resection, fourth ventricular stenting and calvarial augmentation. One argument for a bony decompression alone (FMD) is to minimise post-operative discomfort. We sought to review our practice to determine whether FMD alone was justified in selected paediatric patients.
MATERIAL-METHODS:All Chiari 1 patients who underwent surgery between 2012 and 2018 were identified from our prospective British Paediatric Neurosurgery Group database. Primary outcome measure was symptom resolution with incidence of post-operative headache and nausea and length of stay also assessed by two separate clinicians.
RESULTS:37 interventions were performed in 25 patients (mean age 10 years (2-18), M:F=3:2). 10/25 patients underwent bony decompression alone. Half (5/10) subsequently needed dural opening. Mean length of stay was 5 days with only one patient (10%) reporting significant postoperative discomfort. At median follow-up of 22 months, four patients

described symptomatic resolution (40%). FMD with dural intervention was performed in 14 patients of which three (21%) needed further intervention (one post-operative haematoma). Mean length of stay was 7.4 days with significant post-operative discomfort in 8 patients (57%). At the end of follow-up, four reported resolution of symptoms. One patient had posterior fossa vault expansion.
CONCLUSION:How aggressive a decompression is needed in children with symptomatic Chiari 1 remains controversial. In our admittedly small series, a less invasive approach of bony decompression alone yielded comparable results to a more interventional decompression. Thus FMD alone is not without merit (shorter inpatient stay for instance) but is associated with a higher incidence of re-intervention.

Keywords: Chiari, Foramen Magnum Decompression, Duraplasty

FL-019

Chiari I Malformation: An Australian Paediatric Surgical Cohort

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OBJECTIVE:Chiari I Malformation (CIM) is a pathology marked with variability. Patient presentation, management, and outcomes all demonstrate this, making predictable treatment challenging. Features such as syringomyelia or worsening symptoms support surgical decompression, however less definitive presentations can be complex. Paediatric patients are a sub-group with particular challenges. We evaluated all CIM decompressions in a paediatric cohort, aiming to provide evidence to improve surgical management.
MATERIAL-METHODS:Retrospective chart review was conducted for 65 paediatric CIM patients who received posterior fossa decompression between 2006-2018. Presenting features, surgical procedure, and outcomes were evaluated. Outcomes were assessed using the 16-point Chicago Chiari Outcome Scale (CCOS), the only externally validated outcome scale for CIM surgery in paediatric patients. This provided a framework for comparison in a variable pathology.
RESULTS:Average age at surgery was 9.0 ± 5.1 years, presenting most commonly with headache (64.6%), motor symptoms (30.8%), sensory symptoms (27.7%) and syringomyelia (58.5%). Procedure type was split between dural/arachnoid manipulation and tonsillar diathermy (54% vs 44.4%), with no significant difference in outcome (CCOS 13.51 ± 2.35 vs 13.37 ± 2.62 respectively). Tonsillar diathermy was associated with more complications (35.5% vs 21.3%). Older age at surgery, and scoliosis, were independently associated with significantly better outcome ($p<0.05$). Dysphagia was associated with worse outcome ($p<0.05$). Finally, patients <6 years were more likely to return to theatre (OR 3.02, 95% CI 1.28 – 7.13, $p<0.001$).
CONCLUSION:This study finds tonsillar diathermy increases risk of patient complications, without added benefit in outcome. Furthermore, absence of dysphagia, older patient age, and presence of scoliosis are associated with better outcomes. These findings may influence decision making in surgical management of CIM.

Keywords: Chiari I Malformation, paediatric

FL-020

Altered CSF dynamics following surgical intervention for Chiari malformation in a paediatric population - a 13 year cohort study

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OBJECTIVE:Chiari I malformations are known to affect 1 in 1000 births, and are defined as tonsillar herniation greater than 5mm below the foramen magnum. There are reported changes in CSF dynamics associated with surgical decompression for Chiari malformation. We aim to assess our experience with this.
MATERIAL-METHODS:We interrogated our paediatric database for patients who underwent foramen magnum decompression for Chiari malformation in Leeds Children Hospital between February 2006 and February 2019. We subsequently analysed their medical records to assess for any hydrocephalus or change in CSF dynamics either before or after decompression, as well as any CSF diversion undertaken.
RESULTS:61 paediatric patients (range, 2 – 15 years) underwent foramen magnumdecompression (FMD) for Chiari malformation. Of these, 5 (8%) presented with hydrocephalus, for which they underwent CSF shunting (3 ventriculoperitoneal shunts; 2 ventriculo-atrial shunts), followed by FMD. 50 cases (82%) underwent FMD with no preceding or post-operative problems with CSF dynamics and who did not require any further procedures. Six cases of Chiari (12%) did require CSF diversion following FMD: three cases of post-operative hydrocephalus, for which one underwent ventriculoperitoneal shunting 8 days after FMD, whilst 1 underwent endoscopic third ventriculostomy both more than four years after FMD; one case was complicated by CSF leak and required a lumbar drain for temporary CSF diversion; finally there were 1 cases of persistent headache with small ventricles on CT and MRI, but with raised pressure on formal intracranial pressure monitoring and lumbar puncture measurements and who underwent ventriculoperitoneal shunting at 12 months following the original FMD surgery with good symptomatic relief.
CONCLUSION:Our data corroborates the wider reports of a complex and not fully understood relationship between Chiari malformation and altered CSF dynamics following surgical decompression.

Keywords: Chiari malformation; intracranial hypotension; cerebrospinal fluid leak; intracranial hypertension; paediatrics

Craniofacial Flash Session II

Hall B, Monday, 21st October 2019, 14:00 - 14:25

FL-021

Technical Note: Osteoblastic telescopic Spiral Tecnique for Craniosynostosis Correction

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[4]Cenepe

OBJECTIVE:Combinations of different cranial remodeling techniques are used in an attempt to provide optimal cosmetic results and to reduce sequelae associated with craniosynostosis. The element of deformity that is difficult to correct immediately is to recontouring cranial bone, flattened area and molding cranial bone in sagittal, unilaterally in lambdoid and coronal synostosis or even in severe positional molding. The authors present a novel technique application that resolves this question.

MATERIAL-METHODS:The authors work in different institutions in Cali, Colombia but in HICN decided to fuse diferent tecniques such as osteoblastic craniotomies, multispiral revolution craniotomy to give molding and volume, use of absorbable plaquesto give volume and not limiting bone growth in special positions, open barrel technique fto decrease volume and develop this technique which are used now in all the different institutions.
RESULTS:During 18 years 130 children have been operated with this technique. The surgical procedure, illustrative cases, immediate results, surgery shortening time, reduction in blood loss and apparent cosmetic benefits of this technique are discussed.
CONCLUSION: The advantages of this technique include the avoidance of large areas of craniectomy and immediate correction of the cranial deformity, less blood loss, and save surgical time, decrease bed stay.

Keywords: osteoblastic, telescoping,multispiral revolution

FL-022

Predicting risk of frontal lobe brain changes following frontofacial advancement

Lara Van De Lande[1], Anne Yan Ting Chua[2], Yi Zhang[2], Juling Ong[3], Owase Jeelani[3], David Dunaway[3], Greg James[3]
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OBJECTIVE:Frontofacial surgery (FFS) can be indicated for children with syndromic craniosynostosis to treat raised ICP, facial deformity, exophthalmos, and OSA. FFS can be performed in a static fashion or with the use of external distraction via RED-frame, e.g. monobloc distraction, midfacial bipartition, Le Fort III with fronto-orbital remodelling and orbital box osteotomy. A previous study from our unit reported post-FFS frontal lobe changes (FLC) in 2/3 of the patients, but risk factors were not identified.1 This study aims do identify predictive factors for FLC following FFS.
MATERIAL-METHODS:Patients who had FFS were included for analysis when both pre- and postoperative CT scans were available. Demographics, diagnosis, history of craniofacial surgery, operation notes and complications were collected. Two paediatric craniofacial neurosurgeons independently assessed all CT scans on: bony abnormalities (i.e. copper beating, deep sphenoid and/or midline ridge, high cristae galli, clover leaf skull), metalwork (i.e. wires, plates and screws), and VP-shunt.
RESULTS: The inter-observer agreement for CT assessments was 0.92. 51 patients were included (M:F, 29:22) and underwent FFS at average age 8.3 years (range 3 months to 19.1 years old), of which 20 had had previous FFS. Main results showed FLC in cases who had previous FFS – with pre-existing damage (5/7) and without pre-existing damage (5/13) as well as FFS under the age of 1 year (3/3). FLC was also seen in cases with: 1) intraoperative dural tears: single (6/14) / multiple (5/10); 2) bony abnormalities (overall 15/39 and 3/31 as first-FFS); 3) Monobloc RED-frame distraction (14/36); 4) metalwork (3/6). No association was found between FLC and diagnosis and VP shunt presence. After first-FFS, 77.4% showed normal brain parenchyma on post-operative CT-scan.
CONCLUSION:This study suggests the following predictive factors for post-FFS FLC: FFS at age <1-year-old, previous FFS, RED-frame use, intra-cranial metalwork and abnormal bony structures.

Keywords: Craniofacial surgery, frontofacial advancement, craniosynostosis, craniofacial syndromes

FL-023

Role of lambdoid arch sutures in the cerebellar tonsillar herniation in infants with multisutural craniosynostosis

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[2]Radiologia, Fondazione Policlinico Gemelli IRCCS, Rome, Italy

OBJECTIVE:This study aims at investigating the functional role of lambdoid arch sutures in the development of cerebellar tonsillar herniation. Therefore, posterior cranial fossa (PCF) changes are assessed in infants with premature synostosis of the major and minor sutures of the lambdoid arch without premature synostosis of the PCF synchondroses.
MATERIAL-METHODS:Morphometric and volumetric PCF measurements were performed on preoperative high-resolution CT studies in 12 infants with multisutural craniosynostosis involving the lambdoid arch and compared with those of 12 age-matched healthy subjects.
RESULTS:All 12 patients had hypoplasia of PCF bone structures and normal volumes of the PCF and neural structures. PCF hypoplasia was related to exocciput length in infants with isolated involvement of major sutures, while it was related to posterior skull base hemifossae in infants with isolated involvement of minor lambdoid arch sutures. Foramen magnum AP diameter was reduced in babies with major suture involvement and tonsillar herniation, while foramen magnum AP and LL diameters were reduced in babies with minor suture involvement without tonsillar herniation. Right and left jugular foramen (JF) areas differed in all infants however the area of the smaller JF was significantly reduced only in infants with involvement of minor lambdoid arch sutures.
CONCLUSION:Hypoplasia of PCF bone structures due to sutural synostosis of the lambdoid arch is a required predisposing but not sufficient factor for the development of cerebellar tonsillar herniation through the foramen magnum. Normal PCF volume and foramen magnum anatomy may partly explain the development of cerebellar tonsil herniation in infants with lambdoid arch synostosis

Keywords: lambdoid sutures, complex craniosynostosis, chiari malformation

FL-024

Using statistical shape modelling to assess outcomes in spring-assisted posterior vault expansion

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OBJECTIVE:Spring-assisted posterior vault expansion (PVE) is a surgical technique for treatment or prevention of raised intra-cranial pressure by expanding the posterior skull in patients with syndromic or complex craniosynostosis. In this study, we use statistical shape modelling (SSM) to quantify and analyse head shape differences and correlate these to PVE outcomes, such as the change in intra-cranial volume (ΔICV) and cranial index (ΔCI).
MATERIAL-METHODS:Preoperative CT-scans of twenty-four PVE-patients, age 1.9±1.6 years, were retrospectively collected. 3D skull meshes

were extracted and consistently processed using a cutting plane passing through the nasion and upper border of the external auditory canals. In order to focus the SSM differences on shape, all 3D-models were scaled to the same size. SSM was carried out using Deformetrica (www.deformetrica.org) and principal component analysis was performed to assess principal modes of variations. The skull thickness was calculated for all patients. PVE osteotomy locations in terms of horizontal location (length), vertical location (height) and angle were measured in the respective preoperative 3D-models. Pearson's r was calculated to correlate preoperative characteristics to ΔICV and ΔCI.
RESULTS:From preoperative to postoperative, ICV increased (309±186 cm3) and CI decreased (-3.0±4.6%). The first principal component showed significant correlations to the head length, CI and age, as well as to ΔICV ($r = 0.57$, $p<0.001$) and ΔCI ($r = 0.41$, $p=0.048$). ΔICV was significantly correlated to ΔCI ($r = 0.593$, $p<0.001$). Correlation for the skull thickness to ΔICV ($r =-0.54$, $p<0.001$) was stronger than for age ($r =-0.46$, $p=0.024$). Osteotomy dimensions and locations did not show significant correlations to the outcomes.
CONCLUSION:Spring-assisted posterior vault expansion simultaneously promotes ICV increase and normalisation of CI. Larger ICV increase occurs in younger, brachycephalic patients with lower skull thickness. Osteotomy dimensions did not show significant impact on PVE outcomes.

Keywords: posterior vault expansion, springs, craniosynostosis, statistical shape modelling

FL-025

Stereolithography and Virtual Modeling for Preoperative Planning in Craniopagus Deformity

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OBJECTIVE:Craniopagus deformity is a rare congenital anomaly which occurs in 1/1,700,000 live births. Early attempts at surgical resection in the 20th century have had poor outcomes, with one or both twins not surviving. With the development of staged surgical resection, as well as the advancement of 3D modeling techniques over the last 20 years, enormous improvements in surgical outcomes have occurred. This work will review the advanced modeling and rendering techniques which have refined surgical separation of craniopagus twins and made outcomes safer.
MATERIAL-METHODS:All cases of craniopagus twins evaluated and operated on by the senior author were reviewed with the associated 3D printed and virtual models. Early cases with only 2D traditional imaging studies were compared to newer cases in which advanced modeling was performed to determine to impact on surgical resection and planning.
RESULTS:Twenty eight cases were reviewed along with the advanced modeling used. There appeared to be four realms in which printed and virtual models played a substantial role in assisting preoperative planning. Namely, modeling was vital in determining the volume of potential tissue expansion required to correct postoperative skin defects, crucial for optimal intraoperative positioning and airway management, important to study brain interconnectivity and its relationship to surgical exposure, and finally immensely important to model venous anatomy in order to plan optimally-staged separation.
CONCLUSION:The use of stereolithography and virtual planning has revolutionized how craniopagus anatomy is viewed and operative planning is undertaken. Planning for adequate skin coverage and brain and venous separation is no longer evaluated in real-time, nor does the surgeon have to rely on experience or 'artistic' interpretation to ensure the best outcomes for patients. This review of advanced imaging and printing technology has not been previous reported, and plays a unique role in the management of this rare deformity.

Keywords: Stereolithography, 3D printing, virtual modeling, craniopagus deformity, conjoined twins, surgical separation

FL-026

Association of craniosynostosis with sinus pericranii

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OBJECTIVE:To evaluate the association of SP with craniosynostosis (CS).
MATERIAL-METHODS:We retrospectively reviewed the computerized tomography (CT) images of 145 children with CS. The exams were reconstructed in 3D with adequate window for visualization of extracranial veins.
RESULTS:In 61 (42%) cases enlarged emissary veins draining from dural venous sinus to extracranial venous circulation were visible. Sinus pericranii defined as a localized bulge draining from the dural sinus to the epidural venous circulation were found in 8 cases (5%). There were 7 accessory SP and 1 dominant SP. In 3 cases there was fusion of sagittal and bilateral lambdoid sutures, in 3 there was fusion of sagittal and bilateral coronal sutures, in 1 there was fusion of sagittal suture alone, and in one there was fusion of unilateral lambdoid suture. In 1 case associated with fusion of sagittal and bilateral coronal sutures the superior sagittal sinus (SSS) drainage was done exclusively by extracranial veins. In this series all the cases of SP were related to the SSS. The dominant SP is not amenable to surgery and the knowledge of the presence of a SP helps the management of children with CS.
CONCLUSION:In this series the presence of venous circulation in the scalp from the dural sinus could be visualized at the cranial CT, and the presence of epicranial veins draining from intracranial sinus was more frequent than expected and help planning the CS surgery. Asymptomatic SP could be seen with this simple method and aid the management of the patients.

Keywords: Sinus pericranii, craniosynostosis, epidural veins

Session on Infections

Hall B, Monday, 21st October 2019, 14:25 - 15:00

FL-027

Ventriculostomy-related infections: prevalence and hospital-associated costs and its impact in a low-income country

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OBJECTIVE: Argentina`s health system is public and available to everyone. More than 60% of the population uses it. However, the country has a low gross domestic product (GDP) per capita, and 1/3 of the population falls below the poverty line. It would be expected that in a public health system the costs of complications are registered. Nevertheless, it is not what happens for some pathologies. This prevents knowing the impact of these complications and implementing alternatives to lower costs, still maintaining the

quality of the patient treatments.One example of the above are external ventricular drainages (EVD), they are the most frequent procedures in pediatric neurosurgery. Ventriculostomy-related infections are very common, 3-22% in some reports. It causes high morbidity and high costs, both at the time of hospitalization and in the long term due to complications from it. Given that there is no local or regional information on this particular topic, we decided to estimate the incidence of ventriculostomy-related infections and determine the costs generated by them.
MATERIAL-METHODS:Observational study, including 66 pediatric patients, who received 137 EVD, between 1/6/2016 to 1/6/2017, in a specialized pediatric hospital.
RESULTS: Of the 66 patients, 15 (22%) presented EVD associated infections. The additional resources used by the Hospital were: 66 operating room hours, 39 EVD, 560 hospitalization days, 87 CT scans, considerable days of antibiotic treatment (vancomycin: 215, meropenem: 310, colistin: 133, amphotericin: 54, linezolid: 39, rifampicin: 28, intrathecal colistin: 17, amikacin: 12, ceftriaxone: 14, ceftazidime: 19 and fluconazole: 5). This represented for the institution a cost equivalent of US $ 345,344.60. Patients who presented cerebral spinal fluid fistula showed a significantly higher infection rate than those without a fistula (71% vs. 10%, p <0.0001).
CONCLUSION:Ventriculostomy-related infections cause high morbidity, are frequent and, in addition, triple the costs to the health system, usually underestimated.

Keywords: Cerebrospinal Fluid Shunts – Central Nervous System Infections - Health Care Costs – Morbidity – Pediatrics

FL-028

Outcome analysis of pediatric brain abscess management in a tertiary care center in Nepal

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OBJECTIVE:Brain abscess in children is a common entity in developing countries with fatal outcome at times. Despite various advancement in medical field the management of brain abscess is challenging and with full of controversies. Early diagnosis and treatment with minimal invasive procedure has good outcome.
MATERIAL-METHODS:This is a hospital based retrospective study conducted at institute of Medicine (IOM), Tribhuvan University Teaching Hospital Kathmandu, Nepal over the period of 5 years between September 2014 to March 2019. Clinical profile, management and outcome were analyzed.
RESULTS:A total of 36 cases were taken for the surgical management in the present study. There were 22 male and 14 female and the mean age of the study population was 4.08 years. The most common etiology was found to be ear infection (33.3 %) and both the temporal and frontal lobe had equal presentation (27.8 %). Most of the patients presented with headache (61.1 %) and the initial treatment of choice was burr hole and aspiration. Of them 19.4 % of the cases required multiple session aspiration. Positive culture was seen in 31.2 % and Pseudomonas aeruginosa was the commonest organism grown. The overall mortality rate was 5.5 %.
CONCLUSION: Pediatric brain abscess is still a challenge in the developing country like Nepal. Despite many obstacles which interfere with timely and adequate treatment of the pediatric brain abscess, we still provide acceptable standard of care. Advances in imaging, rapid response and involvement of the multidisciplinary team has decreased the morbidity and mortality.

Keywords: Brain abscess, pediatric brain abscess, Nepal

FL-029

Intraventricular Spring Cleaning: A Case Series on Endoscopic Lavage for Ventriculitis in Pediatric Patients

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OBJECTIVE:The authors present a series of five cases of endoscopic lavage for children with pyogenic ventriculitis, and their subsequent managements.
MATERIAL-METHODS:Between 2016 & 2018, we managed 7 pediatric patients with pyogenic ventriculitis, for whom endoscopic lavage was required in addition to a 6-week course of antibiotics to eradicate the infection. In 3 of the patients, the ventriculitis was a sequelae of meningitis, whereas in the other 4 patients, the ventriculitis was a complication of ventriculoperitoneal shunt infection. We used a zero-degree Minop endoscope for the procedure, and a 6 French suction catheter to endoscopically clear off the pus and slough.
RESULTS:Three of the patients required two endoscopic lavage procedures to clear off the infective materials. In all the patients, the ventricular walls were lined with slough, and networks of fibrous membranes had formed. An external ventricular drainage was inserted at the end of the surgery for CSF diversion, as well as for subsequent CSF analysis to monitor the efficacy of treatment. All but two patients eventually required a permanent ventriculoperitoneal shunt.
CONCLUSION:Pyogenic ventriculitis is a potentially fatal CNS infection that carries high mortality and morbidity risks. Intravenous antibiotics alone will not eradicate the infection; endoscopic lavage greatly improves the patient's outcome.

Keywords: Ventriculitis, endoscopic, lavage, CNS, infection

FL-030

Paediatric spondylodiscitis: A 10-year single institution experience and outcomes

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OBJECTIVE:Discitis in the paediatric population poses diagnostic challenges due to non-specific presentation of symptoms and difficulty with expressing pain in non-communicating children. Discitis remains a relatively rare condition in the paediatric population. We report our experience in management of discitis over a 10 year period.
MATERIAL-METHODS:We retrospectively reviewed cases of paediatric discitis/spondylodiscitis over a 10 year period (2008 to 2018) managed in our paediatric neurosurgery unit. Relevant demographic information, microbiological data, blood investigation profile and clinical outcomes were interrogated from clinical notes and electronic databases.
RESULTS:Overall 21 cases of paediatric discitis were identified between years 2008 to 2018 with a female to male ratio of 1.3:1. The average age at presentation was 4.3 years (range 1 to 16 years). Overall 19 cases of lumbosacral/lumbar, 1 thoracic and 1 cervical discitis were identified. The mean duration of follow up was 20 months (range 6 to 69 months). The mode of presentation was variable with most common feature being back

pain (12/21) followed by refusal to walk/sit/weight bear (9/21), isolated antalgic gait (3/21), fever (2/21). CT guided biopsy was performed in 5 cases of which 1 was culture positive (20%). Microorganism for discitis was identified in 3 out of 21 cases (2 on blood cultures, 1 on CT guided biopsy). At the time of presentation, erythrocyte sedimentation rate was elevated in 14/21 cases as compared to 9/21 for C-reactive protein. All patients were treated successfully with long course of intravenous antibiotics. At the latest follow up, 4 patients had residual back pain despite resolution of discitis.
CONCLUSION:Presentation of discitis in children can be non-specific and requires high index of suspicious. CT guided biopsy in our cohort revealed a low rate of positive cultures.

Keywords: Discitis, spondylodiscitis, paediatric

FL-031

Intracranial Tuberculoma In Children: A 5-Year Experience At A Tertiary Neurosurgical Center In Indonesia

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OBJECTIVE:Tuberculosis of the central nervous system (CNS TB) remains public health concern in Indonesia and is associated with lethal complications, particularly in children. One of CNS TB manifestations is intracranial tuberculoma. It is being a serious complication.
MATERIAL-METHODS:This was a retrospective study of pediatric patients admitted to dr. Soetomo Academic Medical Center Hospital during 2014-2018 (5 years), whose histopathology results meet tuberculoma diagnosis criteria.
RESULTS: We identified five pediatric patients with tuberculoma. Patients' age ranged from 3 to 14 years old, with the mean of 7.2 years old. Three patients were boys and two were girls. The main clinical symptoms present on admission were weakness of extremity (found in 1 patient), decrease of consciousness (found in 2 patients), postural imbalance (found in 1 patient), headache (found in 2 patients), and fever (found in 1 patient). All patients had no history of TB infection, TB contact, or HIV infection. The mean GCS on admission was 12. The most frequent location for tuberculoma based on neuroimaging were in the cerebellum (80%), followed by occipital region (20%) and third ventricle (20%). Multiple location were reported in 3 patients (60%). The mean volume of tuberculoma was 32.85 ml. Neuroimaging of all patients showed hydrocephalus (noncommunicating in 4 patients or 80%), 3 of them (60%) also had TB meningitis. Three patients (60%) had tuberculoma resection surgery in the emergency operating theatre. Three patients (60%) had CSF diversion surgery (external ventricular drain/ventriculoperitoneal shunt) prior to the main surgery. All five patients improved well after surgery and had anti-TB therapy.
CONCLUSION: Intracranial tuberculoma causes significant morbidity and mortality to pediatric patients. Emergency surgical intervention followed by anti-TB therapy may be considered in the diagnosis and treatment of intracranial tuberculoma and may improve the outcome.

Keywords: intracranial tuberculoma, children, pediatric, neurosurgery, indonesia

Miscellaneous Flash Session

Hall B, Monday, 21st October 2019, 15:00 - 15:15

FL-032

Craniofacial Surgery

11 years of experience in 132 craniosynostosis cases: Surgical treatment for Craniosynostosis

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OBJECTIVE:The translation of the term craniosynostosis in a basic way, defines the unification of the cranial bones. Craniosynostosis characterized by the premature fusion of one or more sutures of the skull. The compensatory growth of the skull cause deformity of the calvarium and this results in an altered relationship between the skull and the contained neural and vascular structures. The classification of synostosis is as simple and complex. We call craniosynostosis "simple" when only one suture is involved. This type is also called as "non syndromic" because, sporadic suture fusion is not associated to other developmental malformations in these cases. Craniosynostosis is called "complex" when two or more sutures are involved. In the majority of these cases, suture closure occurs in the context of other developmental anomalies, in particular affecting the limbs. Such cases of complex craniosynostosis is called "syndromic".
MATERIAL-METHODS:132 children were treated for nonsyndromic variety of craniosynostosis in the last 11 years. 14 were treated for syndromic craniosynostosis. There were 9 girls and 5 boys in the syndromic craniosynostosis group. A total of 118 children were operated in the non-syndromic craniosynostosis group. There were 43 girls and 75 boys in this group.
RESULTS:The treatment was customized to each individual variety, the plan of treatment was extensively discussed with the parents, and the outcomes were counseled appropriately.
CONCLUSION:Craniosynostosis is a congenital defect and surgery to correct it must be reconstructive. The need for surgery is both for functional and cosmetic reasons. Many cases may be associated with raised intracranial pressure with its attendant deleterious effects on vision and brain. The aim of treatment is to increase the cranial volume and reshape the skull. Two important points in surgery are hypovolemia and hypothermia. The goal should be intraoperative close hemodynamic follow-up and the strategy should be minimal blood loss.

Keywords: Craniosynostosis; non-syndromic; syndromic; surgical treatment

FL-033

Surgical Treatment of Uncommon Hemispheric Cerebrospinal Fluid Containing Cysts in Children

Anton Korshunov, Youry Kushel, Armen Melikian
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OBJECTIVE:To outline surgical treatment of uncommon hemispheric CSF containing cysts in children.
MATERIAL-METHODS:152 pediatric patients had primary neurosurgical operations for intracranial CSF cysts in our department from 2013 till 2018. After exclusion of sylvian fissure, midline supratentorial and posterior fossa cysts we found 29 patients (19%) with hemispheric CSF cysts for this report. Medical records, imaging data and intraoperative videos were reviewed; families were interviewed in 2019 to gather outcome data.

RESULTS:There were 13(45%) lateral ventricle cysts (LVC), 9(31%) interhemispheric fissure cysts (IHFC) and 7(24%) cysts in and around frontal lobe (FLC). Median age at surgery was 2 years (1m-17y). M/F ratio was 21/8. There were 16(55%) arachnoid, 7(24%) choroid plexus, 4(14%) ependymal and 2(7%) parenchymal cysts. Decisive surgical indications were cyst enlargement in 10(34%) Intracranial hypertension in 9(31%), neurologic deficits in 6(21%); headache in 3(10%), epilepsy in 1(3%). Cyst fenestration was a primary treatment modality in all cases. It was accomplished endoscopically in 17(59%) and microsurgically in 12(41%) patients. In 4 cases stents were used to support unreliable communications. ETV was done simultaneously in 3 patients.Complications occurred in 2 patients (7%) including hemiparesis and intraventricular hemorrhage.Median follow up was 18 months (range 4m-6y; available for 27 of patients (93%)). Redo fenestration was necessary in 1(4%) patient; in 26 patients communications were preserved with cyst reduction. In 4 patients (15%) persistent hydrocephalus required shunt surgery. At last follow up 14(52%) patients developed normally without symptoms; 11(41%) had some symptoms with improvement compared to preoperative state (4 of them shunt-dependent); 1 patient (4%) experienced no improvement of preoperative symptomatology and 1(4%) deteriorated due to complication.
CONCLUSION:Fenestration allows effective management of hemispheric CSF containing cysts with 15% CSF shunt dependency rate. Complication rate is not insignificant and need to be considered in patients with asymptomatic cyst enlargement.

Keywords: Intracranial cyst; arachnoid cyst; endoscopy; hydrocephalus; cerebrospinal fluid

FL-034

Cranial dermal sinus; benign congenital disorder with high morbidity

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OBJECTIVE:Cranial dermal sinus is a rare congenital disorder that can be associated with high morbidity if untreated. Infection and mass effect are common complications. Most authors advise prophylactic surgical resection of sinus tract to prevent these potentially life threatening complications.
MATERIAL-METHODS:Epidemiologic data of 33 patients with cranial dermal sinus operated since 2009 were collected. In this series the presentation, radiological and surgical findings were analyzed. To the best of our knowledge it is the biggest series reported so far.
RESULTS:: Patients aged 2 months to 12 years with median of two years. 17 of children were male and 16 were female. Cranial sinuses were located in occipital area in 16 patients, pterional in 8, frontonasal in 7 and in parietal area in two children. In this series the most common presentation (88%) was due to infectious or mass lesion and dermal sinus per se was a very rare cause of referral. 27% of children experienced meningitis. 3 patients had 2 or 3 holes in their dermal sinus area. In 79% of patients the sinus passed the skull and ended inside the cranium. 3 patients found hydrocephalus during the disease. No death has occurred in this series.
CONCLUSION:Cranial dermal sinus with having a tract to cranium can predispose the child to some serious complications of infections or tumors. Both complications are delayed and developed during time therefore can be prevented if the disease can be diagnosed and managed appropriately. Finding the sinus during primary physical exam of neonate and knowing its serious complications are mandatory for better care of these children

Keywords: cranial sinus, complication, meningitis, abscess, tumor

FL-157

Fetoscopic Repair of Open Neural Tube Defects: The UK's First Experience

Cristina Birlem Bleil, Bassel Zebian, Daniel Ochieng, Anna Oviedova, Faisal Saud, Jin Zhu, Chula Goonosekera, Marta Santorum Perez, Kypros Nicolaides
King's College Hospital NHS Foundation Trust

OBJECTIVE:Myelomeningocele is a significant cause of morbidity world-wide and it affects 33-48 per 100,000 live births. Antenatal repair is gaining in popularity driven by the MOMS trial which showed 50% reduction in the need for a shunt for hydrocephalus and better motor functional outcome at 30 months. However, open fetal surgery is associated with maternal complications. Fetoscopic approaches have been used partly to decrease maternal morbidity. We report the UK's first experience with the fully percutaneous fetoscopic repair.
MATERIAL-METHODS:Two fetuses had treatement using Dr Lapa Pedreira's fetoscopic technique at KCH between September 2018 and March 2019. They were both diagnosed on routine antenatal ultrasound scans and had subsequent fetal MRI. They fulfilled the eligibility criteria and informed consent was obtained after discussion of all the available options. Maternal-fetal anaesthesia was performed and the 4-port fetoscopic technique was used with double patch and single patch techniques on fetus 1 and 2 respectively. Two weekly assessments were performed and fetal MRI scan planned 4 weeks postoperatively.
RESULTS:Both operations were uneventful with good recovery. Mother 1 had premature rupture of membranes 14 days after surgery and had spontaneous vaginal delivery 1 week later at 30+3 weeks gestation. The child had good neurological function at S1. Over the course of 3 months he overcame complications of prematurity but unfortunately developed pneumonia and succumbed to this. Mother 2 is currently still pregnant at 31+3 weeks and 4-week fetal MRI scan has shown closure of defect and improvement in the Chiari 2.
CONCLUSION:Fetoscopic myelomeningocele repair has already been shown to be a valuable addition to the armamentarium for repair of open spinal neural tube defects. The evidence suggests there is reduction in the risk to mother and subsequent pregnancies and much work has taken place to reduce the rates of premature delivery and improve fetal/neonatal outcomes.

Keywords: Antenatal repair, open neural tube defect, fetoscopic repair, myelomeningocele, maternal outcomes

Session on Special Topics: Hindbrain Hernia & Syringomyelia II

Hall A, Monday, 21st October 2019, 16:45 - 17:32

FL-035

Craniovertebral junction surgery associated with craniosynostosis

Nobuhito Morota
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OBJECTIVE:Craniovertebral junction (CVJ) surgery for chronic tonsillar herniation or foramen magnum (FM) stenosis associated with craniosynostosis (CS) was retrospectively analyzed.
MATERIAL-METHODS:Data of187 children (1mo to 16yrs, median: 9mo) who underwent 240 surgeries for CS between November 2002 and March 2019 were subjected for the study. Association of CVJ lesions, surgeries required and management strategy were analyzed.

RESULTS:CVJ lesions associated with 45 children (1mo to 7yrs, median: 1yr) with 43 chronic tonsillar herniation (CTH) and 2 stenosis. Surgical decompression was peformed 10 children with marked delayed motor development or severe respiratory dysfunction. Among 125 non-syndromic single suture CSs, there were19 CTHs and 2 underwent FM decompression (FMD). In 28 non-sydromic multisuture CS, there were 12 CVJ lesions, and 2 CTHs and 2 FM stenosis underwent surgery. In 33 syndromic CS, 14 CTHs with 4 FMDs were present. Pfeiffer syndrome (17) demonstrated the highest association with CVJ lesions (10) and surgeries (4). Regarding CTH, surgery for choice was bony decompression alone in 6 children and with duraplasty in 2 non-syndromic CSs. Among the surgical group, 7 underwent VP shunt as an initial treatment. Timing of the CVJ surgery was post VP shunt before CS surgery in 2 and post CS surgery in 8. Non received one-stage surgery for both CS and CVJ lesion in this cohort.
CONCLUSION:Development of CVJ lesion in CS is multifactorial. However, a VP shunt and CS surgery would come first prior to the surgery of CVJ lesion. Simple bony decompression alone seems sufficient as a surgical procedure for CTH associated with complex CS. Those in mind as a principle, individualized management is required based on the clinical findings.

Keywords: craniosynostosis, craniovertebral junction, chronic tonsillar herniation, foramen magnum, surgery

FL-036

Posterior calvarial distraction is a safe and effective first-line treatment for children with complex craniosynostosis, Chiari malformation type I and syringomyelia

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[2]Department of Craniofacial Surgery, Birmingham Children's Hospital, United Kingdom

OBJECTIVE:Posterior calvarial distraction (PCD) is an effective method to increase the intracranial volume in children with craniosynostosis. Children with lambdoid and multi-suture often have concurrent Chiari malformation type I (CM1). This study investigated the efficacy of PCD in posterior fossa (PF) volume expansion and treatment of CM1.
MATERIAL-METHODS:Ten-year retrospective study in a quaternary craniofacial unit.
RESULTS:Sixteen children were identified (8M, 8F). The mean age was 5.1 years (8m to 19y). Fourteen children had pansynostosis and two lambdoid synostosis; 8 were syndromic. Ten patients had raised intracranial pressure (ICP); 4 had syrinx.Postoperatively, 9 patients improved clinically, 7 remained stable, none deteriorated.The average distraction distance was 23mm (16-28mm). An osteotomy extending inferior to the torcula was associated with a larger PF AP distance increase (13 v 6mm, p=0.028).The average tonsillar descent improved from 9.3 to 6.0mm. Syrinx dimensions also improved in all 4 patients: superior-inferior (203 to 136mm), anterior-posterior (7.9 to 3.1mm).
CONCLUSION:Cranial volume expansion following PCD also includes PF volume expansion. This results in improvement of tonsillar descent and syrinx. PCD is a safe and efficacious first-line treatment for children with concurrent multi-suture craniosynostosis, CM1, and syrinx.

Keywords: Posterior calvarial distraction, craniosynostosis, Chiari malformation type 1, hindbrain herniation, syringomyelia

Session on Spine I

Hall A, Monday, 21st October 2019, 17:32 - 18:20

FL-037

Surgical management of mucopolysaccharidosis -related spinal deformities

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[2]Sergey O. Ryabykh - MD, PhD, spine surgeon, pediatric orthopedic surgeon, Director of Division Axial skeleton and Neurosurgery, Ilizarov Center, Kurgan, Russia.
[3]Alexander V. Gubin - MD, PhD, spine surgeon, pediatric orthopedic surgeon, Ilizarov Center, Kurgan, Russia.

OBJECTIVE:Spinal deformity in patients with mucopolysaccharidosis a problem requiring early treatment.
MATERIAL-METHODS: We analyzed 8 cases of mucopolysaccharidosis (MPS), treated in Ilizarov Center in 2012 - 2018. There were 1 patient with MPS IH-type, 4 patients with IVA-type and 3 patients with MPS type VI. The age of the patients ranged from 6 to 26 years-old (average age - 10.3 years-old). All patients had spinal deformity with primary and/or secondary stenosis of the spinal canal. Various surgical treatments were used: 1) two staged surgery was perfomed in one patient with cervical myelopathy and scoliosis: C0-C7 decompression with occipitospondylodesis (OSD) firstly and dual growing rod construction secondly; 2) final fusion in 2 patients with scoliosis; 3) decompression at the stenosis level (cervical spine) with OSD in 5 patients with cervical myelopathy.
RESULTS:Scoliosis value was from 20° to 65° Cobb, kyphosis from 15° to 80° Cobb. Four patients had vertebral stenosis and myelopathy (Frankel C). All patients had pulmonary and cardiac dysfunctions: vital capacity of the lungs was from 21% to 50% and abnormal ECG. Imbalance in the frontal and sagittal planes was present in 60% of patients. Through surgical treatment correction of the kyphosis was by 68% and scoliosis by 85%. In 4 (50%) patients with spinal stenosis neurologic status improved to Frankel E.
CONCLUSION:Patients with MPS quite often have vertebral stenosis and myelopathy, in such patients with combined stenosis of the spinal canal, it is necessary to combine decompression and fusion.

Keywords: Spinal deformity, mucopolysaccharidosis, cervical myelopathy, scoliosis, decompression, occipitospondylodesis

FL-038

Neurosurgical management of mucopolysaccharidosis: Taiwan experience

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OBJECTIVE:We retrospective review of our experience on surgical decompression with/without craniocervical fixation in mucopolysaccharidosi (MPS) patients.
MATERIAL-METHODS:We retrospectively reviewed 13 MPS patients that posterior occipito cervical decompression (n=13) with internal (n=2) or external (n=5) fixation and fusion (n=7) were performed. The median age at

diagnosis was 15.4 years (range, 4.2-13.5 years). The male to female ratio was 0.86/1. The involved MPS types were MPS I (n=3), MPS IVA (n=6), and MPS VI (n=4). The reason for surgical decompression in non-MPS IVA patients were due to local infiltration glycoaminoglycan (GAG) (n=7). Craniocervical junction (CVJ) instability occurred majorly in MPS IVA patients (n=6) and in one MPS VI patient (n=1). Autologous bone iliac bone graft was used for fusion in 7/7 patients.
RESULTS:There was no operative mortality. In a median follow-up of 3.7 years (range, 0.5-18.0 years), eleven patients had stabilization of neurological status, one patient had slow progressive weakness of lower limb, and one patient died of heart condition.
CONCLUSION:Posterior occipito cervical decompression and fixation with autologous bone fusion (in selective case) are effective for surgical management in MPS patients with upper cervical cord compression and the potential associated CVJ instability.

Keywords: Mucopolysaccharidosis, occipitocervical decompression, craniovertebral junctio, intabiliity

FL-040

Risk Factors for Progression of Osseous Cervical Congenital Scoliosis

Amir A Amanullah, Mohammed Omar Iqbal, Brandon J Toll, Joshua M Pahys, Amer F Samdani, Steven W Hwang
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OBJECTIVE:Thoracolumbar congenital scoliosis has been well described, however there is no literature exploring the natural history and progression of osseous cervical congenital scoliosis (CCS) in children. We investigated risk factors for progression of deformity in CCS.
MATERIAL-METHODS:Medical records were retrospectively reviewed for 38 pediatric patients with CCS and a minimum of 2 years of follow-up. Curve progression was defined as >10˚ increase in cervical Cobb angle at last follow up interval after presentation. Patients were then divided into two cohorts: 1) stable curve (SC, n=28), and 2) progression of Cobb angle (PC, n=10). Cohorts were compared using Student-t tests.
RESULTS:38 patients were included (16 female: 22 male) with a mean age at presentation of 5.6 ± 4.1 years. 26.3% had progression with a mean follow-up of 3.06 ± 2.99 years. The congenital deformities were quite varied, but the apex of cervical deformity was most commonly C5 and C6 with a mean cervical curve of 17.6˚ ± 16.6˚. Over time, the entire cohort had a mean increase in the cervical Cobb of 7.1 ± 6.0° ($p<0.001$) and a decrease in the occiput-C2 angle 6.8 ± 13.6° ($p=0.01$). Other radiographic and demographic measures did not change significantly aside from increases in age, height and weight. At presentation, age, cervical, thoracic and lumbar curve magnitudes, radiographic measures of translation, and cervical measures were not significantly different between groups. At last follow-up, no statistically significant difference was found between the two cohorts as well.
CONCLUSION:26% of osseous congenital cervical scoliosis curves progressed over time. Patients with greater T1 tilt and O-C2 angle were more likely to have progression of cervical deformity.

Keywords: Congenital Scoliosis, Cervical Spine, Instrumentation

FL-042 Global Pediatric Neurosurgery

Achondroplasia: neurosurgical findings. Series of cases in a reference center

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OBJECTIVE:To describe the main neurosurgical complications in patients with achondroplasia as well to establish the frequency and manifestations of craniocervical junction stenosis and hydrocephalus in patients followed up in a reference center between January 2015 and March 2019.
MATERIAL-METHODS:Observational study of 39 patients, retrospective for the first two cases and prospective for the remaining 37 cases. The study was conducted to identify and analyze risk factors associated with craniocervical junction stenosis by compression of foramen magnum and intracranial hypertension in hydrocephalus. Data were collected through study-specific records filled during medical consultations in neurosurgery clinic at our hospital through patient records revision. Variables related to diameter of foramen magnum and cerebral ventricles were analyzed in computerized tomography and magnetic resonance imaging, need for surgical decompression in craniocervical junction or endoscopic third ventriculostomy (TVE), physical, neurological examination and factors related to family history.
RESULTS:Among the 39 patients in the study, ten underwent craniocervical decompression surgery after displaying signs of medullary suffering and alteration of tendon reflexes. We didn't find a meaningful relationship between ventricular diameter and signs of hydrocephalus in these patients. A TVE was performed on one patient, successfully. She presented optic papilla edema, arterial hypertension and convulsive crises.
CONCLUSION:Despite a limited sample of 39 patients, findings were compatible with the literature. The most frequent neurosurgical complications found in patients with achondroplasia in this case series were craniocervical junction stenosis in 25.6% of cases and hydrocephalus at 2,5%. The diameter of foramen magnum was directly related to symptoms of spinal cord compression. The most frequent avoidable surgical complication was accidental dural opening. A TVE performed on a single patient. We observed that ventricular diameter should not be use as a parameter for indication of surgery in these patients because most of them present macrocephaly due to ventriculomegaly.

Keywords: achondroplasia, hydrocephalus, foramen magnum stenosis, craniocervical decompression, endoscopic third vertriculostomy

Session on Epilepsy

Hall A, Tuesday, 22nd October 2019, 09:24 - 10:15

FL-043

Outcome of resective surgery following invasive stereotactic electroencephalography investigation (sEEG) with special reference to electrical seizure stimulation during monitoring

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OBJECTIVE:To assess the success of resective epilepsy surgery in children following sEEG localization of epileptic focus and the predictive value of electrical seizure stimulation. Children evaluated for epilepsy surgery by sEEG are among the most challenging cases to treat, with significant medical resources required to successfully evaluate them, and risk incurred with this invasive investigation.
MATERIAL-METHODS:Prospective epilepsy surgery database at Birmingham Children's Hospital UK was reviewed to report the outcome

of the first 44 children that have undergone sEEG evaluation in this hospital between December 2014 and December 2018, as part of their work up for possible epilepsy surgery. Location of the seizure focus and seizure outcome at 6 months and 1 year following resective surgery is reported as well as the predictive value of electrical seizure stimulation during sEEG monitoring.
RESULTS:The mean length of recordings was 5.8 days (range 1-9 days); no neurological deficits were incurred; 1child had an extradural haematoma that required evacuation. 32 children (73%) had their seizure focus adequately localized leading to an offer of resective surgery, of which 29 have either undergone or are waiting to undergo surgery. Seizure focus was located in frontal lobe 16(36%) temporal lobe 7(16%), insular cortex 4(9%), occipital lobe 3(7%) and parietal lobe 2(5%). 10 children(23%) had epilepsy that could not be adequately localized or was of multifocal origin and 2 children(5%) have been offered hemispherotomy. Following resective surgery 17 of 24(71%) children are seizure free (Engel 1A) at 6 months and 11 of 19(58%) children are seizure free at 1 year. 6 of 7(86%) children that had an electrically induced seizure as part of the sEEG evaluation are seizure free at 6 months.
CONCLUSION:Preliminary results indicate encouraging seizure control rates in this group. Stimulation of seizures provides some additional predictive value of a successful surgical outcome.

Keywords: sEEG; Electrical Seizure Stimulation; Epilepsy Surgery

FL-045

Epileptic focus diagnosis using artificial intelligence and prediction of surgical outcome

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OBJECTIVE:EEG diagnosis using machine learning for epileptic focus detection is having a promising future. In this study, we report some initial results on machine learning based automatic identification of epileptic focus from intracranial EEG (iEEG) data
MATERIAL-METHODS:Subjective were three children with focal cortical dysplasia. These patients were implanted subdural electrodes to decide their epileptic focus, and subsequently carried out epileptic focus resection. The surgical outcome of them resulted into Engel's class Ia. We decided their epileptic focus from decision of epileptologists by visual inspection of seizure and interictal epileptic discharges and analysis of high frequency oscillation. Retrospectively, we analyzed iEEG data by machine learning method using wavelet transform and some entropies. We analyzed 90 segments from 30 minutes of interictal iEEG. Frequency band were divided into 10 sub-band from 100Hz to 600Hz with 50Hz interval. We indicated the following entropies to evaluate; Appropriate, Sample, Permutation, Shannon, Renyi, Tsallis, and phase 1 & 2. The prominent entropies were selected based on maximum values of average linear discriminant analysis scores and support vector machine was used for classifying the epileptic from non-epileptic foci. After adapting oversampling techniques using surrogate data to adjust the number of electrodes between the epileptic and non-epileptic foci, the accuracy was evaluated by 10-fold cross validation; consisting of 9-training set and 1-subset to test and calculated sensitivity, specificity and precision value in each subject.
RESULTS:Sample and appropriate entropies were proper to distinguish the epileptic electrodes. Frequency band over 350Hz were suitable to discrete the epileptic regions. Average sensitivity, and specificity, and precision values were 35.34%, 89.45%, and 27.60%, respectively. AUCs of ROC curves of each patients were 0.88, 0.72, and 0.81, respectively.C
CONCLUSION:Machine learning using the multiband entropy-based feature-extraction method is useful for epileptic focus detection.

Keywords: machine learning, intracranial EEG, focal cortical dysplasia, epilepsy surgery, entropy

FL-046

Predictors of Long Term Surgical Outcome in Pediatric Epilepsy Surgery

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OBJECTIVE:INTRODUCTION: The optimum algorithm for non-invasive localization of epileptogenesis children with medically resistant epilepsy remains elusive. In all series pre-operative findings of normal MRI and extra-temporal epileptogenesis have correlated with more modest surgical outcome. The goal of this study is to evaluate which noninvasive presurgical evaluations were most useful in determining localization. This is a necessary and important step in the eventual hope of developing an algorithm of required presurgical investigations associated with seizure-free surgical outcomes in children with MRE.
MATERIAL-METHODS:We evaluated and operated upon (12/03-06/16)108 children with medically refractory partial epilepsy who have a minimum of 2- year post-operative outcomes (mean follow-up 7.5 years). Multiple presurgical imaging and assessment modalities were analyzed in relation to the seizure-free outcomes using the area under the receiving operating curve (ROC). Other clinical covariates were also examined in relation to long-term surgical outcomes.
RESULTS: No single preoperative modality of assessment can predict a seizure-free outcome. However, concordance of all presurgical modalities yielded the highest predictive value. No difference in long-term outcomes between inconclusive (normal or diffusely abnormal) and abnormal focal MRI results were found. Long-term survival analyses reveal statistical significance association between seizure-freedom and patients with focal ictal EEG, early surgical intervention and no history of generalized convulsions.
CONCLUSIONS: Full utilization of all pre-surgical investigations is contributory and not redundant and comprehensive evaluation improves pediatric epilepsy surgical outcomes particularly in patients with normal or non-localizing MRI.

Keywords: epilepsy surgery, outcomes, pre-operative evaluation

FL-047

Surgical treatment of epilepsy in children with hemimegalencephaly: long term results

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OBJECTIVE:Hemimegalencephaly is a rare malformation of cortical development characterized by abnormal enlargement of one hemisphere or part of it. Pathogenesis is unknown but probably related to activation of mTOR pathway. Typically, children present with refractory seizures very early in life and are neurologically delayed, with lateralized motor deficits; progression to epileptic encephalopathy is the rule if not treated early. MR shows abnormal thickness of cortical gray matter, abnormal gyral patterns, blurring of the grey-white matter transition and hemispheric hypertrophy and hamartomatous appearance with very distorted anatomy. Discussion of our experience concerning 36 operated patients among a series of 667 children operated on for epilepsy (163 hemispheric surgeries).
MATERIAL-METHODS:Review of clinical data of 36 cases diagnosed with hemimegalencephaly operated from 1999 until 2018 at our Institution with a mean age at surgery of 4 years (median <2 years) and a follow-up of 7 years on average. Hemispherotomy was performed in 80% of the cases. Other surgical techniques included posterior quadrantic disconnection or frontal disconnection.
RESULTS:Early results of surgery were very good with 92% of seizure free patients at 6 months follow-up but this declined to 66% at 1 year and 54% after 5 years. We had one case of early postoperative death and one case of permanent neurological deficit after surgery. Post-operative hydrocephalus was very rare.
CONCLUSION:Hemimegalencephaly is a very complex disease presenting with severe epilepsy and demands early surgical treatment. Hemispheric surgery is the technique of choice and usually yields good outcomes, although the distorted cerebral anatomy of such patients can pose a significant challenge for the surgeon.

Keywords: epilepsy surgery, hemimegalencephaly, hemispherotomy, posterior quadrantic disconnection

FL-048

Surgical Outcome of Redo Peri-Insular Hemispherotomy: A Single Institution Experience

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OBJECTIVE:Ongoing seizures after hemispherotomy for epilepsy present a diagnostic and therapeutic challenge in further patient management. Initial response to first hemispherotomy at 1 year may help predict outcome of redo hemispherotomy. We report long term follow-up of a single institution experience with redo hemispherotomy.
MATERIAL-METHODS:Retrospective chart review of all medical records of patients who underwent redo hemispherotomy at Great Ormond Street Hospital for Children. Data collected included diagnosis, age, Engel outcomes after first hemispherotomy, final operation and time to recurrence of seizures.
RESULTS:Between 1998 and 2018, 230 patients underwent peri-insular hemispherotomy (PIH). Of these patients, 24 (10.4%) underwent redo PIH for hemimegalencephaly (14), Rasmussens Encephalitis (3), Sturge-Weber Syndrome (2), cortical dysplasia (2), and Infantile Epileptic Encephalopathy (1). There were 9 females and 15 males with an mean age of 7.79 yrs at final operation. Mean time to seizure recurrence was 27 months (range 1 month to 96 months). Engel outcome reported at 1 year or sooner when seizure frequency worsened was 1 (8), 2 (5), 3 (5), 4 (3). Mean time to seizure recurrence for patients with initial Engel 1 outcome was 50.3 months. Engel outcome after final revision was 1 (11), 3 (8), and 4 (2) with mean follow up 4.6 years after final operation. Of the 8 patients with an Engel 1 outcome after first hemispherotomy, Engel outcome after final operation was 1 (4), 3 (2), and 4 (2).
CONCLUSION:Despite Engel 1 outcomes after initial PIH, seizures may return up to 4 years after operation. Redo PIH offers a 50% chance of Engel 1 outcome after final revision surgery. Long term surveillance for all patients with PIH is necessary to identify patients that may still benefit from further disconnection procedures. Further work is required to identify prognostic factors for outcome of redo hemispherotomy.

Keywords: Hemispherotomy, Engel Outcome, Hemimegalencephaly, Rasmussens Encephalitis, Sturge-Weber Syndrome

FL-049

Seizure Outcomes of Surgical Intervention in Children with Cavernoma-Related Seizures (CRS)

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OBJECTIVE:Seizures are the most common presenting symptom of cavernous malformations (CM). Standard management includes initial radiological surveillance and treatment with anti-epileptic medication. Surgery is often reserved for drug-resistant epilepsy (DRE) or acute neurological deficit caused by haemorrhage. The aim of this study was to evaluate the seizure outcomes of children with cavernoma-related seizures (CRS) after surgical resection and to identify prognostic factors, thereby improving patient selection and management.
MATERIAL-METHODS:A retrospective analysis was carried out on 29 children who had surgical intervention for CRS, defined as having had two or more seizures prior to surgical resection at Great Ormond Street Hospital (GOSH), London and Fondation Ophthalmic Adolphe De Rothschild (FOR), Paris. Seizure outcomes were evaluated and patients were categorised into Group A (Engel I) and Group B (Engel II-IV). Clinical, radiological and neurophysiological data were analysed using univariate logistical regression to identify factors that might influence prognosis. The main factor evaluated was complete CM resection.
RESULTS: Sixteen males and 13 females were identified. Post-operatively, overall seizure outcome was favourable with 24 (82.8%) patients in Group A and 5 (17.2%) in Group B. Two (6.9%) patients experienced adverse events. One had mild left hemiparesis immediately after surgery, which later resolved completely by four month follow up and one experienced wound infection, which required washout. Median age at seizure onset was 6.21 years. Median duration of epilepsy before surgery was 6.18 months. Median age at surgery was 10.83 years. Median duration of follow up was 2.00 years (Range= 0.08-12.92 years). Complete resection of CM was associated with better seizure outcome albeit not reaching statistical significance (p= 0.090, OR= 0.136).
CONCLUSION:A high percentage of children who underwent surgery for CRS achieved favourable outcomes without post-operative complications. Complete CM resection is associated with higher chance of long-term seizure freedom.

Keywords: cavernoma, cavernous malformations, seizure, outcomes, children

FL-050

Early recovery of interhemispheric functional connectivity of corpus callosotomy

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OBJECTIVE:To investigate whether the interhemispheric functional connectivity (FC) recovers in the first year after total callosotomy.
MATERIAL-METHODS:Eight epilepsy patients undergoing total callosotomy were recruited. Resting-state functional MRI were acquired before and after surgery. The precallosotomy and postcallosotomy interhemispheric and intrahemispheric FC were analyzed by using graph theory and voxel mirrored homotopic connectivity (VMHC). The seizure outcome was scored using the Engel surgical outcome scale.
RESULTS:After callosotomy (mean postoperative interval: 4 months), the network density, the average node degree, the characteristic path length and global efficiency of the whole interhemispheric networks were significantly decreased, compared to those in the precallosotomy networks. However, postcallosotomy interhemispheric FC and homotopic VMHC were not significantly reduced in bilateral frontal and temporal lobes. The network density, and average node degree of the intrahemispheric networks are significantly increased. The characteristic path length and global efficiency of intrahemispheric networks are unchanged.
CONCLUSION:The interhemispheric FC may be preserved or recover early within the first postoperative year after total callosotomy, particularly in the frontal and anterior temporal lobes.

Keywords: Corpus callosotomy, Interhemispheric functional connectivity, Graph theory, Voxel-mirrored homotopic connectivity

FL-051

Insights into Epileptic Networks in Tuberous Sclerosis based on Stereoelectroencephalographic Findings: Intertuberal Connectivity and Surgical Implications

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OBJECTIVE:To define epileptogenic networks in tuberous sclerosis complex (TSC) and putative inter-tuberal connectivity using quantitative analysis of stereoelectroencephalography (sEEG).
MATERIAL-METHODS:A single-center, retrospective review of pediatric patients with medically refractory epilepsy secondary to TSC who underwent sEEG for localization of the epileptogenic focus was performed. sEEG tracings of interictal and ictal events were obtained. Ictal events lasting greater than sixty seconds were identified and subjected to quantitative signal analysis methods. Cortical connectivity was quantified by calculating pairwise coherence between all contacts and constructing an association matrix. The global coherence, defined as the ratio of the largest eigenvalue to the sum of all the eigenvalues, was calculated for each frequency band (delta, theta, alpha, beta, gamma).
RESULTS:Four patients with an MRI-confirmed diagnosis of TSC underwent sEEG for localization of the epileptogenic focus. A total of 31 sEEG depth electrodes with 250 contacts were implanted. Of the 165 ictal epochs obtained, 130 met inclusion criteria for quantitative signal analysis. Ictal events were characterized by a change in connectivity (global coherence) in the beta/low gamma (14 – 30 Hz) and high gamma (31 – 70 Hz) frequency bands, which has been reported in other studies as a driver of synchrony and desynchrony.
CONCLUSION:Few studies have assessed intra-tuberal, inter-tuberal and peri-tuberal connectivity in TSC. Our work using quantitative signal analysis of sEEG demonstrates evidence of epileptic networks in TSC. We also show a time-dependent change in global inter-tuberal connectivity during ictal events. These findings have surgical implications for targeted laser ablation or surgical resection of tubers.

Keywords: Tuberous sclerosis complex (TSC), stereoelectroencephalography (sEEG), connectivity, global coherence, epileptic networks

FL-052

Genetics and surgical treatment of the pediatric tuberous sclerosis complex in refractory epilepsy

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OBJECTIVE:The objectives of the study are to perform a clinical and genetical analysis of the tuberous sclerosis complex (TSC) cases operated in our service (a major epilepsy center in Brazil) to determine how the gene deletions and duplications of the TSC correlate to the success of the surgical treatment and what pathways influence the development of hamartomas and epilepsy.
MATERIAL-METHODS:We expect to enroll 30 patients in total, as of yet 8 patients have already entered and all were submited to pre operatory exams including high resolution MRI and video-electroencephalogram in order to determine the type, location and size of the hamartoma and the epileptogenic pattern, the appropriate surgery was performed and crisis control was evaluated with Engel Surgical Outcome Scale. The genetic analyses were performed in the blood, in the resected brain tissue or in both and, sometimes, in their next of kin using multiplex ligation-dependent probe amplification (MLPA).
RESULTS:So far 8 patients were diagnosed with refractory epilepsy caused by TSC and submited to surgery. The mean age at surgery is 1 year 11 months with all but one receiving ElectroCorticoGraphy, 5 lesionectomies were performed with only one lobectomy, hemispherotomy and quadrantectomy; frontal lobe was affected in 50% and the engel surgical scale is I (5 cases) and II (3) in a 6 months follow-up. All patients had their blood samples analysed with the MLPA technique that found deletions on both the TSC1 and TSC2 genes.
CONCLUSION:We speculate that both genes mutation can be related to earlier onset of epilepsy seizures, however, only a partial group of patients has been analysed so far what hinders our ability to correlate the genetical findings to the clinical data. Through the genetic sequencing of more patients we expect to better investigate this possibility and others to complemente the existing literature on the theme

Keywords: Tuberous Sclerosis, epilepsy, surgery, genetics

FL-053

Histopathological topography of the surrogate imaging biomarkers of the epileptogenic zone: Implications for post-surgical seizure outcomes

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OBJECTIVE:Epilepsy surgery remains challenging for poorly defined cases (PDCs) including MRI negative, subtle MRI abnormalities, and lesions known to extend beyond what is seen on MRI, such as focal cortical dysplasia (FCD). The difficulty lies in fully defining the epileptogenic zone (EZ). The presurgical evaluation of pediatric focal epilepsy involves a series of tests to find surrogate biomarkers of the EZ including the lesional zone (LZ) by MRI; the functional deficit zone (FDZ) by PET or interictal SPECT; the irritative zone (IZ) by magnetoencephalography (MEG), EEG-fMRI, or intracranial recording; and the seizure onset zone (SOZ) by intracranial recording, ictal SPECT, and rarely ictal MEG. A successful presurgical evaluation reveals these surrogate zones (sZ), so that a hypothesized EZ is envisioned and surgical plan made. During surgery, the suspected lesion is biopsied while adjacent tissue is often indiscriminately aspirated, and borders are not sampled. In so doing, the histopathological nature of the sZ remains unknown.
MATERIAL-METHODS:In 20 consecutive PDCs we incorporated each sZ into our surgical plan, and collected specimens from each for dedicated histopathological analysis.RESULTS:In 13 cases in which the LZ was sampled, 11 (85%) contained typical pathologies (i.e., FDC, hippocampal sclerosis). In 11 cases where the SOZ was sampled, 10 (91%) contained typical pathologies. In 10 cases in which the adjacent IZ was specifically sampled, 4 (40%) contained typical pathologies, and 3 (30%) had oligodendrocyte hyperplasia (OH). In 17 cases where the surrounding FDZ was specifically sampled, 7 (41%) contained typical pathologies, and 5 (29%) had rare dysmorphic neurons or OH.
CONCLUSION:Histopathological abnormalities exist throughout all surrogate zones of the EZ, well beyond the visible lesion or hypothesized SOZ. This could explain why epilepsy surgery frequently fails despite perceived “complete resection”. Better outcomes would likely be achieved if all surrogate components of the EZ could be safely removed.

Keywords: epilepsy, epileptogenic zone, imaging, presurgical evaluation, histopathology, focal cortical dysplasia

FL-054

Improved seizure control following battery replacement of vagal nerve stimulator (VNS) with cardiac-based seizure detection automatic stimulation (AutoStim)

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OBJECTIVE:The recent vagal nerve stimulator (VNS) models (AspireSR® and SENTIVA®) include an added feature of cardiac-based seizure detection. This uses tachycardia as a proxy to a seizure and the battery delivers a closed-loop electrical current. This feature leads to further seizure reduction in adults, but this advantage has not been reported in the pediatric population.This study aims to investigate whether battery change with a cardiac-based seizure detection VNS leads to further reduction in seizure frequency or severity.
MATERIAL-METHODS:This study included all VNS battery change cases between November 2015 and July 2018. Data regarding patient characteristics, seizure history and burden, seizure frequency prior to battery change were collected retrospectively. Data on post-battery change (2nd VNS) seizure burden were collected prospectively.
RESULTS:Nine patients underwent battery change with AutoStim function. The male:female ratio was 4:5. The mean ages of 1st and 2nd VNS insertion were 7.3 and 11.7 years. All 1st VNSs were model 103. Of the battery change, 4 were AspireSR®, and 5 were SENTIVA®. The mean AutoStim frequency of the 2nd VNS was 54/day.After the 1st VNS surgery, 6/9 patients (67%) achieved ≥50% seizure reduction (McHugh’s Class I and II). After the battery change, 3/9 patients (33%) reported a further ≥50% seizure reduction over their initial VNS. Overall, 8/9 patients (89%) reported ≥50% seizure reduction after the 2 VNS surgeries.In terms of absolute seizure burden, the mean seizure frequency pre-1st VNS, pre-2nd VNS, and post-2nd VNS were 592, 106, 59 per month, respectively. The seizure reduction by the 1st and 2nd VNSs were 65% (p=0.057) and 39% (p=0.037). The mean seizure reduction from pre-1st VNS to post-2nd VNS was 81%.Qualitatively, all patients reported shorter or less severe seizures with AutoStim.
CONCLUSION:This early series suggests that cardiac-based seizure detection AutoStim improved seizure burden.

Keywords: Vagal nerve stimulator, AutoStim, intractable epilepsy, seizure, Aspire, SENTIVA

FL-055

Does the Modified Arrhenius Model reliably predict area of tissue ablation after MRgLITT for pediatric lesional epilepsy?

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OBJECTIVE:To determine the accuracy and precision of the thermal damage estimate (TDE) calculated by commercially available magnetic resonance-guided laser interstitial thermal therapy (MRgLITT) systems using the generalized Arrhenius model.
MATERIAL-METHODS:A single-center retrospective review of pediatric patients undergoing MRgLITT for lesional epilepsy was performed. The area of each lesion was measured on both TDE and intraoperative post-ablation, post-contrast T1 MR images using Image J. Lesions requiring multiple ablations were excluded. The strength of the correlation between TDE measurements and the area of the lesions on post-ablation imaging was assessed via linear regression.
RESULTS:A total of 32 lesions were identified in 19 patients. After excluding lesions with multiple ablations, 11 pairs were available for analysis. Linear regression demonstrated a strong correlation between estimated and actual ablation areas (R2=.97, p<0.00001). The TDE tended to underestimate the area of ablation by an average of 3.92% overall (SE= 4.57%), but this varied depending on the type of pathologic tissue involved. TDE accuracy and precision were highest in tubers, with predicted areas underestimating actual areas by an average of 2.33% (SE= 0.33%). TDE was least accurate in predicting the area of the hypothalamic hamartoma, which was the smallest lesion in our series. In periventricular nodular heterotopias, TDE overestimated ablation areas by an average of 13%.

CONCLUSION:The generalized Arrhenius model utilized by commercial MRgLITT systems reliably estimates the area of tissue that will be ablated when a given amount of thermal energy is applied for a set amount of time. However, the reliability is not consistent across tissue types, particularly in smaller lesions and those located periventricularly. Further investigation of ablation dynamics over a range of pathologies, locations and ablation patterns is needed to improve the accuracy of this emerging minimally invasive technique.

Keywords: Magnetic resonance guided laser interstitial thermal therapy (MRgLITT), lesional epilepsy, ablation

Early Riser Session: Functional Neurosurgery

Hall B, Tuesday, 22nd October 2019, 07:00 - 07:50

FL-057

Can normative brain atlases improve DBS clinical practice in the paediatric population?

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OBJECTIVE:Bilateral deep brain stimulation (DBS) of the globus pallidus internus (GPi) is an established surgical treatment for dystonia in children. MRI-based direct targeting has become the method of choice for stereotactic DBS surgery, but accurate identification of the target structure and of the final position of electrode contacts remains challenging. The aim of this study was to study the applicability of normative brain atlases in the clinical practice of DBS in children.
MATERIAL-METHODS:Six children with bilateral GPi-DBS for dystonia (Medtronic 3389) were reviewed. The preoperative planning MRI was fused with the postoperative CT and the anatomical position of each electrode contact was determined by a senior surgeon on a standard workstation (Stealth, Medtronic). All scans were blindly processed (Lead-DBS Toolbox), normalized to MNI space and merged with a normative brain atlas (Ewert 2017) for 3D reconstruction and parcellation of the basal ganglia. The location of electrode contacts were classified as GPi, internal lamina, GPe or outside GP. Surgeon's and Lead-DBS results were compared.
RESULTS:The median age of the children was 10 (range 7-12). A total of 12 DBS electrodes (48 contacts) were studied. There was a 56% (27/48) agreement between surgeon and Lead-DBS. Following this comparison the surgeon reclassified 13 (27%) electrode contacts resulting in 75% (36/48) agreement. 91% (11/12) of mismatched positions lay within 1.3 mm (one electrode width, within tolerances of image fusion).
CONCLUSION:Visual identification of electrode contacts on the child's own scan remains the gold standard but image quality, fusion accuracy and pathology may introduce errors resulting in electrode contacts appearing outside the GPi. Toolboxes such as Lead-DBS may be a useful adjunct and assist in verification. Further studies with a larger cohort of patients are required to validate this method, and its role in DBS programming and outcome in children.

Keywords: deep brain stimulation, children, dystonia, normative brain atlas

FL-058

Paediatric DBS Surgery: Revision Techniques using the Renishaw Guide Tube and incidence of electrode problems

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OBJECTIVE:DBS is an established treatment for children with dystonia. We reviewed 166 paediatric patients who had DBS insertion for dystonia since May 2005 until September 2018 in our unit. Of these, 25 (15%) cases had hardware problems requiring revision surgery. We review how these cases presented and discuss the technical aspects of revising the electrodes, including a frameless technique using the Renishaw Guide tubes.
MATERIAL-METHODS:We performed a retrospective review of children (<18 years old) who underwent DBS insertion for dystonia at King's College Hospital from May 2005 to September 2018 and presented with hardware problems.
RESULTS:Of 166 paediatric patients with DBS, 21 (13%) patients had specifically lead/electrode problems requiring replacement/revision of one or more electrodes, and 3 patients had hardware problems related to the battery and extension leads. 7 had lead migration and a further 7 had a lead fracture with or without lead migration. 7 had high impedances requiring revision, without obvious lead migration of fracture.6 patients had DBS inserted with the Renishaw Sterotactic Robot and utilised the Renishaw Guide Tubes, in these patients who required lead replacement it was possible to revise the electrode without using stereotactic frame. As the guide tubes are implanted in the correct trajectory it is possible to measure the distance required to advance/implant the lead within this to target without the need for stereotactic reimplantation. 15 patients had original DBS insertion with the Leksell Stereotactic System utilising the Medtronic Stimlock for lead fixation.
CONCLUSION:Electrode dysfunction is common in children with DBS and a systematic approach is required to identify the cause. When an electrode requires repositioning or replacement, the procedure can be performed in the conventional manner with a stereotactic frame, or freehand without a frame if a Renishaw Guide tube is used at time of first insertion.

Keywords: DBS for dystonia, dbs complications, frameless DBS revision

FL-059

Unilateral Deep Brain Stimulation (DBS) of Nucleus Ventralis Intermedius Thalami (Vim) for secondary and lesional tremor: surgical results in four patients

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OBJECTIVE:Evaluation of the efficacy of Deep Brain Stimulation (DBS) of Nucleus Ventralis Intermedius Thalami (Vim) for drug-resistant secondary and lesional tremor in four patients.
MATERIAL-METHODS:DBS of Vim is a validated technique for the treatment of unilateral essential tremor in adults while its efficacy is not yet fully approved for secondary and lesional tremor. On this basis we performed unilateral DBS of Vim in four patients (two males, two females; mean age 15 years-old: range 10-18) affected by secondary unilateral tremor resistant to pharmacological therapy. All the patients did not show any lesion into the target of stimulation at MRI. Three patients had unilateral tremor due to head injury, one secondary to contralateral stroke. All patients were submitted to unilateral frame-based (Leksell, Elekta®) DBS of Vim contralateral to tremor by stereotactic technique coupled with stereotactic robot (Neuromate, Renishaw®). The monopolar stimulation (battery positive/electrode contact 0 negative) started two weeks after surgery with progressive ramp up to a maximum 2.5 V voltage (frequency 90 Hz, impulse duration 180 μs).
RESULTS:After a mean follow-up of 3,7 years (range 10 months – 120 months) the tremor significative reduced and all the patients reported a better control of movements in the affected side. According to patients and parents the improvement was about 50-60% as compared to the pre-operative functioning status. No side effects were reported and three out of four patients stopped drug therapy.
CONCLUSION: The DBS of Vim could be efficacious even in secondary unilateral tremor in pediatric patiens. The outcomes (50-60%) are not dramatic as in essential tremor (about a 80-90%) probabibly due to the damage of neural circuits. However, unilateral DBS of Vim should be offered in all patients not responding to the pharmacological therapy given its very low morbidity and invasiveness.

Keywords: Deep Brain Stimulation (DBS), tremor, movement disorders, stereotactic surgery

FL-060

Percentage of hip dislocation in children with cerebral palsy

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OBJECTIVE:Cerebral palsy is primarily a group of permanent disorder of movement and posture development.Recent studies have found an increase of CP prevalence.Our aim is to assess the percentage of hip dislocation and sublaxation in patients of cerebral palsy at our hospital.
MATERIAL-METHODS:Study design: Descriptive cross sectional pilot study.Patients:This study was carried out in MUCH.In the period from April 2017 to March 2018. Age ranged from 3 to 16 years old.Exclusion criteria: Atonic and hypotonia associated Cerebral palsy (CP).Data collection: All patients in this study were subjected to:I-History taking: Natal- post natal -Developmental.II-Clinical examination: Neurological examination- Presence of skin folds in the upper thigh- Galezzi sign - Topographic classification of CP and gross motor function classification system (GMFCS) assessment. (Fig1)III- Anteroposterior X-ray hip and lower limb to measure the migration percentage (MP) and the acetabular index (AI). (Fig 2) (Table1).
RESULTS:Demographic data of the studied group.(Table2) Topographic classification of the studied group and GMFCS level of the studied group.(Fig 3) Physiotherapy in the studied group.(Table3) Signs applied on the studied group.(Table4) Distribution of hip morphology according to migration percentage. (Fig 4) Relation between hip morphology grades and type of cp,GMFCS level, physiotherapy,Galezzi sign and Botulinum Toxin Type-A (BoNT-A) injection.(Table5) Correlation between Migration percentage and acetabular index.(Fig 5).
CONCLUSION:Hip dislocation and sublaxation was reported 18% and 21% receptively in our studied group.Hip screening (Anteroposterior X-ray) considered a cornerstone in rehabilitation of CP.The incidence of hip dislocation in CP is directly proportional with GMFCS and their topographic classification.Physiotherapy plays role in prevention of hip dislocation through prevention of progression in muscles spasticity while BoNT-A injection can help in pain improvement.Further adequate sized studies including large number of CP cases and parents awareness about the importance of care and rehabilitation should be continued.

Keywords: Cerebral palsy, Hip dislocation,Screening, Physiotherapy

Session on Neuroendoscopy

Hall B, Tuesday, 22nd October 2019, 08:00 - 09:10

FL-061

Surgical treatment of Arachnoid Cysts. Experience of Instituto Nacional de Pediatria

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OBJECTIVE:Intracranial Arachnoid Cyst is a benign disease that accounts for only 1% of intracranial lesions and presents more frequently in the first two decades of life. The objective of this study was to describe the authors' experience in the surgical treatment of Arachnoid Cysts.
MATERIAL-METHODS:The authors reviewed 93 hospital records in which patients were surgically treated for Arachnoid Cysts over a period of 20 years (1996-2016). Sixty patients were male and 33 were female with an average age of 6 years, range 1 month to 16 years; 55% of the patients were younger of 5 years.
RESULTS:Cysts were located infratentorially in 16% (n=15) and supratentorially in 78 % (n=73); of these 63% (N=59) were in the middle cranial fossa with Galassi type II (n=24) and type III (n=34) The most common symptoms were headache (35%), seizure (29%), and hemiparesis (16%). The first-line treatments were microsurgical fenestration (n=25), endoscopic fenestration (n=16), cystoperitoneal/ventriculoperitoneal shunting (n=9) and combined procedure: fenestration and shunting (n=43). Significant clinical improvement occurred in 89 patients and post-operative imaging showed a reduction in the cyst in 71 patients. Twenty-five patients had a recurrence and required to repeat the surgical procedure.
CONCLUSION:The first-line treatment is the fenestration of the cyst whose objectives are to decrease the mass effect and to restore cerebrospinal fluid circulation. The fenestration can be made by a minimally invasive approach such as endoscopy. In the case that the endoscopy is not possible, for example in cases of rupture and subdural hematoma, microsurgery fenestration is suggested. The cystoperitoneal shunt may be considered as the second-line treatment.

Keywords: Arachnoid cyst, symptom, surgery, endoscopic fenestration, microsurgical fenestration, cystoperitoneal/ventriculoperitoneal shunting

FL-062

Neuropsychological impact of temporo-sylvian arachnoid cysts: Results of a prospective study of 100 children

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OBJECTIVE:Selecting eligible criteria for surgery in children with temporal arachnoid cysts (TAC) is controversial and their neuropsychological impact may be underestimated. This study was conducted to assess MRI criteria comparatively to their neuropsychological performances.
MATERIAL-METHODS:We prospectively analyzed children managed in our unit from 2010-2016 looking at the neuropsychological profiles, psycho-affective functions and learning skills comparatively to the cyst MRI characteristics (side/ size (Galassi) and shape).
RESULTS:100 children were included. Mean IQs were very heterogeneous and one-third of children had at least one index impaired. BRIEF questionnaire showed executive dysfunctions in daily life. Half of children had rehabilitation for learning difficulties, 1/4 had school adaptations and 1/3 required psychological therapy. Right cysts were associated with more disabilities than the lefts one's especially in behavior, language, attention, flexibility and visuo-constructive skills. Importantly, cysts with a rounded shape were significantly associated with worse performances than other shape cysts for IQ scores and several other neuropsychological functions, more daily executive disorders and psychological and speech therapies. The effect of the cyst shape was not significantly different depending on the side or Galassi type. The IQ scores were independent of the Galassi types and the smaller cysts leaded to more disorders than the larger in a few domains. Children with a cyst discovered incidentally or after a rupture had good results. Four years later, non-operated children with difficulties needed more rehabilitations and school adaptations.
CONCLUSION:Our study revealed that children with a TAC have a very heterogeneous profile, half of them having elective disorders. The rounded shape of the cyst appears to be linked with a greater risk for neuropsychological disorders than its size. A neuropsychological evaluation is important in case of suspicion of academic or psychological disorder, and with the analyses of MRI features may contribute to the surgical decision.

Keywords: Temporo-sylvian arachnoid cyst, neuropsychological profile, cyst shape, galassi

FL-063

Suprasellar Arachnoid Cysts: Controversies and The Role Of Endoscopy

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OBJECTIVE:Suprasellar arachnoid cysts are relatively uncommon disorders during daily neurosurgical practice Nevertheless they have many controversial issues as regard terminology, classification, treatment options, surgical indications and how to assess the surgical outcome. The aim of the study is to elucidate the main controversial issues and assess the outcome of endoscopic fenestration of suprasellar arachnoid cysts.
MATERIAL-METHODS:We reviewed the published data and retrospectively analyzed the cases of suprasellar arachnoid cysts treated endoscopically at Mansoura university hospital during the period between February 2012 through December 2018. Pre operative clinical and radiological cases were analysed..Ten males and 6 females ranged in age from 6 months to 15 years. Median follow up of our cases was 19 months. Clinical and radiological outcome were reviewed. Success was measured by the patients who need no further management.RESULTS:The overall success rate of endoscopic cyst fenestration was 75%. Venriculo-cystocisternostmoy was successful in eight out of ten patients (80 %) whenever ventriculocystostomy achived success in four out of six patients (66.6%). Our complication included two cases of CSF leaks,two cases of ventriculitis, one case of subdural collection and one case of transient 6th nerve palsy.
CONCLUSION: Symptomatic Suprasellar arachnoid cysts can be fenestrated endoscopically with favorable clinical and radiological outcome. ventriculocystocisternostomy is relatively superior to ventriculocystostomy. Endoscopic fenestration is not without complications, therefore it should be reserved for only symptomatic cases

Keywords: suprasellar arachnoid cyst,cerbrospinal fluid, hydrocephalus. endoscopy, fenestration

FL-156

Endoscopic Fenestration of Arachnoid cysts through Lateral pontomesencephalic membranotomy: Technical Notes and Case Series

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OBJECTIVE:Description of the technique of Cystocisternostomy of Cranial Arachnoid cyst through Endoscopic Lateral pontomesencephalic membranotomy as an effective method for fenestration with subsequent radiological and clinical improvement. MATERIAL-METHODS:Seven children with age ranged from one and half years to nine years old (mean: five years). The cysts were Giant in five cases and Galassi Type III in two of them. They clinically presented with Seizures, Loss of consciousness, unsteady gait and headache.
All cases underwent endoscopic fenestration with zero angled Rigid endoscope(STORZ) through minimally invasive single burr hole and 3cm liner skin incision allowed for direct entry through the cyst and then fenestration of the Lateral pontomesencephalic membrane just medial to the tenurial edge.
This Technique creates direct communication of the arachnoid cyst with the cerebellopontine Cistern.
RESULTS:The size of arachnoid cysts was decreased in the seven cases after three month follow up and the cyst was vanished in two cases after 15 and 18 month follow up. The seizures were controlled in whom presented with fits and the other pre operative symptoms were improved in other children. Insignificant Subdural hygroma was inevitable in the all five cases of Giant cysts, subdural hematoma and hemorrhage within the cysts occurred in two cases after three and six month follow up with conservative treatment, contralateral massive subdural hematoma occurred in one case four month after surgery evacuated with burr holes with good clinical outcome.

CONCLUSION:We present a minimally invasive safe technique through a single burr hole that adds to the success of endoscopic management of intracranial arachnoid cyst when compared to open surgery or shunt even in giant cysts. This Cystocisternostomy done through the Lateral pontomesencephalic membrane Creating a shortcut of CSF flow to the cerebellopontine Cistern with little chances to close compared to other fenestration sites.

Keywords: Arachnoid cysts, endoscopic, fenestration

Session on Hydrocephalus

Hall B, Tuesday, 22nd October 2019, 09:10 - 10:15

FL-064

Trapped 4th ventricle in VP shunted children, how to avoid and manage?

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OBJECTIVE:A trapped fourth ventricle (TFV) is a well-identified problem in children with hydrocephalus. Patients with post-hemorrhagic hydrocephalus are mostly affected with this complication. We tried to find out the predisposing factors as well as the guiding clinical findings to prevent if possible, or early diagnose such a complication and manage it.
MATERIAL-METHODS:We reviewed our hydrocephalus database from 1991 till 2018 and found 21 patients who were diagnosed with trapped fourth ventricle during their follow-up and required operative treatment. We analyzed the prematurity, cause of hydrocephalus, type of valve implanted by the first surgery and its readjustment if a programmable one, revision surgeries, modality of treatment of the TFV as well as their clinical examination and MRI follow-up scans.
RESULTS:Most of our patients suffered from post-hemorrhagic hydrocephalus (16/21), tumor (2/21), post-meningitis hydrocephalus (2/21), congenital hydrocephalus (1/21), 17 out of 21 were delivered pre-term. Most implanted valve was Medos-Hakim programmable valve (13/21). 7/21 suffered from a chronic over-drainage during follow-up with a radiological evidence of slit ventricles. 13/21 were symptomatic with radiological evidence of TFV. Symptoms were mostly unspecific but denote brain stem dysfunction, in 3 patients TFV was asymptomatic but with clear radiological evidence of entrapment of the fourth ventricle, in 5 patients we did not have available information. Surgery in the form of a separate extra 4th ventricular catheter connected to the already implanted VP shunt was the treatment of choice in 18 out of 21 patients. One patient was treated by cranio-cervical decompression. Endoscopic aqueductoplasty with stenting was done in last 2 cases.
CONCLUSION:Diagnosis of clinically symptomatic TFV and its treatment a challenge in our practice of pediatric neurosurgery. However, early detection and intervention may help in avoiding fatal complication and improving the neurological function.

Keywords: trapped fourth ventricle

FL-065

Endoscopic third ventriculostomy in infants: Critical analysis in 118 patients

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OBJECTIVE:Literature reveals difference of opinion regarding effectiveness of endoscopic third ventriculostomy (ETV) in management of hydrocephalus in infants i.e., less than one year age.Aim of this study is to analyse outcome in children less than 1 year and identify factors related to failure or success of endoscopic third ventriculostomy.
MATERIAL-METHODS:This is a retrospective study done in patients who underwent Endoscopic third ventriculostomy during 2006 to 2018 at Kamineni hospital, Apollo hospital Hyderabad, Telangana. During the study period around 189 endoscopic third ventriculostomy were done out of which 118 were in children less than 1 year. ETV was success full in 76 children (64%). Out of 118 patients 73 were male and 45 were female child. ETV was performed in various aetiologies. 57 patients were due to Aqueductal stenosis with obstructive hydrocephalus, 18 patients were in obstructive hydrocephalus due to space occupying lesions in and around 3rd and 4th ventricle, 28 patients in communicating hydrocephalus, 6 patients in dandy walker variant with hydrocephalus, 5 patients in preterm IVH and 1 patient each in craniosynostosis, head injury with IVH and multiseptate hydrocephalus. Non requirement of another csf diversionary procedure like ventriculo peritoneal shunt is considered to be success of surgical procedure. Relationship between success of ETV and various factors like aetiology of hydrocephalus, antenatal diagnosed, post natal complications, age at ETV, head circumference, previous shunt were assessed.
RESULTS:Endoscopic third ventriculostomy was performed in 118 infants. Success of Endoscopic third ventriculostomy was seen in 76 children (64%). Postnatal complications and infection are poor prognostic factors for success of third ventriculostomy
CONCLUSION:Success of ETV in infants is comparable with adults. Endoscopic third ventriculostomy should be offered as first line of management for shunt free survival in infants.

Keywords: Hydrocephalus, ETV, infants

FL-066

Third Ventricle Floor Variations and Abnormalities in Myelomeningocele-Associated Hydrocephalus: Our Experience with 455 Endoscopic Third Ventriculostomy Procedures

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OBJECTIVE:To evaluate the incidence of anatomical variations and abnormalities of the third ventricle floor encountered during endoscopic third ventriculostomy (ETV) procedure in myelomeningocele-associated hydrocephalus (MAH) cases.
MATERIAL-METHODS:A retrospective analysis was performed on 455 pediatric MAH cases that had been treated with ETV. This case series consisted of patients who were initially treated with ETV and also those who were treated with ETV for the management of cerebrospinal fluid shunt dysfunction. Variations and anomalies of the third ventricle floor were determined by reviewing the video records of the ETV procedures.
RESULTS:The analysis of the data revealed that the rate of the MAH cases with variations and abnormalities of the third ventricle floor was 41.1%. The most common anatomical features were “thick and prominent massa intermedia” (37.1%) and “narrow tubercinereum” (33.1%). (Figure 1).

CONCLUSION: This study documents the most common anatomical variations and abnormalities of the third ventricle floor in cases with MAH. Various anatomical situations and specific ventricular configuration of MAH cases may add an operative factor of difficulty which should be well recognized by the neurosurgeon who plans and executes an ETV procedure in this patient population.

Keywords: Endoscopic third ventriculostomy, Hydrocephalus, Myelomeningocele

FL-067

Changes of Third Ventricle Diameter (TVD) mirror changes of the entire ventricular system in pediatric hydrocephalus

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OBJECTIVE:Regular measurement of ventricular size is important in children with hydrocephalus. After closure of the fontanelle this is currently addressed by repetitive cranial MRI or CT imaging, coming along with risks of anaesthesia or radiation. As the third ventricle is accessible via the temporal bone window using ultrasound, determination of its diameter might be an easy and radiation-free alternative to assess the ventricular system. An essential precondition is that changes of the third ventricle diameter (TVD) mirror changes of the whole ventricular system. This study compares changes of TVD with changes of ventricular indices before and after initial treatment of hydrocephalus, at acute shuntfailure and after shuntrevision and during the following evolution.
MATERIAL-METHODS:MRT/CT images from 117 children with hydrocephalus were evaluated at time of diagnosis, after initial therapy, at acute shunt-failure and after shunt-revision as well as during follow-up with functional shunts. Measurements included axial TVD and three standard linear measures of the lateral ventricles (Evans Index - EI, fronto-occipital horn ratio - FOHR Index, and Cella Media Index - CMI). Furthermore, a correlation within subjects was calculated in 8 patients over the entire available follow-up.RESULTS:The best linear correlation was found between TVD and CMI after initial therapy (r=0.7), at acute shunt-dysfunction (r=0.702) and after shunt-revision (r=0.566). After shunt-revision the decrease of TVD correlated well to the decrease of Evans (r= 0.609) and FOHR (r=0.74), $p<0.01$. Inter-individual correlations were outstanding for EI (r=0.988), FOHR (r=0.99) and CMI (r=0.99).
CONCLUSION:TVD showed a significant correlation with all three linear indices after initial therapy, at acute shunt-dysfunction, after shunt-revision and during long-term follow-up. TVD and its changes are therefore a reliable surrogate of changes in ventricular size in pediatric hydrocephalus undergoing treatment.

Keywords: Third ventricular diameter, TVD, pediatric hydrocephalus

FL-068

CSF shunt failure due to ventricular catheter migration in very young infants – do surgical nuances have an impact?

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OBJECTIVE:To assess the incidence and potential contributing surgical nuances for ventricular catheter migration as a cause of shunt failure in very young infants.
MATERIAL-METHODS:We retrospectively analysed a series of 146 children who received a CSF shunt under the age of 12-months ($\bar{x}$ = 85,5 ± 79,7 days) over a frontal trajectory between May 2002 and December 2017. The effect of age, etiology of hydrocephalus, number of prior temporary CSF diversion, ventricular catheter (VC) type, VC insertion technique, surgeon´s experience and operating time on VC migration was evaluated with univariate and multivariate regression analysis ($p < 0.05$). Kaplan-Meier curves were used to estimate the time to first shunt failure.
RESULTS:Ventricular catheter migration causing shunt dysfunction was observed in 36 cases (24,7%; $\bar{x}$=51,7 ± 43,2). Mean duration from shunt placement to first-time shunt revision showed a significant difference ($p < 0.001$) between the VC migrated (670 ± 878 days) and VC non-migrated group (592 ± 1090 days). Univariate and multivariate regression analysis showed a positive effect of age ($p < 0.006$) on the incidence of VC migration with an odds ratio of 1.01. Furthermore, transfontanel insertion showed a lower risk ($p < 0.023$) for VC migration compared to the insertion via a burr hole (odds ratio 0.4). Etiology of hydrocephalus, number of prior temporary CSF diversion, VC type, surgeon´s experience and operating time had no influence on the incidence of VC migration.
CONCLUSION:Ventricular catheter migration causing shunt dysfunction was less seen in transfontanelly then in transosseously inserted catheters. The risk for ventricular catheter migration decreased with age.

Keywords: ventricular catheter migration, pediatric hydrocephalus, shunt failure, CSF shunts, shunt entry site

FL-069

Posthaemorrhagic Ventricular Dilatation in Preterm Infants: A Survey of Management Practices in the UK

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OBJECTIVE:Posthaemorrhagic ventricular dilatation (PHVD) remains a serious complication of intraventricular haemorrhage in preterm infants and is associated with long-term neurological morbidity. Despite this, there currently exists neither a consensus on the optimal timing or mode of intervention in PHVD, and as such, management strategies vary considerably between centres and occasionally between clinicians at the same centre. The aim of this survey was to establish current practice across the UK.
MATERIAL-METHODS:An electronic questionnaire was developed and pilot-tested using the online platform SurveyMonkey (www.surveymonkey.com). Questions in the survey were designed to explore the current management of PHVD including neurosurgical referral criteria, diagnostic and imaging protocols, timing of intervention and related thresholds, preferred temporising and definitive treatment techniques and associated protocols, neurodevelopmental follow-up and the degree of variation between clinicians at the same centre. The survey will be distributed electronically to all neonatal units in the UK via the National Neonatal Audit Programme (NNAP), as well as to members of the British Association of Perinatal Medicine (BAPM).

RESULTS:The survey responses will be collated and analysed, and results presented.
CONCLUSION:The ideal timing and mode of intervention in PHVD has yet to be elucidated, probably due to the relative rarity of the condition and a lack of definitive evidence establishing the superiority of one management strategy over another. Presently there are a number of trials/registries looking at endoscopic lavage and other studies advocating more aggressive management of PHVD (1). A detailed description of the current range of management practices across the UK may be useful in providing a baseline for future prospective work and the standardisation of outcome measures prior to embarking on other treatment protocols.1. Leijser LM, Miller SP, van Wezel-Meijler G, Brouwer AJ, Traubici J, van Haastert IC, et al. Posthemorrhagic ventricular dilatation in preterm infants: When best to intervene? Neurology. 2018;90(8):e698-e706.

Keywords: hydrocephalus, intraventricular haemorrhage, ventriculomegaly, preterm

FL-070

Subgaleal Shunting for Post Hemorrhagic Hydrocephalus: A Series of 22 Cases

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OBJECTIVE:Posthemorrhagic hydrocephalus comprises the most common complication in those premature neonates whose suffered germinative matrix hemorrhage, and its treatment is still matter of controversies. These infants usually weight less than 1500g and a temporary CSF diversion device is needed. This paper depicts the initial 22 cases of ventriculosubgaleal shunting (VSGS) in prematures who suffered grades III and IV periventricular hemorrhage and hipertensive hydrocephalus.
MATERIAL-METHODS:We analyzed a series of 22 preterm infants who underwent VSGS for posthemorrhagic hydrocephalus between July 2015 and January 2019. The median gestation age was 28 weeks (range 24-32). The median weight was 890 grams (range 625-1615). The mean span of time harboring de VSGS was 59,3 days (range 39-78).
RESULTS:The cases were studied for: 1) revision of the system: 4/22 subjects (19%) had 2 system revisions each due to obstruction; 2) shunt related complications: 6/22 infants (28,5%) had positive CSF culture and the VSG converted to EVD and further VP shunt. (2 of these showed previous CSF fistula through the wound); 4) convertion to VP shunt: 11/22 children (50%) showed persistent hydrocephalus at further investigation, and underwent to VP shunt after stable clinical condition and weight higher than 2000g. One death occurred in a very low birth weight (24 weeks gestation) subject, who developed severe thrombocytopenia and pulmonary hemorrhage.
CONCLUSION: Since the VSGS in this study show low rates of infection (28,5%), one must point out that it could be an excellent tool to decrease intracranial pressure meanwhile these infants are too small for definitive treatments. Furthermore the Vp shunt conversion rate (50%) is similar to another devices as Omaya Reservoir and EVD technique with lower handling of the system. Thus, VSGS is a good alternative method to treat posthemorrhagic hydrocephalus in preterm infant whose need a temporary shunt device.

Keywords: post-hemorrhagic hydrocephalus, subgaleal shunting, premature birth

FL-071

Changes in intracranial pressure in neonatal hydrocephalus as measured by diffuse correlation spectroscopy

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OBJECTIVE:In current practice, suboptimal surrogate measurements of intracranial pressure (ICP) and clinician judgment dictate timing of surgical intervention for neonatal hydrocephalus. With no direct measurements of ICP, patient management remains variable, and interventions have uncertain benefit. Diffuse correlation spectroscopy (DCS) has emerged as a promising technique for assessing cerebral blood flow (CBF), which can be used to estimate ICP. We sought to validate DCS-derived ICP with invasive ICP measurements.
MATERIAL-METHODS:We designed a prospective observational study of neonates with hydrocephalus who were undergoing CSF diversion. DCS measurements were obtained preoperatively, after induction, and postoperatively. Non-invasive ICP was calculated by combining blood pressure with DCS measurements of pulsatile arteriole CBF. Invasive ICP was obtained with a manometer during shunt placement. Pearson correlation, Bland-Altman analysis, univariate linear regression, and Student's t-test were used to compare ICP measurements calculated from DCS to those obtained directly.
RESULTS:We report results on 10 neonates (average age: 34 weeks, 1 day) with hydrocephalus associated with myelomeningocele (n=6), post-hemorrhagic hydrocephalus (n=3), and other (n=1). A strong correlation (r=0.663) was observed between preoperative non-invasive ICP and invasive ICP, and a very strong correlation (r=0.976) was seen between intraoperative non-invasive ICP and invasive ICP. The average time from the preoperative non-invasive ICP to invasive ICP was 13 days (range 2-53 days). The Bland-Altman plot (Figure) indicates good agreement (mean difference, 0.186; limits of agreement, -2.837-3.208) between intraoperative non-invasive ICP and invasive ICP (n=7). Univariate linear regression demonstrated preoperative non-invasive ICP was significantly associated with invasive ICP (p=0.037).
CONCLUSION:This data supports DCS as an accurate and noninvasive bedside tool for measuring ICP in neonates with hydrocephalus. Future work will utilize DCS to define optimal timing of intervention to improve neurodevelopmental outcomes and define the natural history of ICP changes.

Keywords: hydrocephalus, non-invasive, intracranial pressure, diffuse correlation spectroscopy

FL-072

Extraventricular Non-communicating Hydrocephalus in Children and Infants: Diagnosis and Surgical Treatment of a Rare Entity

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OBJECTIVE:Patients with non-communicating hydrocephalus due to aqueductal stenosis are most often successfully treated with endoscopic third ventriculocisternostomy (ETV). Other locations of obstruction of the major CSF pathways may also be good candidates for endoscopic treatment options. We investigated our cohort of patients treated by ETV with patent ventricular outflow but pressure gradient signs at the third ventricle in a single-center retrospective study.
MATERIAL-METHODS:We retrospectively reviewed records and imaging studies of 137patients who underwent an ETV in our department from June2010 to March2018. We included all patients without any history of CSF infection or haemorrhage and who showed the following findings in MRI: 1st: open Sylvian Aqueduct, 2nd: open outlets of the 4thventricle, 3rd: open spinal canal, 4th: intra-/extraventricular pressure gradient seen at the 3rdventricle. Perioperative clinical state and possible complications or reoperations were recorded. Shunt dependency and changes in ventricular dilatation (FOHR) were used to judge about ETV success.
RESULTS:A total of 21 infants met the radiological inclusion criteria. During the mean follow-up time of 40.7±30 months (range; 5-102 months), two infants had to undergo a re-ETV, and six infants (all <1year of age) received a VP-shunt. ETV revision free survival was 100% for children >1 year of age. The mean FOHR at the time before ETV was 0.55±0.09 (range0.40-0.69; n =21) and after ETV 0.50±0.08 (range0.42-0.69; n=19). FOHR was significantly reduced at the end of follow-up 0.47±0.05 (range0.41-0.55; n=13; p=0.032)0
CONCLUSION:We conclude that ETV is a successful treatment option when an intra-/ extraventricular pressure gradient is visible at the third ventricle despite the fact of patent aqueduct and fourth ventricular outlets in children older than one year of age. It is assumed that arachnoid malformation is causing an extra-ventricular intracisternal non-communicating type of hydrocephalus, which was visible as a membrane in the pre-pontine cistern in 8/21 patients.

Keywords: extraventricular non-communicating hydrocephalus, intra-/ extraventricular pressure gradient, pre-pontine cistern, arachnoid malformation, ETV

FL-073

Ventriculoatrial and ventriculopleural shunts have equivalent revision, infection, and survival rates in pediatric hydrocephalus patients

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OBJECTIVE:Ventriculoperitoneal shunts remain the preferred option for CSF diversion. Unfortunately, peritoneal drainage is not always possible in a small proportion of children who need a shunt. The purpose of this study was to directly compare outcomes and complications of ventriculoatrial (VA) and ventriculopleural (VPL) shunts in children requiring CSF diversion.MATERIAL-METHODS:Retrospective analysis of all children who underwent VA or VPL shunts in our centre between January 2002 and December 2017.
RESULTS:In total, 54 patients had a VA (36 (67%)) or VPL (18 (33%)) shunt inserted during this period. Mean follow-up time was 4.1 years, 2.8 years for VPL and 4.7 years for the VA group (p=0.111). A total of 24 (66.7%) patients with VA shunts and 9 (50.0%) patients with VPL shunts underwent revision (p=0.236). Mean number of revisions was 2.2 in the VA group and 0.94 in the VPL group (p=0.079). Mean shunt survival time was 22.7 and 16.6 months for VA and VPL shunts respectively.Infection rate was 15.6% and 5.6% in the VA and VPL groups respectively (p=0.358). Four patients (22.2%) developed pleural effusions following VPL shunt placement. A total of 14 deaths (25.9%) were recorded in this cohort during follow-up, of which 8 (22.2%) were in the VA group and 6 (33.3%) in the VPL group (p=0.380). Two of the deaths in the VA group were shunt-related.
CONCLUSION:Our direct comparison suggests that there is no significant difference in outcome, complications and need for further procedures between VA and VPL shunts. Larger series with longer follow up periods are required to confirm these findings.

Keywords: Hydrocephalus, ventriculoatrial shunt, ventriculopleural shunt, comparison, pediatric, complications

FL-074

Management of paediatric hydrocephalous with Miethke fixed pressure valves. The Alder Hey Children's Hospital experience

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OBJECTIVE:The management of paediatric hydrocephalous remains challenging with the complication and revision rates being consistent in the literature. We hypothesise that the use of a fixed pressure valve for all de novo shunt insertions decreases the rate of functional revisions.
MATERIAL-METHODS:Retrospective data collection, in a single centre, from February 2010 and August 2018. All patients with de novo fixed pressure Miethke valve insertion were included. We collected data on patients' demographics, reason for shunt insertion, type of valve and time and reason to first revision. Data analysis was done with SPSS.
RESULTS:235 patients were included in our study, 124 male, 111, female, aged from 0-18.6y (mean 2.3y). 99 shunt revisions were documented, 30 of which secondary to ventricular catheter malfunction and 28 secondary to infection. The overall valve survival rates were 88.5%, 86.4% and 85.5% at one, two and five years respectively. Shunt revision due to overdrainage was documented in only 3 cases (0.08%).
CONCLUSION:Our results are in agreement with existing literature regarding shunt failures secondary to all extrinsic to the valve factors (infection and mechanical failure). We have shown that the use of a Miethke fixed pressure valve for all de novo shunt insertions decreases the need for functional revisions with valve survival rates being superior to the ones described for other types of valves.

Keywords: hydrocephalous, slit ventricle syndrome, overdrainage, fixed pressure valves, miethke

FL-075

Experience with the use of antisiphon devices for symptomatic VP shunt overdrainage – a single institution series

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OBJECTIVE:Children with hydrocephalus treated with VP shunting (VPS) can present with overdrainage symptoms in later childhood.

Antisiphon devices (ASD) have been advocated as treatment for these symptoms. We review our institutional experience of VPS revision to include ASD with overdrainage as the indication.
MATERIAL-METHODS:Departmental operative database was searched for children who received revision of a non-gravitational VPS to include a ASD from 2009-2018. Clinical, radiological and outcome data was retrieved from the electronic patient record.
RESULTS:33 patients were identified; 12 male and 21 female. Mean age of the patients at ASD insertion was 10 years (range 1-17). The most common hydrocephalus aetiology was pre-term IVH (16 patients). Mean age at index VPS insertion was 1.5 years (range 5 days-10 years). Mean latency between index VPS insertion and ASD insertion was 8 years (range 2 months to 17 years). Clinical presentation of overdrainage triggering ASD insertion included headaches (25), vomiting (9) and fatigue (7). 16 patients underwent invasive ICP monitoring before ASD insertion. 16 patients received programmable ASDs, the other patients had fixed devices. 20 patients had undergone at least 1 VPS revision prior to ASD insertion, with a mean 4 revisions per patient (range 1-18) in that group. Following ASD insertion, 15 patients required at least 1 further shunt revision, of which the mean number was 2 (range 1-4). 1 patient required removal of ASD due to underdrainage symptoms after insertion. 30 patients showed initial improvement, defined as resolution or significant improvement of symptoms at 6-month follow-up, and 16 of those 30 showed sustained improvement (> 2 years). 10 patients with programmable ASD required pressure adjustments.
CONCLUSION:ASD is effective for treating overdrainage symptoms initially, but a significant proportion of children may continue to have symptoms and require further shunt surgeries or pressure adjustments.

Keywords: hydrocephalus, siphoning, ventriculoperitoneal shunt, overdrainage, slit ventricle syndrome, antisiphon device

FL-076

Parametric ventricular catheters for hydrocephalus: preliminary clinical results

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OBJECTIVE:Previously, we studied ventricular catheter flow under steady and pulsatile boundary conditions by computational fluid dynamics (CFD) in three dimensional paradigms. We disclosed the flow pattern of the cerebrospinal liquid within the catheter is probably the most important factor related the obstruction of ventricular catheters, which is still the most common hindrance occurred during the treatment of hydrocephalus. Subsequently, out of several designs with improved flow patterns, we present one Parametric catheter behaviour in this prospective, multicentre, randomized, comparative study.
MATERIAL-METHODS:For the prototype catheters, the parameters chosen were the number and diameter of the holes, the number of drainage segments, the distances between them, as well as their relative angular position. Standard silicone was utilised to developed one catheter solution out of several models with same flow homogenous characteristics. This, was later inserted in adult and pediatric patients with all types of hydrocephalus (n=40). Simultaneously, regular catheters were inserted in other 43 patients with hydrocephalus. Catheter positioning was standardised according to the Thomale classification.
RESULTS:All ventricular catheters had a Grade I or Ib positioning. All distal catheters were peritoneal. Programmable valves and antisiphon devices were utilized in 90 and 30% of the cases respectively. No initial case of Parametric ventricular catheter obstruction was disclosed during a mean follow-up period of 12 months by the time of this writing. In out of the 43 randomized cases there were four catheters obstruction, all pediatric cases, during the same follow up. Shunt infection occurred in two cases in the standard group, while there was a recurrent case of ventriculitis in the Parametric cohort.
CONCLUSION:This prototype model representing the next generation of parametric catheters demonstrated to be safe for insertion in cases of hydrocephalus. While it is too early for withdraw relevant clinical results, preliminary data disclose a possible broadening of their lifespan.

Keywords: Ventricular catheter, parametric designs, extended lifetime, hydrocephalus, CSF flow

FL-077

PTEN mutations in congenital hydrocephalus and autism implicate neural stem cells in disease pathogenesis

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OBJECTIVE:One quarter of individuals diagnosed with congenital hydrocephalus (CH) are also diagnosed with autism spectrum disorder (ASD); however, a common mechanism underlying these seemingly disparate disorders is unknown. We hypothesize that rare, damaging mutations in genes cause a pleiotropic effect responsible for the development of both CH and ASD.
MATERIAL-METHODS:We sequenced the exomes of 216 sporadic CH patients and their unaffected parents (trios) to identify rare de novo mutations (DNMs). We selected 42 of the sporadic CH DNMs in genes with the greatest probability of loss of function (pLI >.9), to determine whether there was an enrichment of ASD genes (pLI >.9) found in denovo-do, a national database of ASD DNMs.RESULTS:A 2X2 contingency table revealed a 2.18-fold enrichment of ASD genes in sporadic CH genes (p-value =. 011). Gene Ontology analysis showed TORC1 signaling (GO: 0038202) to be a significantly enriched pathway (p-value =.0001463). We recapitulated fatal, CH in a mice via conditional knockout (cKO) of PTEN in a distinct subset of neural stem cells previously associated with an ASD phenotype in mice. We rescued the fatal CH phenotype in mice via drug inhibition of TORC1 signaling using FDA-approved rapamycin.
CONCLUSION:PTEN mutations have previously been found in individuals diagnosed with ASD and Macrocephaly. PTEN is a direct negative regulator of TORC1 signaling. Here we present a PTEN cKO mouse model that recapitulates CH and ASD phenotypes. We propose PTEN loss-of-function mutations as a genetic subtype of patients diagnosed with both CH and ASD. These findings suggest that early ASD service

interventions may benefit a subset of CH patients who would otherwise be managed solely with surgery. Further, our pre-clinical, proof-of-principle treatment paradigm of CH may prove to be an efficacious non-surgical treatment option of human PTEN-associated CH.

Keywords: hydrocephalus, autism, PTEN, mTOR, rapamycin

FL-078

Improvement in Ventriculomegaly Following Cervicomedullary Decompressive Surgery in Children with Achondroplasia and Foramen Magnum Stenosis

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OBJECTIVE:There has been contradictory evidence as to whether foramen magnum decompression can improve hydrocephalus in children with achondroplasia who present with concordant foramen magnum stenosis. In the current study the authors reviewed their records to determine if there is stabilization or improvement in ventriculomegaly following foramen magnum decompression performed for cervicomedullary stenosis.
MATERIAL-METHODS:The authors retrospectively reviewed 15 patients with achondroplasia who presented to the neurosurgical service at Cedars-Sinai medical center with symptomatic foramen magnum stenosis and signs of progressive ventriculomegaly. These children underwent cervicomedullary decompression between the years 2000 and 2017. Clinical outcomes included changes in fontanel characteristics, head circumference (HC) percentile, and incidence of ventriculoperitoneal shunting. Radiographic outcomes included changes in Evans ratio.
RESULTS:Fifteen children were identified to have symptomatic foramen magnum stenosis and full anterior fontanelle or increasing HC percentiles on achondroplasia growth curves at presentation. Two of these children underwent placement of a shunt for progressive ventriculomegaly prior to foramen magnum decompression. Of the remaining 13 children with full anterior fontanelles, 12 (92%) showed softening and/or flattening of their fontanelles. Nine of these 13 children had both pre- and post-operative HC percentile recordings available, with 7 showing increasing HC percentiles before surgery. Six of those children (86%) showed a decrease or stabilization in their percentiles following surgery. Not all children had both pre- and post-operative brain imaging available. When comparing ventricular size in the seven that did, 43% improved, 14% stabilized and 43% increased in Evans ratio after decompression. Two children (15%) required a shunt after decompression of the foramen magnum.
CONCLUSION:A significant proportion of children with concomitant signs of progressive ventriculomegaly and foramen magnum stenosis may have improvement or stabilization in their signs following cervicomedullary decompression. During close follow-up of these patients, including the two children that required a ventriculoperitoneal shunt, none developed a fixed deficit.

Keywords: Achondroplasia, ventriculomegaly, hydrocephalus, cervicomedullary decompression, foramen magnum stenosis

FL-152

Treatment of Hydrocephalus in the First Year of Life Through Endoscopic Coagulation of Choroid Plexus. - 27 cases

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OBJECTIVE:The author presents a prospective study comparing the results of treatment of hydrocephalus in infants through the neuroendoscopic approach, with and without coagulation of the choroid plexus.
MATERIAL-METHODS:A prospective study was conducted in 43 patients with hydrocephalus who underwent a neuroendoscopic approach in the period of January / 2015 and July / 2018. Patients were aged between 2 and 11 months, and in 42 cases hydrocephalus was associated with aqueduct stenosis and in 1 patient there was closure of the foramen of Monro. In 17 patients, only the third-ventricle endoscopic cisternostomy was performed. In 25 cases the ETV and coagulation of the choroid plexus were performed. In one case, septostomy and coagulation of the choroid plexus were performed. The period of observation ranged from 6 months to 4 years and 6 months, and we considered satisfactory results in all cases that did not require any new intervention.
RESULTS:As a result, comparing a group of 17 ETV patients with another 26 ETV + CPC patients, we observed a better outcome in the second group. In the group submitted to ETV only 8 patients (47%) required some other type of intervention such as external ventricular drainage, ventriculo-peritoneal shunt or new endoscopic approach. In the group submitted to ETV + CPC 10 infants (37%) required additional interventions. Infectious complications were observed in 15 (83%) of the 18 patients that ETV and ETV + CPC failed as the first treatment.
CONCLUSION:The association of ETV + CPC was shown to be more effective than ETV alone. Infectious complications in both groups significantly compromised the results. The indication of ETV + CPC may be a good alternative in infants, as definitive treatment or delaying the implants of shunts. More investigation is need to long term neuronal functions consequence of extensive coagulation of the choroid plexus.

Keywords: hydrocephalus, infants, neuroendoscopy, third-ventriculostomy, coagulation of the choroid plexus

Session on Antenatal diagnosis and treatment

Hall A, Wednesday, 23rd October 2019, 08:00 - 10:15

FL-079

Prenatal myelomeningocele (MMC) treatment: fibrinolysis efficacy on long term follow-up. In vitro 3D model analysis

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OBJECTIVE:Though prenatal surgery has demonstrated its efficacy in reducing the incidence of hydrocephalus and Chiari II malformation in children affected by myelomeningocele, there are actually no data on the way to reduce the incidence of secondary tethering, which is a complication with a higher incidence after in utero compared with neonatal surgical treatment. The aim of the present study has been the development of an in vitro 3D model to test cell to cell and cell to CSF interaction as well as the role of the administration of a fibrinolytic agent (N-acetyl-cysteine: NAC) to reduce the fibrotic reaction at the surgical site.
MATERIAL-METHODS:A 3D Co-colture system composed by neurons coming from IPS-derived neural stem cells and meningeal

cells coming from mesenchymal stromal ones has been created to reproduce an in vitro MMC model. Cells were divided by an alginate compound serving as CSF. A lipopolysaccharide (LPS) solution was added to act as an inflammatory stimulus and its effect was analyzed with cytofluorimetry and electron microscopy. Afterwards, a fibrinolytic agent (NAC) was delivered to analyze its effect on the aberrant scarring formation.
RESULTS:Preliminary observations documented the validity of the model; inflammatory reaction showed the tendency to be substantially reduced by the local administration of NAC.
CONCLUSION:The confirm of these results on a larger series of experimental trials will hopefully represent the base for the start of a preclinical trial.

Keywords: Prenatal surgery, myelomeningocele, tethered cord, neurological deficit

FL-080

Complications related to the prenatal repair of fetal myelomeningocele

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OBJECTIVE:After the Management of Myelomeningocele Study (MOMS) trial showed that in utero myelomeningocele (MMC) repair can be safely done and results in significant benefit to the child, there has been an increasing interest in the procedure. However, this invasive fetal surgery is associated with significant morbidities to mother and baby. Therefore, our aim is to analyse the obstetric, neurosurgical and institutional complications related to the prenatal MMC repair in our service.
MATERIAL-METHODS:We analysed 35 procedures performed at the Hospital das Clínicas of the University of São Paulo for prenatal repair of MMC from 2015 to 2018. Surgery was done between 21 and 26 weeks of gestation. All fetuses presented sonographic signs of Chiari type II. The level of the lesion varied from T12 to S1, with the major one extending from T12 to L5. Complications related to the procedures were analysed.
RESULTS:Obstetric complications included: 2 bleeding at hysterotomy, 2 fetal bradycardia (with 1 fetal death), 4 operative wound dehiscences, 3 uterine atony, 3 chorioamnionitis, 1 acute maternal pulmonary edema, 1 maternal bowel loop lesion, 13 preterm premature rupture of membranes, 5 preterm labor (birth below 30 weeks of gestation). The neurosurgical complications were: 5 placode contusion, 9 cases of difficulty for skin closure, 7 (21%) ventriculoperitoneal shunt (VPS) with one case of postoperative ventriculitis, 1 postnatal bulging at the repair site, 1 postnatal symptomatic Chiari type II. The institutional complications, were: 3 births of procedures performed in other services.
CONCLUSION:The major complications in our service were obstetric, including four severe related to the mother and one fetal death. Prenatal MMC repair decreases the need of ventricular shunt, however it presents obstetric, neurosurgical and institutional complications that must be exposed to the pregnant woman and further discussed. Additional surgical innovations and multidisciplinary approach are likely to optimize maternal and neonatal outcomes.

Keywords: neural tube defects, prenatal repair, myelomeningocele, fetal surgery, obstetric complications

FL-081

The first 11 Open Fetal Surgery Myelomeningocele (MMC) Repairs in Germany

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OBJECTIVE:Open fetal surgery (OFS) for myelomeningocele repair has made significant progress. The MOMS study, published in 2011, showed the benefit of prenatal versus postnatal MMC repair. Since 2016 an interdisciplinary team of the university hospital Heidelberg with initial support from the colleagues of St. Louis established the open prenatal MMC surgery in Germany. Our experiences are presented and discussed.
MATERIAL-METHODS:We performed a prospective analysis of 11 fetuses with OFS at our institution between 2016 and 2019. Sacral lesions were excluded. The surgical technique was similar described in the MOMS study. All pregnant women received a fetal MRI preoperatively.
RESULTS:Fetal surgery was performed between the 24th and 25th week of gestation (GA). The maternal age ranged from 20-33 years. The lesion level was 5xL4/5, 4xL3/4,2xL5/S1. The repair was successful in 10 cases without CSF leakage and reversible hindbrain herniation (case 11 was operated 3 weeks ago). No fetal or maternal death. Average time of delivery was 34+6 GA, 2 preterm <31GA; average birth weight 2349g. Maternal complications: 2 x uterine dehiscence and 1 oligohydramnios. 2 children needed a ventricular-peritoneal shunt. Improvement of motor function was seen in 8 patients. The follow up ranged between 2,7years and 5 month.
CONCLUSION:The open fetal repair of MMC could not cure the defect and is neither free of risks nor complications but offers the unborn child a better quality of life. But this has to be taken into consideration in relation to the maternal risks. The pediatric community should collaborate and collect all the data in a common register to develop treatment standards to improve the outcomes.

Keywords: open prenatal surgery, myelomeningocele, hindbrain herniation

FL-082

The MOMS Trial - how convinced are you? An International Survey

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OBJECTIVE:The landmark paper 'A randomised trial of prenatal versus postnatal repair of myelomeningocele' (MOMS Trial) was published in 2011 (Azdick NS et al.). The findings of this trial MOMS trial bas been the main impetus for expansion of fetal surgery for myelomeningocoele internationally. The aim of this survey is to ascertain the acceptance or otherwise of the interpretations of MOMS study to support prenatal surgery for myelomeningocoele, amongst neurosurgeon world-wide.
MATERIAL-METHODS:A questionnaire relating MOMS trial was created on Google Form. A link to this survey was sent through the Neurosurgery Research Listserv and the Ped-ML Listserv of the joint section of the AANS/CNS. The responses were collected through Google Form. The survey was opened on the 3 March 2019 and closed on the 9 March 2019. The data was analysed through Google form as well using MS Excel and Stata 13.
RESULTS:There were 48 responses from 20 countries. 85%t of those responded were paediatric neurosurgeons. Others were general surgeons

or spinals surgeons. 79% were senior neurosurgeons. 21% of those responded had a fetal surgery programme for myelomeningocoele in their departments. 52% of those responded were not convinced that the findings of the MOMS trial supported prenatal surgery for myelomeningocoele; whereas, 48% were convinced. There was no statistically significant difference (Chi-squared test, Fisher exact test) views on MOMS trial between senior neurosurgeons vs junior neurosurgeons, Paediatric Neurosurgeons vs general/spinal neurosurgeons or those who had prenatal surgery programme for myelomeningocoele in their department vs those who did not.
CONCLUSION:The interpretation of MOMS trial remains controversial. Longer follow-up from MOMS trail cohort or an up to date trial or registry would be needed to decide on the benefits of prenatal surgery for myelomeningocoele.Adzick S et al. NEJM 2011; 364:993-1004

Keywords: Myelomeningocoele, prenatal surgery, fetal surgery, MOMS trial

Early Riser Session

Hall B, Wednesday, 23rd October 2019, 07:00 - 08:00

FL-083

New paradigms in the diagnosis and treatment of Dysembryoplastic Neuroepithelial Tumors

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OBJECTIVE:Dysembryoplastic neuroepithelial tumors (DNTs) have been considered benign and stable lesions. Nevertheless, in the last couples of years there have been some reports about atypical evolution.The aim of the current study was to analyze the clinical, imaging, surgical and anatomopathological findings of a group of patients with an initial diagnosis of DNT and identifying characteristics that may predict an atypical evolution.
MATERIAL-METHODS:We retrospectively analyzed the clinical reports of 65 patients with diagnosis of DNT from 1985 to 2017. We evaluated images, surgery, anatomopathological and clinical findings emphasizing on tumor recurrence, and the relationships with the imaging and clinical findings.
RESULTS:The gender distribution showed a slight male predominance 1; 1.7. The initial symptom was complex partial seizure 51%, followed by generalized seizures 28%. Gross total resection was performed only in 42% (27/65) of the patients while the other 58% (38/65) had partial resections. 46% (30/65) of the patients had tumor recurrence throughout the follow-up. All of them have had partial excision. The average time of recurrence was 4.5 years (6 months to 13 years).The post-surgical images show atypical findings like enhanced contrast, mass effect, and infiltration of adjacent structures in 48% (31/34) of the cases. The presence of atypical images was a risk factor for tumor recurrence at long-term follow-up (p<= 0,001).The follow-up was 9.2 years (+/- 6.9 SD). 85% of patients are without seizures, and 55% (36/65) of these are out of medication.
CONCLUSION:Despite the benign behavior in most DNTs, some patients may have a recurrence. It is essential to carry out an exhaustive analysis of the pre and post-surgical images in order to identify characteristics that allow us to predict unusual behavior.Gross-total resection has proved to be an important prognostic factor.The follow-up must be strict because recurrences have been noticed after prolonged disease-free periods.

Keywords: Pediatrics - Central Nervous System Neoplasms - Neoplasms, Neuroepithelial - Epilepsy - Neoplasm Recurrence, Local

FL-084

Satellite lesions of DNET: implications for seizure and tumor control after resection

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OBJECTIVE:Dysembryoplastic neuroepithelial tumors (DNETs) are a common cause of chronic drug-resistant epilepsy and are known for their favorable surgical outcomes. Nevertheless, the seizure recurrence-free rate is not as favorable if tumorous nodules are present near the main mass. We call these small tumorous nodules in the vicinity of the main mass satellite lesions (SLs). We analyzed tumor and seizure control in the presence and following the subsequent removal of SLs.
MATERIAL-METHODS:We retrospectively reviewed the medical records, radiological data, and surgical procedures to obtain the outcomes of children who underwent resection surgery for DNET. The analyses were designed to address the associations among the demographic, tumor and seizure-related variables. A Cox proportional hazard model was used for the univariate and multivariate analyses.
RESULTS:In total, 39 consecutive patients were included (26 males and 13 females). SLs were found in 22 patients (56%). The year-to-year analysis of patients with Engel class I was approximately 80% during the follow-up period. However, the actual seizure recurrence-free survival (RFS) rate was 82%, 73% and 70% at the first, second and fifth year, respectively. The patients who initially presented with SLs had 46% seizure recurrence rates, while those without SL had 18% seizure recurrence rates.
CONCLUSION:As the seizure-RFS rate significantly declines over time, a more accurate seizure-free rate analysis using survival curves could be important for determining the outcome of DNET surgery. A thorough review identifying satellite lesions preoperatively and using intraoperative neuronavigation, electrocorticography (ECoG) or intraoperative ultrasonography is warranted to accomplish the wide resection of tumors with accompanying satellite lesions.

Keywords: Dysembryoplastic neuroepithelial tumor, epilepsy, epilepsy-associated tumor, focal cortical dysplasia, recurrence

FL-085

Long-term follow up of ganglioglioma in pediatric patients

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OBJECTIVE:Ganglioglioma is a rare, generally benign pediatric brain tumor that typically causes refractory seizures. Optimal management and long-term outcome remain unclear. The aim of the study was to investigate the seizure control and long-term outcome after resection of gangliogliomas in pediatric patients.
MATERIAL-METHODS:We retrospectively reviewed all patients diagnosed with a ganglioglioma at our department who presented 2006 through 2018. Patient demographics, clinical presentation, operative procedure, pathology, and outcome were analyzed.

RESULTS:Of the 38 patients identified, 23 were males (60 %), 15 were females (40%), 34 (89%) presented with seizures at an average age of 7.3 yrs. The most common seizure presentation was partial complex in 19 cases, followed by secondary generalization in 15 cases. The most common tumor location was temporo-mesial (15), followed by parietal (11) and frontal (12) cases. Average duration of follow up was 5.5 yrs. 27 of 34 patients undergoing a gross total excision were seizure free without medication (ILAE Class Ia) compared to 4 of 34 patients with a residual tumor, also seizure free but with medication (p-value 0.01). 3 patients had no follow ups. One patient with early tumor regrowth received radiation therapy. Showing evidence of further dissemination he subsequently received chemotherapy. Repeated resection 4 years after initial diagnosis revealed a malignant transformation with BAF47 negative cells, suggestive of anaplastic ganglioglioma. All patients were alive at last follow up.
CONCLUSION:Pediatric gangliogliomas are rare tumors with an excellent overall prognosis. Gross total excision provides excellent tumor and seizure control. Tumors not amenable to complete excision require continuous surveillance. The need for adjuvant treatment is exceptional and should initiate the differential diagnosis of a malignant transformation.

Keywords: ganglioglioma, neuro-oncology, pediatric neurosurgery

FL-086

Clinical Features of 1248 Tumors of Central Nervous System in Children: Single Institutional Report from Shanghai Xinhua Hospital, the Founding Member of CNOG

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OBJECTIVE:Central nervous system (CNS) tumor is the most common solid neoplasm in children. Here we report clinical features of children with CNS tumor treated in our institute during recent 12 years. METHODS: Retrospective study was conducted in children with CNS tumor treated in Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, during Jan 2006 to Jun 2018. Clinical data were collected. Statistical calculation was conduct for characteristic analyses.
MATERIAL-METHODS:Retrospective study was conducted in children with CNS tumor treated in Xinhua Hospital Affiliated to Shanghai Jiaotong University School of Medicine, during Jan 2006 to Jun 2018. Clinical data were collected. Statistical calculation was conduct for characteristic analyses.
RESULTS:1248 cases of CNS tumor in children were collected, with 779 males and 469 females. Age ranges were 9.87% in infants (< 1 y/o), 26.43% in toddler (1 - 3 y/o), 36.04% in preschool children (3 - 7 y/o), 26.87% in school-age children (7 - 15 y/o) and 0.79% in adolescence (> 15 y/o). 556 cases were diagnosed with WHO I-II grades and 519 cases were with WHO III-IV grades. There were 617 supratentorial tumors and 553 subtentorial tumors. The most common tumor type was medulloblastoma (n=165, 14.54%), followed by pilocytic astrocytoma (n=166, 12.42%).
CONCLUSION:The gender ratios in different age ranges were stable, with high incidence in male than in female. In total, low grade tumors were more common than high grade tumors. Compare to our previous report, pilocytic astrocytoma was second most common tumor, following medulloblastoma.

Keywords: Central Nervous System Tumor, Children, Clinical Features

FL-087

Cross-sectional study of central nervous system tumors in children in China - a report of CNOG multicenter study

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OBJECTIVE:Tumors of Central Nervous System are most seen solid tumor in childhood. Accounting approximate 25-30% of pediatric tumor, treatments on these tumors are very complicated. There is huge gap of medical services for children with CNS tumors in different regions in China, which is blamed to limited clinical knowledge in medical workers and lack of epidemiology data for Chinese population.
MATERIAL-METHODS:After the establishment of CNOG (Children's Neuro-Oncology Group) in China, national wide survey was conducted to collect data on the basic information about pediatric tumors of CNS. The screening forms for CNS tumor cases in children in year 2016 according to 2016 WHO classification, along with quaternaries for information about neurosurgeons conducting pediatric brain tumors were sent to CNOG and Chinese Society of Pediatric Neurosurgery member sites.
RESULTS:Data of 3644 cases of pediatric CNS tumors in year 2016 from 47 centers providing medical services for pediatric CNS tumors in 17 provinces in China showed the similar tumor ratio to would wide data by WHO classification. Medulloblastoma (587 cases, 16.11%) and Astrocytoma (520 cases,14.27%) are most seen tumors in CNS of children. While ratio of germ cell tumor (397 cases, 10.89%) is much higher than that in western countries. Neurosurgeons treating pediatric CNS tumors in China are much less than neurosurgeons for adult, especially in remote areas, with only 292 surgeons in the field (162 attendings and 131 fellows/residents). In backward areas (north-western China), there were less treated children which may not only due to the population composition, but also owing to the limitation of available pediatric neurosurgeons.
CONCLUSION:In all, this national wide survey not only revealed a characteristic tumor patterns of pediatric CNS neoplasms, but also indicated terrible situation of medical service for pediatric CNS tumor in China and which needs attraction from the public and government in the future.

Keywords: Cross-sectional study, multicenter, Chinese pediatric brain tumor, children's neuro-oncology group

FL-088

Effect of Concurrent CDK4/6 inhibitor and Radiotherapy for Pediatric Malignant Brain Tumor Treatment in Patient-derived Xenograft Model

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OBJECTIVE:The therapeutic approaches for many challenging pediatric brain tumors including atypical teratoid/rhabdoid tumors, medulloblastomas, high-grade gliomas and anaplastic ependymomas are still pending development. We explore the feasibility of concurrent chemo-radiation and evaluation of treatment effect and survival in these patient-derived xenograft (PDX) NOD/SCID mice model.

MATERIAL-METHODS:Through microarray analysis of various pediatric malignant brain tumors, the growth and division of tumor cells related cyclin D1 gene (CCND1), cyclin-dependent kinase 4 (CDK4) and cyclin-dependent kinase 6 (CDK6) were significant over-expressed. Overexpression of CCND1 play a role in progression and radio-resistance of pediatric malignant tumors. The therapeutic effect of concurrent CDK4/6 inhibitors, Palbociclib and Abemaciclib and low-dose radiotherapy (6Gy) were evaluated in PDX mice model.
RESULTS:RNA-seq expression of treated tumor cells showed that downstream genes of E2F pathway decreased significantly, while the genes which are related to immunotherapy showed overexpression, such as PDL1, PDL2, and the chemotaxis chemokine, CXCL10 was also overexpressed. Moreover, tumor volumes of concurrent treatment group are smaller than the chemo- or radio-therapy alone and the control group, which result in prolong survival of experimental animals.
CONCLUSION:Our preliminary data demonstrate the feasibility of concurrent CDK4/6 inhibitor and low dose radiation in PDX mice model preclinically. Further combination with immunotherapy and validation in clinical trial are potential therapeutic strategies for these tumors in children.

Keywords: Pediatric Brain Tumors, Cyclin D1, CDK4, CDK6, PDX model

FL-089

Cytomegalovirus DNA in non-glioblastoma multiform infantile brain tumors

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OBJECTIVE:Cytomegalovirus (CMV) is linked with malignancies arising from numerous tissues. This subgroup of herpes-virus family infects 70% - 100% of normal population, with a life-long persistence in myeloid lineage cells and periodic asymptomatic reactivations. CMV antigens are present in the majority of adult glioblastoma multiform (GBM) and 67 % of pediatric GBM samples. The virus expression in pediatric GBM has been associated with poor prognosis. CMV may induce oncomodulatory effects via inhibition of apoptosis and promoting the growth of glioma stem cells. The upcoming landscape of antiviral therapies against CMV is depicted with great promise for halting tumor progression in glioblastoma patients.As infantile brain tumors are among the most aggressive brain neoplasms with poor prognosis, novel therapeutic options like targeted therapy against virus antigens are demanded. In this study, the presence of CMV-DNA (as potential viral targets) in non-GBM infantile brain tumors was investigated.
MATERIAL-METHODS:The paraffin blocks of brain neoplasms of 36 infants (age<24 moths) who were operated on for non-GBM brain tumors between 2006 and 2016 were investigated for CMV-DNA using Real-time PCR method.
RESULTS:: Histopathological diagnoses consist of glial/neuroglial tumors (36.1%), ependymomas (22.2%), medulloblastomas (19.4%), choroid plexus tumors (8.3%), atypical teratoid rhabdoid tumors (5.6%), embryonal tumors (5.6%), and germ cell tumors (2.8%). CMV-DNA was not found in any sample.
CONCLUSION:Although CMV may have roles in progression of GBM, similar roles could not be proposed for non-GBM infantile brain tumors. However, exact conclusion could not be drawn as the sample is small consisting of heterogenous tumors. Further investigations should be conducted to find other potential targets for molecular treatment of these aggressive malignancies.

Keywords: Cytomegalovirus, Glioblastoma multiform, Brain tumor,

FL-091

Perioperative Dexamethasone Dosage in Paediatric Neuro-Oncology

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OBJECTIVE:Dexamethasone is prescribed to control peritumoural oedema in paediatric neuro-oncology patients undergoing neurosurgery. Despite widespread use, there is no consensus over optimum dosage or duration to balance symptom control with toxicity. This study aimed to evaluate the safety and efficacy of an optimised dosing regimen in comparison with variable practice.
MATERIAL-METHODS:A 2010 audit was undertaken to review practice in our institution. This resulted in a recommended regimen of 0.25mg/kg/day starting on admission before weaning post-operatively. This was used in emergency and elective patients undergoing surgery for cranial and spinal tumours at Leeds Children's Hospital. This retrospective cohort study was conducted to evaluate the downstream impact of this regime. Ineffective peritumoural oedema control was defined by the surrogate clinical marker of new onset post-operative neurological deficit requiring a dose increase. Data regarding new onset deficit and dexamethasone-related side effects in this group were compared with patients receiving alternative regimens.
RESULTS:Fifty patients were identified and included in the analysis; 27 received 0.25mg/kg/day of dexamethasone, whilst 23 received an alternative dose as per the responsible consultant's preference (range: 0.05-0.49mg/kg/day). The number of patients with new onset neurological deficit and dexamethasone-related side effects were 1 and 6 respectively, with no significant differences observed between the standardised and alternative dose groups ($p>0.05$). This remained true when the alternative dose cohort was stratified into >0.25mg/kg/day or <0.25mg/kg/day. The majority of patients prescribed 0.25mg/kg/day were weaned off treatment over 3 days post-operatively, starting at day 2. There was no incidence of significant rebound cerebral oedema or adrenal insufficiency.
CONCLUSION:In this series we demonstrate that 0.25mg/kg/day dexamethasone achieves adequate peritumoural oedema control with minimal toxicity, at a lower dose than recommended elsewhere. Our results inform an appropriate treatment length and safe weaning process.

Keywords: Dexamethasone, brain tumour, neuro-oncology, outcome

FL-092

Racial Disparities in Outcomes for Pediatric Spinal Cord Glioma: A National Cancer Database Analysis

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OBJECTIVE:Pediatric spinal cord glioma is a small and relatively uncommon subset of pediatric central nervous system tumour.

Large database analysis is helpful in overcoming the challenges in outcome analysis given small samples at most institutions. This study examines data from the National Cancer Database (NCDB), a surveillance database comprising 34 million records from 1500 accredited US cancer programmes, to examine for outcome trends in pediatric spinal cord glioma.
MATERIAL-METHODS:The Participant User File of the NCDB was queried for patients under the age of 18 years diagnosed with primary spinal cord gliomas between 2004 to 2014. Descriptive statistics were used to define the study population and identify potential predictors of outcome which comprised clinical, demographic, and socioeconomic variables. Survival analysis techniques were used to examine the relationship of predictors to outcome.
RESULTS:342 patients met inclusion criteria. Mean age at diagnosis was 8.5 years. Median follow up was 55 months and there were 62 deaths during the follow up period. Survival was significantly better in low grade glioma patients compared to high grade. Survival in black patients was worse than for white patients, even when stratified for tumour grade. Race was also a significant predictor of survival in multivariate models adjusting for tumour grade and comorbidity; the hazard of death was twice as high in black patients. This racial difference was almost doubled when adjusting for grade, insurance status, income, and educational attainment.
CONCLUSION:Black patients with spinal cord gliomas have worse survival outcomes, even when accounting for clinical and socioeconomic variables. Further detailed study is needed to determine contributing genetic and epigenetic factors so that targeted therapy may be used to improve outcome in this population.

Keywords: spinal cord, tumour, glioma, pediatric, cancer, race

Session on Spinal dysraphisms

Hall A, Wednesday, 23rd October 2019, 10:45 - 13:00

FL-093

Assessing the importance of urodynamic investigation in children with lumbosacral lipoma

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OBJECTIVE:To assess the importance of urodynamic investigations in the management of children with lumbosacral lipoma (LSL) with regard to both their clinical status, and their Health Related Quality of Life (HRQL).
MATERIAL-METHODS:The urological function of 54 children with LSL was assessed using renal ultrasound and standardised Bladder Function Assessment (non invasive and if indicated, invasive studies) The HRQL of the same 54 children with LSL and neurogenic bladder was assessed using standardised assessment tools.
RESULTS:Regular standardised urodynamic assessment are shown to form an essential part of the management of children with LSL in making the crucial functional distinction between a high-pressure bladder (unsafe) and a low pressure one (safe), to maintain healthy renal function and to monitor for deterioration.A reduced HRQL is identified in children with urinary incompetence.
CONCLUSION:Regular Urodymanic assessment identifies the abnormal but stable status of bladder function in children with LSL, verses a deterioration which may herald the presence of tethered cord. Assessing the HRQL of this group of children helps target management strategies to address the issues often associated with a disturbance in sphincter function

Keywords: Lumbosacral lipoma, Urodynamic studies, Health Related Quality of Life

FL-094

Monitoring function in children with spinal lipoma through MDT assessment: Part 2 Motor function and mobility

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OBJECTIVE:To monitor functional mobility of children with spinal lipoma who have a spectrum of neurological and urological presentations, contributing to musculoskeletal deformity, pain and motor deficits (Cochrane, 2000; Segal et al, 2013). Evidence to support prophylactic untethering is conflicting and current practice at GOSH is monitoring within an MDT clinic and intervene promptly if function deteriorates. Identifying deterioration is challenging as baseline function and presentations vary. GOS-ICH Paediatric Gait Centiles (GOS-ICH PGC) offer an alternative to standard mobility classification, often insensitive to symptom progression.
MATERIAL-METHODS:The gait profiles of 30 children with spinal lipoma who attended clinic between Jan 2013-June 2014 have been previously presented (Alderson et al 2015). Approval for retrospective review was granted by GOSH/ICH Research and Development Office. Routine data collection of gait measurements continued for children at risk of deterioration. Recovery of mobility after radical spinal untethering was also explored. All children walked across a 6 m pressure sensitive carpet, the GAITRite (R) 3 times at preferred speed. The GOSH-ICH PGC, developed from 650 typically developing children using Gamlss analysis (Alderson et al, 2019), were used to interpret the data.
RESULTS:Longitudinal gait data was collected for 7 children, 3 boys. Mean age at initial assessment 9.8yrs (range 4.7-14.1yrs). Velocity mean(sd) was 121.7cm/s (29.6) pre-operatively, 49.1cm/s (29.3) post-operatively, and 119cm/s (8.8) at follow-up. Data were plotted on the age and gender specific gait centiles (Figure 1).
CONCLUSION:Preferred walking velocity of children with lipoma falls within normal range for age. Progressive symptoms are associated with slowing of gait compared to peers; sometimes accompanying urological deterioration. The anticipated reduction in walking speed post-operatively improves over time, however subtle changes in walking performance in individual children are lost in an heterogeneous cohort. The GOS-ICH PGC allow individual changes to be tracked against expected developmental trajectories, and Z-scores allow for further analysis.

Keywords: paediatric, spinal lipoma, gait, velocity, centiles

FL-095

Retrospective analysis of subtotal versus partial resection of conus lipoma

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OBJECTIVE:The goal of surgery for spinal conus lipoma is to prevent the emergence of new symptoms. We evaluated the surgical procedure,

intraoperative neurophysiological monitoring, postoperative complication and outcome of spinal lipoma surgery performed by first author.
MATERIAL-METHODS:89 Surgery for spinal conus lipoma was performed by first author since 2002. The initial surgey was 60, and the redo surgery was 29. Of the initial cases, 17 patients (group A: before 2008, mean follow-up period 13.2 years) underwent partial removal of lipoma, and 43 cases underwent subtotal or complete removal (B Group: Since 2009, the average follow-up period was 4.2 years). For neurophysiological monitoring, direct motor spinal nerve roots stimulation was performed in all cases, and transcraninal motor evoked potential (MEP) and bulbocavernous reflex monitoring(BCR) was performed in selected cases.
RESULTS:In group A, reoperation was performed in 8 cases (47%), and the average time from initial surgery to reoperation was 6.1 years (0.3-13). On the other hand, in Group B, two patients (4.6%) underwent reoperation. Postoperative complication occurred in two cases. Both cases had tibial muscle paralysis, which required ankle bracing for walking. One case was from group A, and another case was from group B.
CONCLUSION:Maximum resection of lipoma appears to reduce the rate of symptomatic retethering. Moreover, there was a possibility that postoperative complications could be avoided by performing MEP and BCR.

Keywords: spinal conus lipoma tethered cord syndrome

FL-097

Intraoperative neuromonitoring for tethered cord surgery in infants: feasibility and nuances

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OBJECTIVE:To evaluate the efficacy and safety of intraoperative monitoring in surgery for tethered cord in very young.
MATERIAL-METHODS:The study was prospectively done in the Division of Paediatric Neurosurgery, AIMS, Kochi, India. 66 patients below 1 year of age who underwent surgery for spinal dysraphism under intraoperatively electro physiologically monitoring were included. Their preoperative neurological, urological and orthopaedic status compared with post-operative status clinically. The duration of study was from 2011 January-2019 February. Intraoperative monitoring (MEP, and Direct stimulation) was done with XELTEK PROTEKTOR 32 IOM System, NATUS NEUROLOGY/ MEDICAL INC. Middleton, USA. All statistical analysis was done with IBM SPSS version 20. For finding association with categorical variables Pearson Chi-square test was used.
RESULTS:There were about 66 surgeries. Preoperatively, 25.75% had motor deficit, 89.39% had normal bladder function, 12.12% had abnormal bowel function and 10.60% had orthopaedic deformity. Follow up ranged from 6 months-8 years. During immediate post-operative period 96.96% had preserved motor function, while 96.96 % had preserved bladder function, 98.48% had bowel function preserved. Function deterioration and 1(0) patient had bowel function deterioration (figure in the bracket show the figures at 6 month follow up). Improvement was seen in 18 patient with motor deficits, 16 with bladder deficits and 15 with bowel issues. The monitorability for motor and sphincter was 98.48% and 91.83% respectively. Sensitivity of IOM in predicting new neurological deficit was 80%. Specificity of IOM in predicting new neurological deficit was 98.36%. Positive predictive value was 80% Negative predictive value was 98.36%. Diagnostic accuracy was 96.97%. There were no complications in this cohort directly related to the IOM procedure.
CONCLUSION:
- Use of IOM was efficacious and safe in below 1 year
- Intraoperative monitoring was specific but not very sensitive in diagnosing any neural injury.
- IOM has a good diagnostic accuracy even in very young.

Keywords: Spinal dysraphism; lipomyelomeningocele; Detethering

FL-098

Predicting outcome in surgery for tethered cord- how close can we get? Role of electrophysiological monitoring in detethering of tethered cord

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OBJECTIVE:To evaluate the significance of intraoperative neuromonitoring in surgery for tethered cord in relation to outcome.
MATERIAL-METHODS:The study was prospectively done in the Division of Paediatric Neurosurgery, AIMS, Kochi, India. 170 patients who are diagnosed with spinal dysraphism and operated and intraoperatively electrophysiologically monitored were included. Their preoperative neurological, urological and orthopaedic status compared with post-operative status clinically. The duration of study was from January 2011 to February 2019. Intraoperative monitoring (MEP, and Direct stimulation) was done with XELTEK PROTEKTOR 32 IOM System, NATUS NEUROLOGY/ MEDICAL INC. Middleton, USA. All statistical analysis was done with IBM SPSS version 20. For finding association with categorical variables Pearson Chi-square test was used.
RESULTS:The following significant observations were made: Out of 170, Male: Female = 57.6%: 42.4% Preoperatively, 36% had motor deficit, 66.5% had normal bladder function, 28.8% had abnormal bowel function and 27% had orthopaedic deformity, %%% had regular follow up. Mean of 45 months. Follow up ranged from 0-8 years. During immediate post-operative period 98.8% had preserved motor function, while 97.6% had preserved bladder function, 98.2% had bowel function preserved. On follow up 2(1) patient had motor function deterioration, 4(2) patient had bladder function deterioration and 3(0) patient had bowel function deterioration (Figures in bracket final numbers on follow up). The monitorability for motor and sphincter was 99.4% and 89.3% respectively. Sensitivity of IOM in predicting new neurological deficit was 90%. Specificity of IOM in predicting new neurological deficit was 99.38%. Positive predictive value was 90%. Negative predictive value was 99.38%. Diagnostic accuracy was 98.82%.
CONCLUSION:
- Intraoperative monitoring is sensitive in diagnosing any neural injury during spinal dysraphism surgery but are not very specific.
- IOM has a good diagnostic accuracy
- Postoperative motor and urological outcome were significant.

Keywords: Lipomyelomeningocele, Cauda equina mapping, Tethered cord syndrome

FL-099

A multicenter study of surgical site infection following complex tethered spinal cord surgery: Is current antibiotic prophylaxis enough?

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OBJECTIVE:Surgical site infection (SSI) is one of the most common complications seen after surgical release of complex tethered spinal cords. Routine prophylactic antibiotic coverage for these patients most commonly includes an intravenous first generation cephalosporin. Many of these children are too young or do not have complete bowel and bladder control that may lead to wound contamination. This has been seen in the neurogenic scoliosis population, where high rates of gram negative and polymicrobial SSIs were identified.
MATERIAL-METHODS:A retrospective multicenter study of all SSIs following complex tethered cord repair over a 10-year period from 2007-2017 was performed. All cases that presented with postoperative signs of infection requiring culture, prolonged antibiotics or reoperation were included. Specific microbial species and sensitivities were investigated to determine if routine prophylactic antibiotic coverage was adequate for these patients.
RESULTS:Preliminary results from the initial six centers demonstrated an overall rate of SSI at 11% (41/377). Antibiograms showed 43% polymicrobial infections, 60% with gram negative species, 33% with gram positive only, and 23% with gram negative only. Overall, 35% of organisms were resistant to cefazolin.
CONCLUSION:Similar to SSI data from children undergoing deformity surgery for neuromuscular scoliosis, our preliminary data suggest high rates of polymicrobial and gram-negative surgical site infections after release of complex tethered spinal cords. Over a third of these infections are resistant to cefazolin, suggesting that broader antibiotic prophylaxis with gram negative coverage in these cases may be indicated.

Keywords: dysraphism, tethered spinal cord, infection

FL-100

Split Cord Malformation – Spectrum of Associated Anomalies

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OBJECTIVE:To highlight the spectrum of associated pathological (AP) entities that can occur with (Split cord malformations) SCMs and the limitations of imaging techniques to diagnose these entities preoperatively.
MATERIAL-METHODS:Patients with SCMs and associated pathologies (AP) operated between Jan 2012 and Dec 2017 were included. All had neurological evaluation, plain radiographs, high resolution CT and MRI. Postopertive complications were recorded. Follow up ranged from 6 months to 3 years.
RESULTS:24 of the 30 patients treated during this period had APs. M:F-18:6. Age: 1 month – 17 years. 16 had Type II SCMs and 8 had Type I SCMs. Twenty of the 24 patients were neurologically intact. Of the remaining 4, 3 had urinary disturbances and one had weakness of one lower extremity. All patients had one or more APs in addition to SCMs. High resolution MRI and/or CT were unable to completely identify the full spectrum of the pathology in these patients in whom the diagnosis was often made intraoperatively.The associated anomalies included in the descending order of frequency included: LDMs (Limited Dorsal Myeloschisis), Lipomas; Spondylo -costal Dysostosis, spinal arachnoid cyst, spinal dermal sinus and neurenteric cyst. Complications included CSF leak and wound break down. No patient worsened neurologically either immediately following surgery or during the follow up.
CONCLUSION:80% of SCMs have APs. Even high resolution MRI /CT cannot completely identify the full spectrum of the pathology in SCMs. A high index of suspicion and a meticulous search for associated pathology is required while operating patients with SCMs.

Keywords: Limited Dorsal myeloschisis - Split cord malformation - Tethered cord- Neurenteric cyst

FL-101

Neurosurgeon`s Opinion on the Management of Meningomyelocele: an international survey

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OBJECTIVE:Due to improvement in operative technique and instruments, advances in fetal surgery were made to treat otherwise lethal fetal conditions. Meningomyelocele (MMC) is a severe disabling condition but it is a non-lethal condition during gestation. The MOMS-trial showed that open prenatal surgery for MMC reduced the need for shunting and improved motor function but was associated with maternal and fetal risks. It is largely unknown how these findings have impacted the current management of MMC.
MATERIAL-METHODS:An online survey was emailed to members of the Congress of Neurological Surgeons on the 29th of March 2019. The survey is to be distributed amongst ISPN members as well. The survey focuses on: 1) characteristics of the respondents, 2) own experience in counseling and management of MMC, 3) opinions and expectations of fetal surgery for MMC and 4) knowledge on outcomes of fetal surgery.
RESULTS:So far a total of 140 neurosurgeons filled in the survey, the majority (57.9%) being specialized in Pediatric Neurosurgery. Of all respondents, 91.4% of their departments offer postnatal surgical closure of MMC. However, only a minority provided prenatal procedures: 13.6% for open fetal surgery and 8.6% for fetoscopic surgery. Most important objections for providing fetal surgery according to the respondents was 1) too few cases available to become proficient (30.1%), the risk of maternal complications (21.5%) and the risk of fetal complications (17.2%).Most important reasons in favor of providing fetal surgery were the decreased rate of shunt dependency (39.8%) and the improved rate of motor function (24.7%).
CONCLUSION:Almost a decade after the MOMS-trial, a minority of the respondents' departments provide fetal surgery to treat MMC. The most important objection for providing fetal surgery was a too low case load to become proficient in the technique. Centralization of the prenatal treatment in MMC in tertiary referral centers might remedy this.

Keywords: meningomyelocele (MMC) fetal surgery, fetoscopic surgery, survey, MOMS

FL-102

Outcome of our most recent 100 myelomeningocele patients

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OBJECTIVE:Due to improvement in operative technique and instruments, advances in fetal surgery changed the treatment of meningomyelocele (MMC). The MOMS-trial showed that open prenatal surgery for MMC reduced the need for shunting and improved motor function but was associated with maternal and fetal risks. The need for untethering of the spinal cord after fetal surgery is largely unknown. We are currently starting a fetal surgery center for MMC and aimed to understand the outcome of our most recent 100 MMC patients.
MATERIAL-METHODS:The most recent 100 MMC patients treated at our institution were identified using a departmental database. Medical reports and radiological imaging were reviewed. Operative interventions were recorded.
RESULTS:In total 97 were treated postnatally, 2 underwent prenatal open surgery in another institution. Level of lesion was cervical in 1, thoracic in 19, lumbar in 36, lumbosacral in 24 and sacral in 19 patients.Hydrocephalus was present in 81 out of 99 patients (81%), 80 were primarily treated with a VP-shunt, 3 via ETV. On shunt failure 9 patients were succesfully treated via ETV.Out of 95 patients 35 (37%) walk independently, 14(15%) with aid, 46 (48%) are incapable of walking, 4 have not reached the age of walking yet.Out of 89 patients 55 attend normal schools (62%), 34 go to special schools,(38%), 10 kids are still below school age. Radiological hindbrain herniation was present in almost all patients; surgical decompression was performed in 2.Surgical untethering was performed in 14 patients (14%) (aged 0.5yrs-10.5yrs).
CONCLUSION:We show outcome comparable to that of the postnatal group in the MOMS-trial. Our untethering rate is rather low, the incidence of this longterm complication after fetal closure is still rather uncertain. We will use our results as comparison for our future outcome after fetal repair.

Keywords: MMC meningomyelocele, hydrocephalus, tethering, fetal surgery, MOMS

FL-103

Can artificial intelligence predict the necessity of MRI for children with lumbosacral skin stigmata?

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OBJECTIVE:Several kinds of clinical decision rule regarding the necessity of magnetic resonance imaging (MRI) have been proposed for children with lumbosacral skin stigmata. Recent progress in artificial intelligence (AI) has been remarkable, and it has been proven to be useful in the medical field. Therefore, we studied whether AI could be useful to determine the necessity of MRI.
MATERIAL-METHODS:Of the children with suspected spina bifida occulta who visited our hospital from 2014 to 2017, 160 children who underwent MRI were enrolled. Nineteen variables of clinical information such as physical and neurological findings were collected retrospectively. We performed supervised machine learning using decision tree analysis in terms of the presence of MRI lesions such as spinal lipoma, tight filum and low lying conus, and examined whether AI could predict the necessity of MRI.
RESULTS:The learning algorithm in AI was decided by machine learning with decision tree analysis. The variables adopted in the decision tree regarding MRI lesions were bladder symptoms, other anomalies and/or medical history, neurological findings of the lower extremities, and age. The accuracy of the obtained learning algorithm was 76%, 74% negative precision, 91% negative recall, showing good performance index. With regard to the low lying conus, AI showed that the neurological findings of the lower extremities, presence or absence of normal gluteal fold, and bladder symptoms were predictive factors. The performance of the learning algorithm showed good performance indexes of 85%, 85%, and 99%, respectively.
CONCLUSION:We studies whether AI could predict the need of MRI for children with lumbosacral skin stigmata. The obtained learning algorithm in AI showed a good performance index, therefore, it was considered that AI could be used in clinical settings.

Keywords: spina bifida occulta, MRI, AI

FL-148

Prophylactic ETV in the management of transition of care in shunted adolescents with Spina Bifida

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OBJECTIVE:
•Specialized Spina bifida (SB) clinics are located almost exclusively in pediatric multidisciplinary institutions.
•With folate fortification shunted hydrocephalus has decreased in this group.
•SB patients present with difficult to diagnose and treat hydrocephalus.
•Older children and adolescents with marginal or non working shunts are frequently seen in clinic and are considered as shunt independent.
•Transition of care can represent a risk of not detecting acute hydrocephalus in these patients.
•Real time Intracranial pressure and the role of prophylactic ETV has not been determined in this particular setting.
•Identify SB adolescent patients in clinic who have a marginally or non working shunt prior to their transition to adult care institutions.
•Measure ICP intraoperatively prior to prophylactic ETV.
•Recollect clinical data regarding their symptoms before and after a prophylactic ETV.
•Recollect clinical data regarding their neuroimaging information before and after the ETV.
•Determine the safety of performing a prophylactic ETV in this group.
•Establish a recommendation in this group given the risk of pitfalls In diagnosis at adult institutions.
MATERIAL-METHODS:
•12 adolescent patients (7 male, 5 female) were identified during their routine SB clinic visit as having marginally or non working CSF shunts.
•CT and MRI imaging was performed in order to determine which of these had increase in ventricle diameter, transependimal edema, evidence of cause of shunt failure and configuration of floor of III ventricle and prepontine cistern as elements for preoperative planning.
•Patients were subjected to intraoperative ICP measuring followed by prophylactic ETV without revision of their shunt.
•Postoperative CT was performed to determine changes in ventricular volume.
At the time of follow up (3 years) no patient had required a shunt revision at their adult institution and were feeling well.

CONCLUSION:
•Many older children and adolescent patients with Spina bifida and shunted hydrocephalus present with marginal or non working shunts at their regular follow up with minimal or no symptoms of raised ICP.
•These patients may be at risk of being undetected with acute raised ICP at adult institutions where there is little interest and expertise to manage SB patients.
•Abnormal ICP levels may be found in 60% of marginal function and 85% of non working shunt patients.
•Prophylactic ETV had minimal complications.
•Less than half had significant CT imaging changes after ETV.
•Most patients reported feeling better after prophylactic ETV
•At 3 year follow up, none of the patients had required CSF shunt revision or repeated ETV.
•Prophylactic ETV seems to be a safe alternative in the transition of care of the SB patient who has a marginal or non working shunts as evidence of raised ICP with little symptoms can be found in more than two thirds of these pts.

Session on Neuro-oncology

Hall B, Wednesday, 23rd October 2019, 10:45 - 12:05

FL-104

Decision making in surgery for Brain stem lesions

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OBJECTIVE:Brain stem lesions are being operated with an increasing frequency. There is a shift in the decision making process with increasing knowledge of pathological anatomy, and improved operating room technology.
MATERIAL-METHODS:A retrospective study was done of the 33 children operated (2002 to 2018), with 10 midbrain lesions, 15 pontine lesions and 8 lesions in the cervico-medullary region. All patients underwent contrast MRI scans preoperatively. Advanced MRI imaging was used in the evaluation protocol in the last 10 patients. We looked at how these advanced imaging modalities changed or influenced management planning of the children.
RESULTS:The decision to operate on a Brain stem tumour was based on the contrast MRI image (circumscribed lesion), and location of the lesion (close to a pial surface or exophytic). Diffuse Pontine lesions were not offered surgery. Diffusion Tensor Imaging (DTI) and Tractography (DTT) was used to provide information on the integrity and displacement of tracts. This information changed our decision regarding surgery in 4 patients. A child with DIPG, with all the tracts were displaced posteriorly, and no infiltration, was operated. DTI was not useful in 3 children with cavernomas because of signal distortion. Operative approaches were based on the location of the lesion and designated safe entry points. In 7 gliomas, operative corridors were planned using DTI and DTT. The approaches used were Telovelar (9), Retrosigmoid (8), Midline Suboccipital (6), Trans-Sylvian (4), Supracerebellar Infratentorial (4) and Inferior Temporal Gyrus (2). Transient worsening was seen in 4 children operated early in this series.
CONCLUSION:Decision making regarding surgery for brain stem lesions has improved with DTI and DTT as these further delineate the lesions that can be operated, as well as safe operative corridors. Excellent results are possible when technology is used to improve decision making in difficult surgeries.

Keywords: Brain stem, Decision making, MRI, Operative approach, Glioma

FL-105

Brainstem cavernoma in children

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OBJECTIVE:Brainstem cavernoma (BC) are rare in children, and present significant challenges in management due to their uncertain prognosis and eloquent location. We review a consecutive series from our institution.
MATERIAL-METHODS:Retrospective chart and radiology review of all children with BC identified from our departmental database, from 2002-2018.
RESULTS:9 children were identified, 5 male, with a mean age at presentation of 6 years (range 1-13). 8/9 presented with focal cranial neuropathy, with 4 of those also having symptomatic intracranial hypertension. 2 had hydrocephalus. 1 BC was an incidental finding after workup for meningitis. 3 children had multiple cavernomata (1 KRIT1, 2 awaiting genetics). 1 had previous radiotherapy. Pons was the most common location (8/9), with 1 purely in medulla. 5/8 pontine BC extended either to midbrain (2), medulla 2) or both (1). Mean BC volume was 2.5 cc (range 0.02-6.8). 4 patients had microsurgical resection of BC (with 1 patient requiring 2 operations) with conservative management in 5. Indication for resection was multiple symptomatic bleeds. No major peri-operative morbidity occurred. Radiosurgery was not used in our series. Mean follow-up was 7 years. At last follow up, all children had improved (6) or were stable (3) compared to presentation neurology. Modified Rankin scale outcome (mRS) was favourable, with 2 children mRS 0 (no symptoms), 2 children mRS 1 (symptoms, no disability), 1 child mRS 2 (slight disability), and 4 children mRS 3 (moderate disability). There was no mortality in our series.
CONCLUSION:BC often presents with neurological deficit but our follow up suggests that this remains stable or improves in the majority. Around half of children may require surgery for multiple bleeds. Close clinical surveillance is recommended.

Keywords: cavernoma, cavernous malformation, brainstem, pons, intracerebral haemorrhage, cavernoma syndromes

FL-106

Management of Tectal Gliomas by Stereotactic Radiosurgery or Radiotherapy

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OBJECTIVE:Tectal gliomas are known generally slow-growing, low-grade tumors presented with hydrocephalus. However, some tectal gliomas can progress despite low-grade characteristics and rarely malignant transformations were reported. Because of their critical location, the management of these tumors has been controversial, ranging from observation to open surgical excision. Authors analyzed the result of stereotactic radiosurgery and radiotherapy for progressive or large tectal gliomas.
MATERIAL-METHODS:Between 2002 and 2017, total 23 patients (median age 16 years) were diagnosed as tectal glioma. Among them, 16 patients (median age 13 years) with progressive or larger (>2.0 CM in diameter) tectal gliomas were treated with stereotactic radiosurgery or radiotherapy. All patients presented

with hydrocephalus and underwent endoscopic 3rd ventriculostomy before radiosurgery. Thirteen patients (median volume 1850 mm3) were treated with Gamma Knife (Median 10 Gy). Among them, one was treated with additional Cyber Knife (17 Gy) due to tumor recurrence (8585 mm3). Two patients having larger tumors (> 5500 mm3) were treated with Cyber Knife (18 Gy, 20 Gy), The patient with largest tectal glioma managed with proton beam radiotherapy.
RESULTS:In 14 patients, tumors were controlled after radiosurgery and no neurological deficit occurred. One patient with recurrent tectal glioma treated with additional Cyber Knife was also improved eventually. Two of 3 patients with larger tumor volume(>5500mm3) experienced cystic change of tumor after radiosurgery or radiotherapy; one requiring endoscopic cyst fenestration and the other undergoing surgical resection followed by long-term steroid therapy for radiation induced brain edema.
CONCLUSION:Despite, progressive or Large tectal gliomas are difficult for treatment due to critical location. stereotactic radiosurgery or radiotherapy can be effective and safe armamentarium for long-term tumor control. Cystic change and radiation induced edema can be risks of radiosurgery or radiotherapy in tectal glioma.

Keywords: tectal glioma, gamma knife, cyber knife, stereotactic radiosurgery, radiotherapy

FL-107

Pineal Region Tumours: A Retrospective Review of Patients Presenting to a Single Institution over the last 30 years

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OBJECTIVE:To review the surgical and oncological management of children diagnosed with pineal region tumours presenting to our institution over the past 30 years.
MATERIAL-METHODS:This is a retrospective case review using a neuro-oncology database where data had been collected prospectively over the study period.
RESULTS:This study consisted of 104 patients (69 male: 35 female) presenting with pineal region tumours from 1978- 2018. The median age on admission was 9 years. 49% of patients were diagnosed with a lesion of germ cell origin, the next most common tumour being a primary pineal gland lesion (19%), other tumours included glial tumours, PNET and ATRT. The majority of patients were managed initially with a CSF diversion procedure (n=44), but with the evolution of endoscopic surgery 28 patients underwent CSF diversion procedures and a biopsy, 25 patients were directly managed with surgical biopsy or resection without a CSF diversion procedure. 80% of patients had adjuvant oncological treatment. Educational performance was analysed within this cohort, we had complete data on 47 patients, within this group 50% required educational support following treatment.
CONCLUSION:Pineal tumours remain a challenge to neurosurgical community. We present our series over the last 30 years and examine the change in surgical decision making during that time. It is clear from our data that patients can have significant educational requirements, it is difficult to separate the primary affect of the tumour, associated hydrocephalus and/or the subsequent adjuvant treatment used as the principal cause of this reduction in educational performance.

Keywords: pineal, pineoblastoma, germinoma, neurosurgery, neuro-oncology, education

FL-109

Impact of hearing preserving surgery on long-term hearing and facial function in NF2-associated vestibular schwannomas in children and young adults

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OBJECTIVE:To investigate short- and long-term hearing and facial nerve function of Neurofibromatosis type 2 (NF2-) associated vestibular schwannomas (VS) before and after brainstem auditory evoked potential (BAEP-) guided surgery in adolescents and young adults under the age of 25 at time of diagnosis.
MATERIAL-METHODS:For a total of 39 operated tumors (in 23 patients), 784 audiometries and BAEP data sets as well as 579 tumor volumetries were analyzed pre- and postoperatively. The follow-up period was 21 to 167 (mean 75) months. Mutation analysis of the NF2 gene was carried out in 21 patients.
RESULTS:Decompression of the internal auditory canal (IAC) was performed in all and partial resection in 82% of patients via retrosigmoid approach. Postoperatively, hearing class (Gardner Robertson Scale), could be maintained in 74% of cases, with 72% (PTA) and 62% (SDS) of ears being within preservation criteria. Facial function was preserved in 95%. In long-term follow-up (6.28 years), more aggressive operated tumors exhibited the same (less beneficial) course as 20 observation-only cases. Large resection amount ($p = 0.018$), large preoperative tumor volume ($p = 0.043$) and presence of constitutional truncating mutations ($p = 0.012$) were significantly associated with deteriorated hearing. The better preoperative hearing indices, the better hearing and long term result after surgery.
CONCLUSION:Decompression of the IAC and BAEP-guided partial resection is associated with low morbidity and has a positive impact on hearing preservation in the long run. The ideal time point of intervention determined by frequent monitoring and a defensive surgical strategy are essential for good hearing results and beneficial long-term impact.

Keywords: neurofibromatosis type 2, vestibular schwannoma, auditory evoked brain stem potentials, partial tumor removal, hearing preservation, long-term outcome

FL-110

A comprehensive method for subgrouping posterior fossa ependymomas

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OBJECTIVE:Recent molecular studies have revealed ependymomas in posterior fossa are consisted with two subgroups. The patients suffering from ependymomas having hypermethylation on DNA of their tumors have ended up relatively poor prognosis and are required more intensive therapy (group A: PF-A). In contrast, tumors without the hypermethylation may not need aggressive radiation therapies, since the patients with ependymomas in this group (group B:PF-B) has good prognosis if the tumors are successfully removed. At present, these two subgroups are defined by DNA methylation status using methylation array commercially available in basic science field. However, this methylation array is not suitable for clinical diagnosis because of its measurement scales for this rare tumor. In this study, we tried to use a pyrosequence method for

classify ependymomas in posterior fossa which is easy to use in clinical diagnosis.
MATERIAL-METHODS:Twenty-one ependymomas were performed immunohistochemistry (IHC) for H3K27me3, previously used for the clinical classification of this tumor. Eighteen tumors were measured methylation levels of CpG sites in cysteine rich protein 1 promoter region (CRIP1) with pyrocequence method. Copy number analysis (CNA) was performed as well. Kaplan-Meier curves were generated to estimate overall survival and progression free survival. The results of pyrosequence was compared with IHC results.
RESULTS:IHC subgrouping was successfully performed because Kaplan-Meier curves and CNA showed similar results with historical data. In this condition, pyrosequence results exhibited hypermethylated status in PF-A and hypomethylated status in PF-B with significant differences.
CONCLUSION:Pyrosequence of DNA methylation status in CRIP1 promoter region could be alternative method for molecular diagnosis of ependymomas for clinical diagnosis.

Keywords: Ependymoma, Pyrosequence, DNA methylation, subgrouping

FL-111

Ependymomas in infancy: Underlying genetic alterations, histological features and clinical outcome

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OBJECTIVE:Young age represents an adverse prognostic factor in children with ependymomas. Treatment of these infants is challenging since beneficial therapeutic options are limited. As ependymomas are considered a biologically heterogeneous group we aimed to characterize infant ependymomas in respect to their histological and genetic features.
MATERIAL-METHODS:We analyzed 28 ependymomas occurring in children younger than18 months at diagnosis treated according to HIT2000-E protocols in which irradiation was postponed until the age of 18 months. All cases underwent neuropathological review, including immunohistochemical characterization. Genome-wide copy number alterations (CNA) were assessed by molecular inversion probe assays and RELA and YAP1 fusions were detected by RT-PCR and sequencing.
RESULTS:All infant ependymomas were anaplastic (WHO grade III). 75% of cases were located in the posterior fossa. Complete resection was accomplished in 57% of cases. All tumors showed loss of H3-K27me3 characteristic for PFA ependymomas. CNA analysis showed a stable genome in all cases with lack of chromosome 1q gain, an adverse prognostic marker in PFA tumors of older children. However, after a median follow-up of 5.4 years, 71% relapsed, and 43 % died. Seven ependymomas occurred in the supratentorial region of which in only two cases a complete resection could be achieved. Four tumors carried C11orf95-RELA fusions and two cases typical YAP1-MAMLD1 fusions (one case, not analyzable). The RELA-fused cases did not display CDKN2A loss as an adverse indicator of prognosis in this disease entity. Although 43% of infants with supratentorial ependymomas relapsed, all patients survived (median follow-up, 8.0 years).
CONCLUSION:Infant ependymomas seemed to fall into three biological entities, with supratentorial tumors carrying RELA or YAP fusions and PFA posterior fossa ependymomas. The latter showed an inferior outcome even though chromosome 1q gain was not present. Therefore, further biological studies are warranted in these neoplasms to identify suitable targets for a more effective treatment.

Keywords: Ependymomas

FL-112

young age at surgery is an independent predictive factor of poor long-term functional recovery in survivors of posterior fossa tumors

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OBJECTIVE:. In the treatment of posterior fossa tumors (PFT), a controversy still exists whether undergoing surgery at young age is an independent predictive factor of poor functional recovery for patients surviving the surgical procedure. Generally, in small children, PFT have a large volume.
MATERIAL-METHODS:We evaluated long-term recovery (mean follow-up, 5 years) in 51 consecutive patients with posterior fossa tumors operated at our institution. Daily (Health-related Quality of Life -hrQol-, Performance Status -PS-), motor (International Cooperative Ataxia Rating Scale -ICARS-, Pegboard Purdue Test -PegBoard-) and cognitive (Full Scale Intelligence Quotient -FSIQ-) functioning were measured. A General Linear Model controlling for age at surgery (early < 7 years; late > 7 years), post-treatments (radio and chemotherapy), preservation of deep-cerebellar nuclei, tumor volume, cerebellar mapping and delay between surgery and assessment, was used to investigate significant variations in outcome measures.
RESULTS:Early age at surgery, lesion of deep cerebellar nuclei when not included in the tumor and existence of post-treatment procedures all had a significant, independent negative influence on long term recovery. Tumor volume and delay between surgery and assessment had no statistically detectable impact. The negative influence of early age at surgery was significant in all domains (and remained so after corrections for multiple comparisons): daily functioning (hrQoL, -18%; PS, -11%), motor functioning (ICARS, +53%, Pegboard, -38%) and cognitive functioning (FSIQ, -12%).
CONCLUSION:We provide evidence that young age at surgery is an independent predictive factor of poor long-term functional recovery in survivors of posterior fossa tumors. Although the role of plasticity to reverse this negative influence needs to be established. Our results clearly plead for the implementation of prompt and intense rehabilitation program in children operated before 7 years of age. The cerebellar mapping contributes to avoid heavy sequalae related to surgery detecting functional structures.

Keywords: cerebellum, recovery, young age, functional outcome, deep cerebellar nuclei

FL-113

Does pre-operative ETV prevent hydrocephalus in paediatric posterior fossa tumour surgery?

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OBJECTIVE:To quantify the rate of persistent hydrocephalus after paediatric posterior fossa craniotomy, an assess the value of pre-operative ETV in preventing this. Analyse possible factors responsible for ETV failure.

MATERIAL-METHODS:A retrospective review of prospectively collected data.All patients aged 18 years or younger receiving a primary posterior fossa craniotomy between January 2008 and November 2018 in a single tertiary paediatric neurosurgery centre.Demographics, surgical details and post-operative complications were prospectively recorded. Data analysis was done in R, with logistic regression.RESULTS:There were 121 patients identified with primary surgery for a posterior fossa tumour (65 male, median age 7, IQR 8). These comprised 103 craniotomies for tumour excision, and 18 biopsies. 95 patients had craniotomy without a pre-operative shunt, and 23 (24%) had persistent hydrocephalus 30 days post op. 31 children had an attempt at endoscopic third ventriculostomy (ETV) prior to craniotomy, of which 32% required additional post-op CSF diversion. 64 children had craniotomy without any prior CSF diversion, of which 22% developed persistent hydrocephalus needing CSF diversion.
CONCLUSION:Persistent hydrocephalus after paediatric posterior fossa surgery is common (24%). Pre-operative ETV does not consistently prevent the need for a postoperative shunt, but can be used to temporise hydrocephalus to allow surgery on a dedicated, specialised neuro-oncology list.

Keywords: Posterior fossa tumours; Hydrocephalus; Pre- Op ETV

FL-114

Pre-operative dosing of dexamethasone for the management of symptoms in children with posterior fossa tumours in South Wales

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OBJECTIVE:Posterior fossa (PF) tumours are associated with vasogenic oedema causing symptoms of increased intracranial pressure. Preoperatively this is managed with dexamethasone. To minimise steroid related complications, the lowest dose should be administered. No neurosurgical guidelines exist for pre-operative dosing of dexamethasone in PF tumours. Anecdotal evidence from our unit suggests that doses are high in the paediatric population. This is particularly evident in referrals from district general hospitals (DGH).
MATERIAL-METHODS:A retrospective review was performed of surgically managed cases for patients under 16 years of age between 2013 and 2018 to ascertain the initial dose of dexamethasone with symptomatic PF tumours. Data was collected regarding demographics, referring DGH, presenting symptoms, weight (kg), initial dosing of dexamethasone and proton pump inhibitor (PPI) use.
RESULTS:Thirty-six patients were identified of which 30 notes were available. Sixteen were male and 14 female. Median age was 6 years (range 10 months - 15 years). Twenty-two (73%) were referrals from DGH and 8 (27%) presented to our neurosurgical centre. All patients presented with symptomatic PF tumours including headache (97%), vomiting (93%), gait disturbance (43%), and nystagmus (17%). Four (13%) had papilloedema on examination. Average stat dexamethasone dose was 9.15mg (range 1mg-16.7mg). Stratified according to weight, average dose (and range) was 8.8mg (1mg-16.6mg) in those weighing <10kg; 9.7mg (4mg-16.7mg) in those between 10-20kg; 12.3mg (8mg-16.7mg) in those between 20-30kg and 7.8mg (2mg-16.7) in those >30kg. PPI was used in 24 (80%) of cases. All doses were reduced after review by the neurosurgical team and a PPI added.
CONCLUSION:Pre-operative dexamethasone dosing does not always reflect the severity of clinical symptoms for PF tumours. DGH's are often guided by the dosing schedule in the British National Formulary. Guidelines are required to correlate clinical symptoms with a suggested suitable dose of dexamethasone to prevent overdose and complications associated with corticosteroid use.

Keywords: posterior fossa tumours, dexamethasone, steroid, guidelines

FL-115

Surgical approach and morbidity of paediatric fourth ventricular tumours: analysis of a large institutional series

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OBJECTIVE:To characterise the complications and morbidity related to the surgical management of paediatric fourth ventricular tumours.
MATERIAL-METHODS:All patients referred to our institution with posterior fossa tumours from 2002-2018 inclusive were screened to include only true fourth ventricle tumours. Pre-operative imaging and clinical notes were reviewed. Data analysis was carried out in R.
RESULTS:355 posterior fossa tumours were treated during the study period; of these, 194 were in the fourth ventricle. 150 fourth ventricle tumours with full datasets were included in this analysis. 93 patients were male, mean age ± S.D. was 6.03y ± 4.16. The commonest presenting symptom was vomiting (65.3%). The commonest tumour type was medulloblastoma (83 cases) > pilocytic astrocytoma (30) > ependymoma (25) > choroid plexus neoplasms (5) > ATRT (2), with 5 miscellaneous lesions. 60.7% of pts presented with hydrocephalus, of whom 37.4% had an EVD sited (61.8% of these prior to tumour surgery, 38.2% frontal). 18 had an ETV, of whom 7 later underwent VP shunt. Overall, 14.0% had a VP shunt sited during treatment. Across the whole series, transvermian approach was more frequent than telovelar (68.7% vs 28.7%); however telovelar surgery is becoming increasingly common (see Figure 1). The commonest post-operative deficit was cerebellar mutism syndrome (CMS; 29.3%), followed by new weakness (25.3%), cranial neuropathy (16.7%), diplopia (15.3%) and gait abnormality (13.3%). There was no significant difference in the rate of CMS between telovelar or transvermian approaches ($\chi 2$ test $p=0.423$). There was no mortality within 30d of operation.
CONCLUSION:Surgical management of paediatric fourth ventricular tumours continues to evolve, and resection is increasingly performed by the telovelar route. CMS is enduringly the major post-operative complication in this patient population.

Keywords: Fourth ventricle, cerebellar mutism syndrome, telovelar, transvermian, tumour

FL-116

Management of pediatric brain tumors, strategies and long term outcome

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OBJECTIVE:This study is aimed at shedding the lights on different patterns of presentation of Sudanese children with brain tumors and reflecting the experience of the national center for neurological sciences in setting strategies for management together with long-term follow up over 14 years period.

MATERIAL-METHODS:Retrospective, observational study for all Sudanese children with brain tumors operated in the National Center for Neurological Sciences in the period between September 2000 to March 2015. Data were collected and patients were followed throughout the entire 14.5 years study period. All patients with deficient clinical pre and post-operative data, patients with missed operative details, patients with missed histopathology reports and adult patients were all excluded from the study.
RESULTS:During this 174 months period, 54 patients were operated aging between 1-17 years with average presentation at 9 years of age. M:F 2:1. The commonest presenting symptoms are headache (90.7%), back pain (81.3%), vomiting (59.3%) and unsteady gate (48.1%). The average duration of symptoms was 1 year. Most patients were operated through posterior fossa craniectomy (n=30/54, 55.9%and histopathology reports were mainly medulloblastoma (n=15/54, 27.8%) and pilocytic astrocytoma (n=11/54, 20.4%). Most patients improved or cured post-operatively (n=43/54, 79.7%) 1 deteriorated and 9 died.
CONCLUSION:Pediatric brain tumors are among the most challenging neurosurgical problems that needs stepwise multidisciplinary team. The lesions tend to be infratentorial with obstructive hydrocephalus. In our center it is found that 2 steps surgery first with VP shunt followed by second stage tumor resection after few weeks is both effective and safe way with apparently good outcome.

Keywords: pediatric brain tumors, management, long term outcome

FL-117

Use of 5-aminolevulinic acid fluorescence guidance in resecting pediatric brain tumors

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OBJECTIVE:The compound 5-aminolevulinic acid (5-ALA) has been approved for fluorescence-guided resection of malignant gliomas in adults, but not for children. The application of 5-ALA in children remains an off-label use. We analyzed our experience retrospectively
.MATERIAL-METHODS:Participants comprised 13 patients (17 surgeries) under 18 years of age who underwent surgeries for central nervous system (CNS) tumors between 2013 and 2017 in our institute. Administration of 5-ALA was performed according to the adult protocol, as 20 mg/kg, 3 h before induction of anesthesia. A standard surgical exposure was performed using a neurosurgical microscope. Fluorescence was detected using a spectrometer under a flexible endoscope. The correlation between fluorescence status (positive or negative) and histology was investigated.
RESULTS:Histology revealed ependymoma (n=5), pilocytic astrocytoma (n=4), diffuse astrocytoma (n=1), glioblastoma (n=1), medulloblastoma (n=1), and dysembryoplastic neuroepithelial tumor (n=1). Positive fluorescence was observed in cases of ependymoma (n=3, 60%), pilocytic astrocytoma (n=1, 25%), glioblastoma, and medulloblastoma. Positive fluorescence was observed in 6 of 10 tumors showing gadolinium-enhancement on MRI, but not in 3 cases of non-enhancing tumor. No adverse reactions were observed.
CONCLUSION:Positive fluorescence was observed in infratentorial ependymomas and mural nodules of cerebellar pilocytic astrocytoma, as well as glioblastoma and medulloblastoma. The use of 5-ALA fluorescence guidance in resecting pediatric brain tumors appears beneficial. In particular, since ependymoma is chemotherapy-resistant and the surgical removal rate affects prognosis, establishment of intraoperative diagnosis by 5-ALA is an important subject.

Keywords: 5-aminolevulinic acid, pediatric brain tumors

FL-118

Surgical treatment of deep-seated tumors in children

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OBJECTIVE:To study the surgical approaches used in the resection of deep-seated tumors and the choice of the surgical approach for various topographic types of intrinsic tumors using data from MR tractography.
MATERIAL-METHODS:This study included data of 146 pediatric patients (79 male and 67 female) aged from 2 to 18 years with deep-seated gliomas who were operated in Burdenko Scientific Center of Neurosurgery between 1994 and 2018.
RESULTS:The analysis included 172 surgical removals in 146 patients. 24 patients were operated twice and 1 patient three times due to a previous partial removal or recurrence of the tumor. Various types of deep-seated gliomas in children included the thalamic, thalamopeduncular, basal ganglia and optic tract tumors. Transcallosal (n=66), occipital interhemispheric (n=34), supracerebellar infratentorial (4), transsylvian (n=16), frontal and parietal transventricular (28) and temporal transchoroid fissure (n=24) approaches where used during microsurgical removal. The choice of the surgical approach depended on the topography, the size, degree of dislocation of the adjacent anatomical structures, hydrocephalus and the condition of the corticospinal tract based on MR tractography data. Intraoperative monitoring of motor evoked potentials was used to identify and preserve the corticospinal tract. All of these approaches have their advantages and disadvantages. Total resection was achieved in 53 cases (31%), subtotal - in 84 (49%) and partial - in 35 (20%). 109 patients (75%) had improvement of their neurological status and general condition after surgery, 24 (16.5%) - worsened, 9 (6%) patients had no change and 4 (2.5%) died in the early postoperative period.
CONCLUSION:Deep-seated tumors can be operated with various surgical approaches depend on the topography of the tumor. The correct choice of the surgical approach according to MRI and MR tractography, as well as the use of intraoperative neurophysiological monitoring may lead to total and subtotal removal and reduce the frequency of postoperative complications.

Keywords: deep-seated tumor, surgical approch

FL-119

Outcome of Choroid plexus Papilloma Total Microsurgical Excision in Children

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OBJECTIVE:Choroid plexus papilloma (CPP) is rare, benign tumors of neuroectodermal origin; they represent 1-3% of central nervous system (CNS) tumors in pediatric patients. Authors present their experience in management of such lesion in Mansoura University Hospital.

MATERIAL-METHODS:Retrospective analysis of children with Choroid plexus papilloma over 7 years from January 2012 to January 2018 in Mansoura University Hospital was done for age, sex, clinical manifestation, surgical treatment and follow up.
RESULTS:23 pediatrics were treated over 7 years. Age ranged from (7 months - 8 years).There was 13 female and 9 male. Tumors were located in lateral ventricle in all cases, Presentation were predominantly with feature of raised intracranial pressure. Total microsurgical excision was achieved in all cases. All patients had intraoperative loss less than 100ml with mean Hematocrit 28%.Follow up period (7-53 months). There was complete relief of symptoms in all patients with no mortality. Two of our patients needs postoperative vetriculoperitoneal shunt and another two required subduralperitoneal shunt for persistent subdural CSF collection.
CONCLUSION:Total excision of Choroid plexus papilloma is usually the rule with excellent outcome.Routine external ventricular drainage for at least 3 days is effective in lowering shunt dependant cases as it allow release of bloody CSF and small tumor residue.With proper microsurgical technique through superior parietal lobule to access lateral ventricle then coagulation of tumor under irrigation to shrink and excise in toto avoid excessive bleeding. The vascular pedicle of tumor should be sacrified with last part of the tumor removal to avoid retraction of pedicle and ventricular hemorrhage.

Keywords: Choroid plexus papilloma,Children,microsurgery

FL-121

Craniopharyngioma in children: improved trends from a third consecutive single-centre cohort study

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OBJECTIVE:The management of craniopharyngioma has become more conservative in recent decades. However, direct comparison of outcomes with previous cohorts in the same institution has seldom been possible. The object of this study was to evaluate safety and effectiveness of our current management when compared to previous cohorts (1996-2004, and 1973-1994) at our centre.
MATERIAL-METHODS:A prospective database was searched over a 14-year period between 1st January 2005 and the 31st December 2018 to identify all children with a new diagnosis of craniopharyngioma. A retrospective case note review was performed to extract data on presentation, investigation, treatment, and outcome. Morbidity was assessed as in previous cohorts, using the following categories: visual loss, pituitary dysfunction, hypothalamic dysfunction, neurological deficits, and cognitive impairment.
RESULTS:59 children were identified during this period. 92 operations were performed, including cyst drainage (35/92; 38.0%), craniotomy and resection (30/92; 32.6%), and transsphenoidal resection (16/92; 17.4%). Approximately two thirds of all procedures were performed using image guidance (66/92; 71.7%) and one third using endoscopy (27/92; 29.3%). Most children had adjuvant proton beam (18/59; 30.5%) or conventional radiotherapy (16/59; 27.1%). Median follow up was 44 months (range 1–142 months) and approximately half the children had no evidence of residual disease on MRI (28/59; 47.5%). Of the remaining 31 children, there was growth in 5 (5/59; 8.5%). There was significantly reduced morbidity in all categories compared to our earlier cohorts ($p < 0.05$) (Figure 1).
CONCLUSION:Our institutional experience of paediatric craniopharyngioma confirms a trend toward less invasive neurosurgical procedures, most of which are now performed with the benefit of image guidance or endoscopy. We have identified an expanding role for proton beam therapy to deliver more targeted radiotherapy for children with residual disease. These advances have allowed for comparable tumour control to our previous cohorts, but with significantly reduced morbidity and mortality.

Keywords: craniopharyngioma, outcomes, hypothalamus-sparing surgery, proton beam therapy

FL-122

Re – recurrence in paediatric craniopharyngioma: are we taming the untameable

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OBJECTIVE:To study the factors associated with recurrence and re recurrence in paediatric craniopharyngioma.
MATERIAL-METHODS:A total of 102 patients who underwent surgical management of paediatric craniopharyngioma from January 2004 to December 2018 were included in this study. Institute ethical committee approval was taken for this retrospective observational study. Operation records were reviewed from the department of neurosurgery record keeping system. The scans were retrieved from picture archiving and communications system or archived compact discs from the department of radio diagnosis and radiotherapy. Inclusion criteria for the study were those patients who were operated 3 or more than three times for tumour decompression (Group R). Exclusion criteria includes patient undergoing tumour decompression less than 3 times (Group N). Procedures done for cerebrospinal fluid diversion or wound related complications were not counted as surgery for tumour decompression. Radiotherapy was offered to almost all the patients who underwent subtotal tumour decompression as per the institute policy.
RESULTS:Total 102 patients with craniopharyngioma were analysed for tumour recurrence. Patients age ranged from 6-16 (12.1 ± 2.9) years with male 61% and female 41 %. Patients with symptom of headache (92% vs 70%, p=0.016) and hormonal disturbance (46% vs 13%, p=0.0003) were significantly more in Group R than Group N. Patients with hydrocephalus (78% vs 28%, p=0.00005) were significantly more in Group R than Group N. Pre-operative tumour volume (10 ± 2 cc vs 4 ± 1 cc) were significantly more in Group R than Group N. Intra operative vascular adhesions (85% vs 32%) and neural structure adhesions (89% vs16%) were significantly more in Group R than Group N. Calcification was noticed in all the re recurrences.
CONCLUSION:The larger tumour size, vascular and neural adhesions precludes the complete excision of paediatric craniopharyngioma in our study, which in turn leads to the re recurrence of such tumour.

Keywords: recurrent, craniopharyngioma, surgery, adhesion, hydrocephalus

FL-123

The most influential papers in the neurosurgical management of paediatric central nervous system tumours

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OBJECTIVE:Citation number can be used as a measure of the influence an academic publication has. Papers in paediatric neurosurgery with more than 50 citations and a citation rate of more than 5 per year have been suggested to be high impact. This study aims to determine and categorise the most highly cited papers related to the neurosurgical management of paediatric central nervous system (CNS) tumours between 2005-2010 and 2011-2016.
MATERIAL-METHODS:Wilcox et al., 2013 identified the three journals publishing the most influential papers in paediatric neurosurgery: Child's Nervous System, Journal of Neurosurgery: Paediatrics and Paediatric Neurosurgery. All papers published by these journals between 2005-2016 were collected from Web of Science. Papers related to the neurosurgical management of paediatric CNS neoplasms were identified and the 50 most cited between 2005-2010 and 2010-2016 were determined. Papers not relating to surgical management were excluded. Trends between the two time periods were compared.
RESULTS:Child's Nervous System published the most highly cited papers in both 2005-2010 (54%) and 2011-2016 (52%). Between 2005-2010, citation number ranged from 27-93 (mean = 43) and citations per year ranged from 2.31-8.25. 24% had more than 50 citations, 8 of which had a citation rate of more than 5 per year. 42% of the 50 most highly cited and 70% of the top 10 most cited papers were related to the surgical management of craniopharyngiomas. Between 2011-2016 only 10% of the most cited papers related to craniopharyngiomas with the most common theme being 'brainstem tumours' (16%). The majority of papers between 2011-2016 were classified as 'Other'.
CONCLUSION:There has been a shift in the most influential papers from craniopharyngiomas to brainstem lesions such as DIPGs between 2005-2010 and 2011-2016. An increase in 'other' in 2011-2016 could reflect an increase in the diversity of research on the neurosurgical management of paediatric CNS tumours.
Keywords: neuro-oncology, CNS tumours, research trends

Session on Global Neurosurgery

Hall B,Wednesday, 23rd October 2019, 14:00-15:30

FL-124

Medical Experiments in Children Revisited – what is a real "Informed Consent" in Modern Era of Internet / Digital exposure?

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OBJECTIVE:BACKGROUND: A patient under 18 years of age, is enrolled to a medical study in which a drug, material, device or procedure are planned. Some important questions arise: is it ethical to enroll the child to an experiment for "diagnostic" but not "therapeutic" goals? Is it enough to merely state that "the specific child may not benefit from the study" and yet enroll the child? Is it ethical to prevent data about potential risks from the child? Is it ethical to expose the child to an experiment that can delay standard therapy? If risk is not impossible, and the potential benefit for the specific child enrolled is very questionable, IS IT still ETHICAL TO ENROLL THE CHILD?.
MATERIAL-METHODS:Dilemmas and examples: Medical experiments in the pediatric population are a sensitive issue, because the parents or the legal guardians will be signing "informed consent" and most children under 18 will be "passively" cooperative. NOT all procedures are contributing to treatment/cure (even though they may contribute to general scientific knowledge). Two examples will be discussed in the lecture, addressing the difference between "invasive" and "non-invasive" experiments.
RESULTS:The authors suggest that in the era of modern technology and ability of children to use and access internet almost unlimitedly and from a very young age, we must re-visit and discuss the definition and applicability of an "informed consent" in experiments involving patients under 18 years.
CONCLUSION:If there is a reasonable option that the experiment will not be beneficial for the specific child, or may expose him to side effects that may actually affect his quality of life – proper preparation and discussion of the information adjusted to child's intellect and ability to digest should be advised.

Keywords: children, informed consent, internet, digital information, ethics

FL-125

Experiences of treating 10 consecutive cases of frontobasal encephaloceles in sub-saharan Africa on a floating hospital ship

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[3]Dr Gary Parker, Mercy Ships, Maxillo-facial surgery, Garden View Texas. U.S.A.

OBJECTIVE:To see the sustainability and feasibility of treating complex craniofacial anomalies in Sub -Saharan Africa through teamwork and mentoring of local expertise.Help to enhance the craniofacial know how in treating these conditions to the the local Neurosurgical and plastic/Max-fac team.Emphasis on telecommunications and telemedicine and radiology in the process is highlighted.
MATERIAL-METHODS:12 encepahoceles were treated during a four year period.Each field visit was for 15 days.Visiting team was made up of Peadiatric Neurosurgeon, Plastic surgeon and Maxillo facial surgeon with CF expertise, 10 out of 12 encephaloceles presented were fronto-basal.male to female ratio was 7 to 3.All cases were operated by the same team of 3 surgeons - neuro, plastic and max-fac, along with international team of anaesthesiologist.Age varied from 3months to 19 yrsPre-operative planning was done with the help of CT with contrast and 3D reconstruction to help the planning of repair and to see the associated brain anomalies.
RESULTS:All cases were operated successfully via an combined craniofacial and direct approach to repair the herniated brain and correct the cosmetic deformity with no mortality.All patient were prophylactically given antibiotics during their hospital stay.the most common morbidity was CSF leaks ~ 50%, this was managed successfully with conservative methods which will be discussed in the presentation.There were on short to medium term neurological sequelae due to the intervention.
CONCLUSION:It is feasible to treat complex frontal encephaloceles via a conbined craniofacial approach in countries with very poor access to safe surgical care. The involvement of local expertise which included

max-fac and neurosurgeon during the 4 consecutive field services helps to dissociate knowledge and skills.The model of care is one of the alternatives to manage difficult craniofacial anamoloies and could be applied to other areas of complex conditions.

Keywords: encephaolcele, CSF Leak, Sub-Saharan Africa, team.

FL-154

Neural tube defects: Burden and multi-disciplinary treatment in Addis Ababa, Ethiopia

Abenezer Tirsit
Addis Ababa, Ethiopia

OBJECTIVE:Ethiopia, as in most developing countries face a huge challenge from rapid population growth. Surgeries for NTDs and hydrocephalus are the most common procedures done by Neurosurgeons in all part of the country.
MATERIAL-METHODS:A community based prospective study was done to determine the intra-uterine prevalence of NTDs among pregnant women in Addis Ababa, Ethiopia. Institutional based combined prospective and retrospective methods were used to see the epidemiology and long term treatment outcomes of children operated for Neural tube defects.
RESULTS:A total of 958 pregnant mothers with gestational age of 9 -22 weeks were screened for NTDs.The prevalence of NTDs were 0.005. Most mothers with affected pregnancy were house wives, completed secondary level education and did not take folate during their pregnancy. On a retrospective evaluation of 88 children who were operated for NTDs, we were able to trace only 61 children (69.3%) after four years from the first surgery. Of these, 36 children were alive (59%) and 25 children (41%) were confirmed dead. When we see the survivors, 33/36 had no hydrocephalus pre-operatively (P Value=0.00) and 27/36 children had full pre-operative motor power function (P Value = 0.00). Children who had better pre-operative motor power (P Value =0.001) and access to rehabilitation care (P value = 0.029), had better ambulatory function (able to walk unsupported) after four years from the first surgery.
CONCLUSION:The higher prevalence rate shows a clear gap on the prevention of NTDs and the long term outcomes of operated children shows a need to improve access and quality of multi-disciplinary treatment in our and other resource limited setups.

Keywords: Neural tube defects

FL-155

Pediatric scalp vascular malformations

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OBJECTIVE:Scalp vascular malformations are relatively rare lesions especially in pediatrics. Different nominations used to describe these lesions include serpentinum aneurysm, plexiform angioma, and arteriovenous malformation.The etiology of these lesions is still controversial (traumatic or congenital). We illustrate our clinical experience with those lesions and review the literature for better understanding.
MATERIAL-METHODS:We reported all cases admitted to our hospital from February 2016 to February 2019. Detailed natal and postnatal history was taken. Full examination was done. Initial CAT scan (CT) and magnetic resonance (MR) imaging were ordered for all the patients. Angiography was done according to preference upon each case condition.Review of all kind of related papers in the literature (case reports and reviews) was carried on.
RESULTS:7 cases presented with visible, palpable and/or pulsatile scalp lump were documented.(Table1) All were males with a mean age of 11 years.History of head trauma was evident in 4 cases and irrelevant in 2 cases.One case with craniofacial malformations was noticed. Preoperative CT and MR angiography were done for all cases, while digital subtraction angiography (DSA) was done for 3 cases.Surgical excision and ligation of possible feeders were performed for all cases. Scalp skin incision was designated according to the lesion location.Complete resolution was achieved for all cases upon followup radiology and observation.
Case presentation:
Case1: 13 years old male presented with left frontal supraorbital palpable scalp lesion. DSA was done for anticipated intracranial feeder prior to surgery.(Fig 1)
Case2: 1.5 years old male diagnosed with craniofacial vascular malformations (Wyburn-Mason syndrome). DSA was done for detailed angioarchitecture. Surgery excision was done for scalp lesion only.(Fig 2)
CONCLUSION:Trauma is a considerable etiology for scalp vascular malformations and this is maybe relevant to the male predominance in our study. DSA is preserved for cases anticipated with intracranial component or feeders. Surgical excision is preferable for treatment.

Keywords: Pediatric, Scalp, Vascular malformations

Session on Neuro-oncology I

Hall A, Thursday, 24th October 2019, 08:00 - 10:45

FL-126

Medulloblastoma with myogenic and/or melanotic differentiation does not align immunohistochemically with the genetically defined molecular subgroups

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OBJECTIVE:Background and OBJECTIVES: The WHO classification of CNS neoplasms (2016) recognizes four histological variants and genetically defined molecular subgroups within medulloblastoma (MB). MB with myogenic differentiation is one of its rare variants which is usually recognized as a pattern alongside any of the known variants. Due to its rarity, less is known about its molecular landscape and importantly about its placement in the current molecular schema. We aimed to analyse this rare variant for expression of three immunohistochemical markers conventionally used in molecular stratification of MB. Demographic profile, imaging details with survival outcome was also analysed.
MATERIAL-METHODS:Sixty-five MB cases were molecularly stratified using immunohistochemical markers (YAP1, GAB1, β-catenin). MB with myogenic differentiation and MB cases showing variable immunoreactivity with above three antibodies were further evaluated for SMA, desmin, myogenin and HMB45. Presence of p53 mutations were also assessed using immunohistochemistry for TP53.
RESULTS:: Seven cases were categorized as MB with myogenic and/or melanotic differentiation. Age ranged from 2-40 years with M:F ratio of 1:1.3. In four cases, myogenic or melanotic differentiation was evident on histology, while in three, differentiation was highlighted only with muscle

markers. Interestingly, all seven cases showed variable immunoreactivity with three molecular markers and did not follow the conventionally accepted algorithm used for molecular stratification. None of them harboured p53 mutation. Follow-up period ranged from 9-57 months. Overall survival revealed a varied pattern, with three deaths and four patients being alive with no evidence of disease at last follow-up.
CONCLUSION:Our results provide evidence that this variant is a distinct entity and does not align immunohistochemically with the currently recognized genetic subgroups.

Keywords: Medulloblastoma, molecular subgroups, Medullomyoblastoma, myogenic differentiation, melanotic medullomyoblastoma, Brain tumor

FL-127

Status of Tumor Suppressor P53 Defines the Therapeutic Responses in Treatment of Medulloblastoma

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OBJECTIVE:Medulloblastoma (MB) is the most common primary pediatric malignant brain tumor. Current molecular analysis classifies MB into 4 groups, classic (WNT), sonic hedgehog (Shh), group 3, and group 4. Atypical p53 signaling is associated with disease progression and confers poor prognosis. This study investigated the correlation of p53 mutation and status of iSO17q status with disease progression and metastatic potential. To investigate the effect of a HDAC inhibitor, a PI3K inhibitor, and a dual HDAC/PI3K inhibitor in aim of finding a novel therapeutic agent in p53-mutant MB cell line was used.
MATERIAL-METHODS:MB tumors (n=53) were evaluated for GLI-1, GAB-1, NPR, KV1, YAP expression and mutant p53 via immunohistochemistry and correlated to patient outcomes. Fluorescence-in situ hybridization (FISH) technique was used to determine the Isochromosome 17q(iso(17q)). Effect of small molecule inhibitors, targeting HDAC (LBH-589), PI3K (Buparlisib), and combined HDAC/PI3K inhibitor (CUDC-907) was assessed via functional assays (cell proliferation, migration, cell cycle, and drug resistance) in MB cell line.
RESULTS:We demonstrated high expression of GAB-1 and YAP in Shh group while KV1 expression was present in all subtypes. Mutant p53 was present in various subset of MB with no apparent correlation with metastasis or disease progression. Patient displaying iso17q exhibited metastatic disease. LBH-589, Buparlisib, and CUDC-907, caused a dose and time dependent inhibition of MB cell proliferation and migration. MB cells were resistant to PI3K inhibitor Buparlisib demonstrated by drug-resistance studies.These inhibitors may function by targeting mTOR signaling pathway.
CONCLUSION:Expression of GLI-1, GAB-1, NPR, KV1, YAP, and mutant p53 are essential criteria for defining metastatic potential of the MB sub-groups. Although a significant number of MB samples displayed mutant p53, their association with the disease remains elusive but presence of iso17q may define metastatic potential in MB. Furthermore, small molecule inhibitors of PI3K and HDAC provide a novel option for treatment of MB.

Keywords: Medulloblastoma, p53, SHH, metastasis

FL-128

Malignant non-DIPG pontine tumors in children

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OBJECTIVE:Pediatric Diffuse Intriinsic Pontine Gliomas (DIPGs) are considered to have a typical appearance on MRI but the development of newer molecular genetic techniques have led to reconsider the role of stereotactic biopsy.
MATERIAL-METHODS:We reviewed the MRI and histopathological datas from biopsies of 150 children with a suspicion of DIPG treated in our institution.
RESULTS:The majority of these diffuse lesions developed in the pons were indeed DIPG with H3K27 mutations (=Diffuse Midline Gliomas). However these biopsies allowed identifying other lesions mimicking a DIPG on MRI. Other tumor types were observed such as ATRT, PNET, Ganglioglioma with a double mutation of BRAFV600E and Histone K27, tumors with MYB-QKI rearrangements, ETMR (locus C19MC) lesions and High grade glioma with no Histone K27m but with amplification of Myc-N. Some of these lesions doesn't share the same dismal prognosis as DIPGs.
CONCLUSION:The majority of the diffuse lesions of the pons are DIPG. However, the recent discovery of new entities with different prognostic and treatment recommendations highlight the importance of the biopsy of such lesions to perform an integrated histo-molecular diagnosis

Keywords: DIPG, stereotactic biopsy, integrated histo-molecular diagnosis

FL-129

Comparison and statistical analysis of natural course and survival time among different treatment schemes in pediatric DIPG patients

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OBJECTIVE:To investigate the related factors affecting the survival time of children with DIPG, and discusses how to select the treatment for pediatric DIPG patients under the existing conditions.MATERIAL-METHODS:Clinical data of 134 DIPG patienets under 14years old diagnosed in Beijing Tiantan hospital between 2011-2017 were analyzed retrospectively. Univariate analysis was conducted to determine the influence of clinical, Analysis of the difference in survival time of DIPG patients with

different treatment options by using Kaplan-Meier method. The differences between groups were analyzed by a log-rank test. The factors ($P < 0.05$) in univariate analysis were analyzed by COX proportional hazards regression model in the multivariate analysis.
RESULTS:Univariate analysis showed that the factors influencing the survival time of children with DIPG included: age of onset, course of disease, pathological grade, operation and radiochemotherapy (all $P < 0.05$).
CONCLUSION:the survival time of children with DIPG is related to many factors. Surgical resection combined with radiotherapy and chemotherapy can prolong the survival time.

Keywords: diffuse intrinsic pontine glioma(DIPG),microsurgery,chemotherapy, radio-therapy

Session on Trauma

Hall B, Thursday, 24th October 2019, 08:00 - 09:05

FL-130

Outcomes of Decompressive Craniectomies in traumatic brain injury in the paediatric population

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OBJECTIVE:Decompressive craniectomy in traumatic brain injury in children has a potentially good outcome even in cases of severe TBI. The aim of this study is to provide evidence of the outcome of decompressive craniectomies in this population.
MATERIAL-METHODS:A retrospective review of prospectively collected data was conducted on all children (younger that 18 years old) that underwent a decompressive craniectomy for the management of traumatic brain injury either immediately or following optimal medical management of raised intracranial pressure between 2004 and 2018. Electronic and paper notes as well as imaging was reviewed and demographics, mechanism of injury, pre-operative GCS and pupil status, time to surgery and outcome including presence of epilepsy was recorded.
RESULTS:A total of 22 children had a decompressive craniectomy following TBI with average age at time of surgery of 10,2 years (range 2 months-17 years) and an average follow up of 4,4 years. Underlying mechanism was: Road traffic collision n=13, fall from height n=6, crushing injury n=1, gunshot wound n=1 and non-accidental injury n=1. Pre-operative GCS was <11 in all patients pre-operatively/pre-intubation, while for n=10 patients one or two pupils were fixed and dilated. For n=10 patients initial optimal medical management of raised ICP was attempted. For n=20 patients the outcome was good (return to school, non-severe disability/requiring less than full time care), while one patient has severe disability (NAI) and one patient died soon after the operation (crushing injury). From the 21 patients who survived, n=5 developed post traumatic seizures.
CONCLUSION:The most common cause of severe traumatic brain injury in children is a road traffic collision. Decompressive craniectomy in children has a favourable outcome even in severe traumatic brain injury and following aggressive medical management of high ICP while almost 1 out 4 children will develop post traumatic seizures.

Keywords: traumatic brain injury, decompressive craniectomy

FL-131

The ugly side of the coin: Cranioplasty after decompressive craniectomy in pediatric population – a meta-analysis

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OBJECTIVE:Contrary to the adult population, cranioplasty after decompressive craniectomy in pediatric population is still carrying the weight of unsolved problems, mainly due to the visible lack of alternative materials replacing the autologous bone, whose high rate of resorption may sometimes turn it to a liability. The purpose of our meta-analysis was to reflect the current state of affairs to open the door to improvements.
MATERIAL-METHODS:A systematic search was done in MEDLINE and Web of Knowledge databases for publications regarding the cranioplasty after DC in pediatric population, with the keywords cranioplasty, and 'pediatric' or 'children' along with any combinations of the words 'decompression', 'decompressive' or 'craniectomy'. The list was supplemented by reviewing the bibliographies of selected papers. Individual case reports as well as studies not providing quantitative data were excluded. In the end 7 retrospective case series were analysed. Obtained data included demographics, clinic at presentation, treatment protocols and outcome.
RESULTS:610 patients underwent cranioplasty after DC. Mean age was 8.35 years. Postoperatively 49 infections were seen leading to a re-surgery (8.03%). Out of 472 autologous cranioplasties, 138 had to be removed due to osteolysis (29.23%). In a study osteolysis was found to be most dependent on the age of the patient, with younger patients at higher risk for resorption, although this could not be checked due to the nature of the data on other studies. It was also interesting to note that a study showed an underlying contusion and the presence of comminuted skull fracture were independent risk factors for bone flap resorption, although this was not analysed in other studies.
CONCLUSION:Cranioplasty after decompressive craniectomy in pediatric population is a procedure prone to complications. Utmost care must be taken during the planning and performing the operation. Moreover, further studies are needed for finding ways to contain the complications in acceptable levels.

Keywords: cranioplasty, decompressive craniectomy

FL-132

Autologous cranioplasty after decompressive craniectomy in children – a single center experience

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OBJECTIVE:Autologous cranioplasty (AC) is commonly performed after decompressive craniectomy (DC). Protocols for bone flap preservation, timing and surgical technique vary between centers. In the absence of prospective randomized trials or large series, evidence based recommendations are lacking. In this study we reviewed our institutional series.
MATERIAL-METHODS:This is a retrospective study of AC performed in children after DC since 2010. According to our protocol, bone flaps are preserved in sterile packaging at -80°C. We analyzed relevant variables and performed descriptive statistics.
RESULTS:From a cohort of 15 children undergoing DC for trauma (N=12), hemorrhage (N=2) and ischemic stroke (N=1), 11 patients

survived and received AC (5 unilateral hemicraniectomies, 3 bilateral hemicraniectomies and 2 bifrontal craniectomies) or primary CAD CAM implant (1 unilateral hemicraniectomy with multiple fractures of autologous bone) after a mean latency of 1.5 months (range 1-2 months). Mean craniectomy area was 12166mm2 (range 7520-15933mm2). Complications occurred in 6 cases (2 hygroma, 2 CSF leaks, 1 subdural hematoma, 1 infection), requiring revision surgery in 2 cases (repair of CSF fistula and removal of infected bone flap). Osteolysis was observed in 8 autologous implants after a mean period of 19 months (range 4-54 months) and implantation of a secondary CAD CAM implant was performed. Mean follow-up was 25 months after DC (range 2-84 months).
CONCLUSION:Complication rate after cranioplasty was 43%, but the revision rate was only 14%. Bone flap resorption occurred in 62% and required implantation of a secondary CAD CAM implant in all cases. Considering this significant rate of osteolysis and thus revision surgery, it is worthwhile to identify high-risk patients who might benefit from a primary CAD CAM implant. However, due to variations in local protocols and overall low incidence of pediatric DC, such data would be best collected in a multicenter prospective registry.

Keywords: traumatic brain injury, decompressive craniectomy, cranioplasty, osteolysis

FL-133

Association between intracranial pressure and heart rate variability in children with severe traumatic brain injury

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OBJECTIVE:Autonomic dysfunction associated with traumatic brain injury (TBI) has been suggested as marker of severity and prognosis. Integrity of autonomic nervous system can be measured by heart rate variability (HRV). HRV is typically analysed using combination of a time-domain based index such as heart rate root mean squared standard deviation (HRRMSSD) and a frequency-domain based index such as the ratio of low to high frequency power (LHF ratio). This study aims to examine the association between intracranial pressure (ICP) and HRV indices. If a clinically meaningful correlation is observed, such association may be useful in management and prognosis of TBI patients.
MATERIAL-METHODS:We prospectively collected neuromonitoring data from children admitted to a paediatric intensive care unit with severe TBI between November 2016 and March 2019. Data collection, and calculation of HRRMSSD, LHF ratio every minute based on trailing 5 minutes of waveform ECG data were performed using ICM+ (Cambridge enterprises, UK). Analysis was restricted to the first 48-hours of neuromonitoring. Analysis also used grouped data based on progressively increasing ICP values (5-10, 10-15, 15-20, 20-25, 25-30 and >30mmHg).
RESULTS:47,676 minutes of paired HRV-ICP variables from 23 children were analysed. Both HRRMSSD and LHF ratio showed highly statistically significant, but only weak linear correlation [(r=0.21; p<0.001) and (r=-0.12, p<0.001) respectively] with ICP values (Fig 1, 2). When grouped, higher ICP value groups were associated with significantly higher mean HRRMSSD values (p<0.001) and lower mean LHF ratio (p<0.001) (Fig 3, 4). However, the magnitude of differences in actual mean HRV variables between the groups was small.
CONCLUSION:Despite the statistically significant association between ICP and HRV variables, weak correlation with ICP, relatively small differences and wide confidence intervals in HRRMSSD and LHF ratio between the different ICP groups, suggests that the association may not be clinically significant.

Keywords: Heart rate variability, Intracranial Pressure, Traumatic Brain Injury, Critical Care, Children

FL-134

How Does Vomiting after Pediatric Isolated Skull Fractures affect Admission Decision-Making and ED Revisit Rates?

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OBJECTIVE:Isolated, non-displaced skull fractures (ISFs) are a common, minor result of pediatric head trauma. They rarely require surgical intervention; however, many are admitted. This study investigates predictors of vomiting and ondansetron use following pediatric ISFs and the role that these play in admission decision-making and ED return visits.
MATERIAL-METHODS:Pediatric patients (<18 years old) who presented to the ED of a single tertiary care center between 2007 and 2017 with a non-displaced ISF were identified. Patients with intracranial hemorrhage, significant fracture displacement, or other traumatic injuries were excluded. Outcomes included vomiting, ondansetron use, admission, and 72-hour revisit following ED discharge. Both univariate and multivariate analysis were used to determine significant predictors of each outcome (p<0.05).
RESULTS:518 patients were included. Average age was 24.4 months and 59% (n=307) were male. Parietal (57%, n=293) and occipital fractures (28%, n=144) were most common. 24% of patients (n=124) experienced vomiting and 44% were admitted to the hospital (n=229). Of those patients with vomiting, 52% (n=64) received ondansetron. ED revisit rate was 4% (n=21), 52% of which (n=11) were due to vomiting. Following multivariate analysis, predictors of vomiting included older age and occipital fractures (Table 1). Predictors of ondansetron use included older age, motor vehicle collisions, occipital/temporal fractures, and vomiting. Predictors of admission included consultations to the neurosurgery, trauma, or child abuse teams. Patients presenting 24 hours after time of injury had lower admission rates. Ondansetron use was the single predictor of revisits after ED discharge.
CONCLUSION:In this study, older patients and those with occipital fractures were more likely to present with vomiting and be treated with ondansetron. Additionally, ondansetron use was found to be a significant predictor of revisits following ED discharge. Ondansetron could be masking recurrent vomiting in ED patients, and this should be considered when deciding which patients to observe further or admit.

Keywords: Isolated skull fracture, occipital fracture, ondansetron, ED revisit

Session on Vascular

Hall B, Thursday, 24th October 2019, 09:10 - 10:45

FL-136

Pediatric Moya Moya disease: clinico-angiographic outcome after surgical revascularization in 83 patients

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OBJECTIVE:Moya Moya is progressive occlusive disease affecting bilateral supraclinoid ICAs, proximal ACA and MCA. Revascularisation surgery improves cerebral blood flow in patients with ischemic disease. The study elucidates clinico-angiographic outcome after surgical revascularization.
MATERIAL-METHODS:We analysed discharge summaries and operation notes of pediatric Moya Moya disease operated from 2011-2018. Direct revascularisation entails STA-MCA bypass; indirect revascularisation include encephalo-duro-arterio-myosynangiosis(EDAMS) or encephalo-myosynangiosis(EMS). These patients were followed up clinically for improvement in symptoms. Follow-up angiogram were analysed to study extent of revascularisation.
RESULTS:Out of 83 patients, 34 were females(40.9%). Three(3.6%) patients presented with hemorrhagic stroke, 28(33.7%) with TIAs and 24(28.9%) with ischemic stroke. Thirty one(37.3%) presented with seizures, 68(81.92%) with limb weakness, 15(18.03%) with facial palsy and 3(3.6%) had visual deterioration. Ten(12.4%) had delayed developmental milestones and 19(22.89%) had speech impairment. Mean age of study population was 8.81 yrs. A total of 45 direct revascularisations – 18 double-barrel and 27 single-barrel STA-MCA bypass and 118 indirect revascularisations were performed(73 EDAMS+ 45 EMS along with direct revascularisation). Combined revascularisation(direct+indirect) was performed in 45 patients. The mean duration of surgery was 4.8 hours; average blood loss was 135.9 ml. In short-term follow-up, no seizures,meningitis, CSF leak, recurrent stroke or TIAs were recorded. In long-term follow-up(average 18 months),improvement in motor power was reported in 35(42.1%);rest remained neurologically static, with no worsening. Two patients in combined revascularisation group and 4 patients in indirect revascularisation group reported seizures. Angiographic data showed improved cerebral perfusion; angiographic outcome score was significantly better for transdural and leptomeningeal collaterals and area of perfusion($p>0.05$).
CONCLUSION:Early intervention in patients with Moya Moya disease can halt disease progression and surgical revascularisation has a significant impact on clinical outcome in form of durable protection from stroke and new onset seizures. The angiographic pattern following surgical revascularisation suggests improvement in good collaterals and positive correlation with clinical improvement.

Keywords: Moya Moya, stroke-in-young, revasularization, ST-MCA Bypass, EDAMS, EMS.

FL-137

Outcomes of revascularization surgery in pediatric Moyamoya disease– the Singapore experience

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OBJECTIVE:Moyamoya disease (MMD) is characterized by the spontaneous occlusion of the distal internal carotid arteries and resultant neoangiogenesis of fragile collateral blood vessels. Direct and indirect revascularization surgeries have shown to effectively reduce stroke risks in pediatric MMD[1-4]. However, such findings were largely confined to Korean and Japanese studies, where MMD has higher prevalence. This study was undertaken to determine the risks and benefits of indirect revascularization in our South-East Asian population.
MATERIAL-METHODS:We retrospectively reviewed case records of 16 paediatric MMD patients who underwent 24 indirect Extracranial-intracranial (ECIC) surgeries between January 2002 to January 2019 under Division of Neurosurgery at National University Hospital, Singapore and KK Women and Children's hospital.
RESULTS: Wilcoxon-signed Rank test revealed statistically significant improvement in MRS scores of paediatric ECIC bypass patients from baseline to discharge ($Z=-3.572$, $p<0.001$), and 3 months post-operatively ($Z=-2.451$, $p=0.014$). We observed 2 cases of peri-operative stroke within 1 month of surgery. Most patients were Matsushima grade B s/p ECIC bypass, via radiological investigations conducted at least 3 months post-operatively. No stroke recurrence was observed outside the peri-operative period, although 4 patients reported recurrent TIAs in the follow-up period (which ranged 3 months to 12 years).Chi-square test and Fisher's Exact test was used to find correlation between ischaemic recurrence with age, gender, ethnicity, cardiovascular co-morbidities, extent of lobe infarction, ASA score, peri-operative anti-platelet therapy. We observed that increased age had a significant correlation with risk of recurrent ischemic events ($p=0.04$). In addition, we noted an inverse relation between peri-operative aspirin use and ischemic recurrence, which reached near-significance ($p= 0.06$).
CONCLUSION:The study identifies the perioperative complication risks factors of revascularization surgery for Moyamoya disease and offers insight into the disease presentation in our regional population. This is the first study to date reporting the outcomes of indirect ECIC in a South-East Asian Population.

Keywords: Moyamoya disease, ECIC Bypass, Revascularisation, Encephaloduroarteriosynangiosis, encephalomyoarteriosynangiosis

FL-138

Indirect revascularisation surgery for childhood moyamoya arteriopathy – South African experience

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OBJECTIVE:Moyamoya disease is an increasingly recognized cerebral arteriopathy characterized by chronic progressive stenosis of the intracranial arteries, associated with cerebral ischemia,

accounting for about 6% of childhood strokes. There are extremely limited data on children with moyamoya arteriopathy from Africa, especially patients that have undergone surgical revascularisation. The authors present their experience with indirect revascularisation for pediatric moyamoya arteriopathy in the African context.
MATERIAL-METHODS:This is a retrospective review of 20 children with moyamoya arteriopathy treated by a single surgeon (LP). Demographic, clinical, radiological and perfusion (SPECT) imaging, operative and follow-up data were recorded to describe the temporal evolution of the pre- and post-operative status.
RESULTS:A total of 21 patients (11 female [52.3%] and 10 male [47.7%]), with a mean age at diagnosis of 3.6 years (SD 1.4 years) and a mean follow period of 4.1 years (SD 2.1 years). The mean Suzuki angiographic staging was 3.4 (SD 1.1), with 13 patients (61.9%) stage 3. All but 3 patients presented with bilateral disease, and 8/21 (38.1%) were moyamoya syndrome, (Downs' syndrome – 6, sickle cell anemia – 2) The mean number of pre-operative cerebral ischemic events was 4.7 (SD 1) compared to 0.19 (SD 0.03) ($p < 0.05$). All surgically treated patients underwent bilateral revascularisation, with 1 staged procedure, using a combination of pial synangiosis and multiple burrhole surgery. Complications were post-operative CVA – 1, post-operative seizure – 1, subgaleal CSF collection – 2 (19.05%), with no patients requiring repeat surgery.
CONCLUSION:Moyamoya arteriopathy is underdiagnosed in Africa, most likely due to lack of awareness of the disease. Treatment using indirect revascularisation techniques provides an effective approach which appears to provide protection from repeat cerebral ischemic events in the medium to long term.

Keywords: revascularisation surgery

FL-139

Moyamoya disease following proton beam therapy in childhood

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OBJECTIVE:Proton beam irradiation (PBI) is increasingly preferred to traditional radiotherapy for skull base lesions in children, due to potential reduction of exposure to surrounding tissues. We report a single institutional case series of children who developed symptomatic moyamoya vasculopathy after PBI.
MATERIAL-METHODS:Retrospective review of medical records including a neurosurgical operative database to identify patients who developed moyamoya following PBI. Data collected included oncological history, radiation dosimetry, time to onset of vasculopathy and clinical presentation.
RESULTS:Between May 2010 and Jan 2018, we identified seven children presenting with moyamoya who had previously undergone PBI. All children had parasellar tumours: craniopharyngioma (4), optic pathway glioma (1), Ewing's sarcoma of the temporal bone (1) and embryonal rhabdomyosarcoma of the nasopharynx (1). The median age at delivery of PBI was 4 years (interquartile range: 2 years to 6 years). The median time between irradiation and presentation of vasculopathy was 22 months (interquartile range 16 months – 38 months). 3 of the patients presented within 18 months of PBI. Patients first presented with TIA (4), stroke (1) or clinically silent infarcts identified on surveillance MRI (2). During the 10 year window March 2009-March 2019, a total of 67 patients underwent surgical revascularisation for moyamoya in our institution which included 4 of the 7 patients in this series. Only 1 of these 67 patients had previously received conventional radiotherapy.
CONCLUSION:Moyamoya vasculopathy is a potentially serious complication of PBI. Our data suggest that this risk may be higher than following conventional radiotherapy. The possibility of post-treatment moyamoya should be included whilst counselling patients pre-PBI. Further studies are required to assess the absolute risk of PBI induced moyamoya vasculopathy as well as the risk relative to conventional radiotherapy. MRA should be incorporated into the post treatment surveillance strategy for children with parasellar tumours who have received PBI.

Keywords: Moyamoya, Vasculopathy, Proton Beam

FL-140

Treatment of Cerebral Arteriovenous Malformations in Children

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OBJECTIVE:The objective of this study was to analyze clinical presentations and clinical and angiographic outcomes in pediatric populations under 16 years old, admitted in our institution from January 1990 to January 2018.
MATERIAL-METHODS:We admitted 63 patients with a diagnosis of cerebral arteriovenous malformations (AVM). Fifty-two patients were included in this study. Eleven patients had no further evaluation. All data, including clinical and imaging files, were collected retrospectively. The Spetzler-Martin grading system classified the AVMs.
RESULTS:Distribution regarding gender showed with 27 males and 25 females, with the mean age of 8,2 years of age (range 1y-16y). The clinical presentations were bleeding in 34 (64,3%), seizures in 8 cases (15,3%), progressive neurological impairment in 6 (11,5%), chronic headache without bleeding in 2 (3,8%), and incidental findings in 2 cases (3,8%). Based on the Spetzler-Martin grading system: 8 AVMs were grade I, 22 grade II, 15 grade III, 6 grade IV, and 1 grade V. 32 patients underwent microsurgical resection of the AVM. 29 out of 32 patients the surgery was performed during one month from the admission. For three patients the surgery was performed on a selective basis. Total obliteration of the nidus was obtained in 31/32. Only one patient had a residual lesion and needed a second surgery. Eight patients were referred to radiotherapy with total occlusion of the nidus in 3. Embolization was performed in 4 patients with total occlusion of the AVM in 1, and the association of Radiotherapy + Embolization were performed in 2 patients, with partial obliteration of the AVM. The remaining eight patients a conservative follow up was maintained. 30/32 patients operated on evolved with improvement or maintenance of the neurological condition.
CONCLUSION:Surgical treatment of cerebral AVMs in children performed during the acute phase is a safe procedure and offers good outcome.

Keywords: Cerebral arteriovenous malformations, Intracranial hemorrhage, Pediatric Neurosurgery

FL-143

Clinical characteristics of intracranial arteriovenous malformations in Children: Results of medium-term follow-up

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OBJECTIVE:To investigate the clinical characteristics and treatment of intracranial arteriovenous malformation (AVM) in children.
MATERIAL-METHODS:The clinical features of intracranial AVM in 35 children with an average age of 7.8 years were analyzed retrospectively.

Based on 28-78 months follow-up data, the effect of interventional embolization, gamma knife surgery or combination of both in the treatment of intracranial AVM in children was analyzed.
RESULTS:The ratio of male to female was 1.3:1, and 27 cases (27/35 77.1%) suffered from intracerebral hemorrhage. According to Spetzler-Martin classification standard, there were 3 cases of grade I, 13 cases of grade II, 12 cases of grade IV and 7 cases of grade IV, among which 28 cases (80%) were of low grade AVM. Of the 21 patients who underwent embolization, 4 had achieved one complete embolization and 15 had been treated with gamma knife surgery after embolization. 1 patient underwent surgical treatment after embolization. Complete excision of lesions was performed in 14 cases with direct gamma knife surgery. 13 cases had satisfactory curative effect, and there was no obvious residual vascular malformation after operation.
CONCLUSION:Intracranial AVM in children has the characteristics of small size, infantile morphology, low grade and easy to bleed. Interventional embolization combined with gamma knife surgery is a safe and effective method for the treatment of cerebral AVM in children.

Keywords: Intracranial arteriovenous malformation; Children; Digital subtraction angiography; Interventional embolization; Gamma knife

FL-144

Clinical features and outcomes of pediatric Intracranial aneurysm: 11 years' experience of a tertiary care hospital in a developing country

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OBJECTIVE:Pediatric intracranial aneurysm is extremely rare accounting for less than 5 % and due to its scarcity, the clinical features, coarse and outcomes are understudied. There is not a single study done from Pakistan which highlights its outcome. Our study aims to focus on the clinical and radio logical features, treatment options and outcomes of patients younger than 18 years of age.
MATERIAL-METHODS:A retrospective medical record review of pediatric patient treated at our university hospital between 2008 to 2018.
RESULTS:During the period of 11 years, 24 patients (20 males and 4 females) are treated at our center. More than 50% of the patients were presented with Headache, vomiting and loss of consciousness. 50%had good Hunt and Hess score (<2). 16 patient had sub arachnoid Hemorrhage. Two third of the aneurysms were small. Most common location of aneurysm was Internal carotid artery (37.5%) followed by Middle Cerebral Artery (29.2%) and Anterior Cerebral artery (16.7%). Only 16.7% of the aneurysm belong to Posterior circulation. Mean Hospital stay was 11.25 days. 13 patients underwent surgical clipping of aneurysm, 9 patients had endovascular treatment,1 had mycotic aneurysm and 1 had coil dislodged. On discharge, 62.5% of the patients had no symptoms at all (Modified Rankins 0), while only 25 % had modified Rankin's of more than 3.
CONCLUSION:Our study showed male predominance in pediatric intracranial aneurysms. It has been observed that most aneurysms are treated successfully with favorable outcome. Endovascular treatment is associated with shorter hospital stay. Long term follow-up is needed to rule out new arising aneurysm

Keywords: Aneurysm, Pediatrics, Clipping, Endovascular

FL-145

Developmental venous anomalies in pediatric neurosurgical practice

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OBJECTIVE:Developmental venous anomalies (DVAs) may be associated with distinct vascular brain malformations, especially cavernous malformations (CMs). In very rare cases, patients with DVA may develop ''de novo" CM in the close proximity. With more frequent use of MR, newly diagnosed pediatric DVAs come in focus of pediatric neurosurgeons more often than before. How to manage asymptomatic pediatric patients with diagnosis of DVAs remains an open question.
MATERIAL-METHODS:At Children's Hospital Zagreb-Klaiceva, in period from 2005 – 2018, all pediatric patients with diagnosed DVA were followed by periodic MR examinations. DVAs were classified by location and associated CM.
RESULTS:Among 130 pediatric patients with diagnosed vascular brain malformation, 85 patients had DVA (62 supratentorial, 22 infratentorial, 1 supra+infratentorial), 29 CM (25 supratentorial, 2 brainstem, 2 cerebellar), 14 arteriovenous malformation (13 supratentorial, 1 pontine), and 2 pontine capillary teleangiectasia. In patients with DVA, 3 of them had associated CM. Among them, one patient with cerebellar CM was operated after rebleeding of CM, and in one patient with right temporal DVA, multiple (two) ''de novo" CMs developed in the close proximity during follow-up.
CONCLUSION:Asymptomatic pediatric patients with brain DVA (with or without associated cavernoma) require careful clinical and MR follow-up, especially because of possible ''de novo" CM development.

Keywords: Developmental venous anomalies, Cavernous malformations, "de novo" cavernoma

FL-146

The work of the primary center of children's stroke in a multidisciplinary hospital

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OBJECTIVE:The number of detected cases of child stroke increases every year and is 2-13 cases per 100,000 children. Developing an algorithm for assisting children with stroke in the prehospital phase, creating a routing within the hospital to reduce the time of diagnosis.
MATERIAL-METHODS:A primary center for children's stroke has been functioning on the basis of a multidisciplinary hospital (MCCH) since April 1, 2014. During the existence of the center, ambulance delivered 1300 patients with suspected stroke, of whom 894 underwent a full diagnosis using a child stroke algorithm.
RESULTS:According to MCCH, 58.70% of cases are caused by ischemic stroke, hemorrhagic stroke in 36.50% and sinus thrombosis in 4.90% of cases. The main causes of the hemorrhagic stroke were: AVM, cavernous angioma, aneurysm, arterio-venous fistula. Creating a routing inside the hospital reduced the diagnostic time from 18 hours to 2 hours. An MRI diagnostic protocol has been developed for a stroke. The reduction in time made it possible to conduct thrombolysis (in 11 months, 9 thrombolysis and 1 thromboextraction were performed).
CONCLUSION:The creation of a primary center for child stroke is advisable on the basis of a multidisciplinary hospital because of the multifactorial etiology of child stroke. This allows you to

concentrate the main resources in one hospital and reduce the time to start treatment of the patient.

Keywords: Vascular, neurosurgery, stroke

FL-147

Cerebral proliferative angiopathy in children: a case series of 7 patients

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OBJECTIVE:Cerebral proliferative angiopathy (CPA) was described by Lasjaunias in 2008 as a separate entity from arteriovenous malformation (AVM). It is rare with less than 80 cases in the literature. We review paediatric cases from our institution.
MATERIAL-METHODS:Retrospective cohort study of all children with a diagnosis of CPA managed in our institution. Clinical, radiological and outcome data were obtained from the electronic patient record.
RESULTS:7 children were identified (5 female, 2 male). Mean age at presentation was 7 years (range 3-13). 6 children presented with focal neurological deficits (2 also had seizures) whilst 1 was an incidental finding. On MRI imaging, most (6) children had more than one brain lobe (most commonly frontal + parietal or temporal) affected. 5 were left hemisphere, 1 right and 1 bilateral. On angiography, all lesions had involvement of at least two feeding arteries, and 4 out of 6 lesions had both superficial and deep venous drainage. 6 out of 7 patients were managed medically (with anticonvulsants), while 1 was treated with chemotherapy and partial embolisation. Mean follow up was 6 years (range 1-10). At last follow-up, 5 children were modified Rankin score (mRS) 2 (slight disability, normal activity), 1 was mRS 3 (moderate disability, needs some assistance) and 1 was mRS 6 (died). The mortality was due to progressive neurological incapacitation. There were no haemorrhages in any patient. All patients remained on anticonvulsants at last follow up.
CONCLUSION:CPA presents a challenging clinical problem and outcomes are poor. Clinical/radiological presentation, prognosis and treatment, are quite distinct from "standard" AVMs. Due to the extensive size of these lesions curative microsurgical resection and embolisation appears impossible. Potential future treatment directions include systemic chemotherapeutic antiangiogenic agents, staged radiosurgery and indirect extracranial-intracranial revascularization surgery.

Keywords: cerebral proliferative angiopathy, vascular malformation, arteriovenous malformation, seizure, stroke

Session on Innovation and Technology

Hall B, Thursday, 24th October 2019, 11:15-12:15

FL-149

Developing a dynamic simulator for endoscopic intraventricular surgeries

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OBJECTIVE:A novel dynamic simulator brain model with hydrocephalus has been developed for intraventricular surgeries.
MATERIAL-METHODS:Detachable components allow us to enhance the walls of the ventricle by choroid plexus, ependymal veins and the floor of third ventricle which are derived from lab animal tissues and can be changed for every exercise. Ventricles are filled with injection of saline to give appropriate transparent medium and connected to a device transmitting pulsations creating conditions similar to live surgeries.
RESULTS:35 participants have used this model over the last one year and found it to be useful for conducting third ventriculostomy. Further development of the model for septostomy, aqueductoplasty and tumour biopsy have also been recently tested successfully by over 15 participants.
CONCLUSION:It is hoped that this simulator model for intraventricular endoscopy is comprehensive as a learning tool in carrying out the surgical procedures currently practised.

Keywords: Brain simulation model, Endoscopic third ventriculostomy, Intraventricular tumors, Septostomy, Tumor biopsy.

FL-150

Transcending the brain: is there a cost to hacking the nervous system?

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OBJECTIVE:Great advancements have recently been made in understanding the brain and the potential that we can extract out of it. Much of this has been centred on modifying electrical activity of the nervous system for improved physical and cognitive performance in those with clinical impairment. However, there is a risk of going beyond purely physiological performance improvements and striving for human enhancement beyond traditional human limits. Simple ethical guidelines and legal doctrine must be examined to keep ahead of technological advancement in light of the impending mergence between biology and machine. By understanding the role of modern ethics, this review aims to appreciate the fine boundary between what is considered ethically justified for current neurotechnology.
MATERIAL-METHODS:Published articles up to January 2018 from MEDLINE, PubMed and Ovid were used by searching for specific terms. We analysed the effects of neurotechnology including deep brain stimulation, transcranial direct current stimulation and brain computer interfaces in different perspectives including autonomy, commercial and societal implications, and distributive and legal justice. Keywords included Brain Computer Interface; Deep brain stimulation; transcranial direct current stimulation; neuroprosthetics; ethics; law.
RESULTS:The influence of neurotechnology can be devastastating and can lead to a number of negative consequences for both individuals and society. This can lead to a dystopian future where there is a greater increase in inequality from neurotechnology that can be used for enhancement as appose to treatment to improve cognition, and motor performance. Here we summarise the potential negative consequences of using this technology to improve those who are without disability.
CONCLUSION:Legal and ethical doctrine must be updated to meet the future concerns associated with the rising prevalence of neurotechnology

Keywords: Brain Computer Interface, Deep brain stimulation, transcranial direct current stimulation, neuroprosthetics, ethics, law

FL-151

3D printing in paediatric neurosurgery: an evolving tool

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OBJECTIVE:In this new era of technology, 3D printing is a rapidly evolving tool. Also known as additive manufacturing, 3D printing involves the construction of three-dimensional structures slice by slice. The technology has been translated for use in the field of neurosurgery, allowing neurosurgeons the ability to plan and create patient tailored surgery. There have been widespread investigations of its application in neurosurgical adult patients. Although 3D printing has made its way into paediatric neurosurgery, it is still in its infancy, with practice in this area comparatively lacking and yet to catch up. Research into the use of additive manufacturing in paediatric neurosurgery is reflective of this with a lack of literature available. The objectives of this study are to review and bring together global research data and case reports within this area, to understand current and future potential applications of 3D printing in paediatric neurosurgery.
MATERIAL-METHODS:A comprehensive systematic search was carried out in databases such as OVID MEDLINE, CINAHL, Embase, Cochrane Library and PubMed. A manual search for relevant articles was also carried out as literature within this field remains scarce.
RESULTS:In total, 39 studies relating to the use of 3D printing for paediatric neurosurgery, with 23 specifically related to paediatric cases, were identified. The main application of additive manufacturing in paediatric neurosurgery were found to be (i) surgical planning, (ii) prosthetics, (iii) tissue generation, (iv) simulation training and (v) drug printing. These uses spanned across cerebrovascular, neuro-oncological, spinal, endoscopic and functional neurosurgery.
CONCLUSION:Overall 3D printing was found to be a useful and accurate tool for paediatric neurosurgical planning, constructing tissue, implants, secondary devices and prosthetics, medication printing and education. The wide range of applications of additive manufacturing makes clear that advancements in 3D printing will benefit paediatric neurosurgery from many angles.

Keywords: cranial surgery, three-dimensional printing technology, children, brain, spinal cord

Nursing Symposium Abstracts

Hall B, Monday, 21st October 2019, 09:00 – 13:30

NS-001

Monitoring function in children with spinal lipoma through MDT assessment: Motor function and mobility

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OBJECTIVE:To monitor functional mobility of children with spinal lipoma who have a spectrum of neurological and urological presentations, contributing to musculoskeletal deformity, pain and motor deficits (Cochrane, 2000; Segal et al, 2013). Evidence to support prophylactic untethering is conflicting and current practice at GOSH is monitoring within an MDT clinic and intervene promptly if function deteriorates. Identifying deterioration is challenging as baseline function and presentations vary. GOS-ICH Paediatric Gait Centiles (GOS-ICH PGC) offer an alternative to standard mobility classification, often insensitive to symptom progression.
MATERIAL-METHODS:The gait profiles of 30 children with spinal lipoma who attended clinic between Jan 2013-June 2014 have been previously presented (Alderson et al 2015). Approval for retrospective review was granted by GOSH/ICH Research and Development Office. Routine data collection of gait measurements continued for children at risk of deterioration. Recovery of mobility after radical spinal untethering was also explored. All children walked across a 6 m pressure sensitive carpet, the GAITRite (R) 3 times at preferred speed. The GOSH-ICH PGC, developed from 650 typically developing children using Gamlss analysis (Alderson et al, 2019), were used to interpret the data.
RESULTS:Longitudinal gait data was collected for 7 children, 3 boys. Mean age at initial assessment 9.8yrs (range 4.7-14.1yrs). Velocity mean(sd) was 121.7cm/s (29.6) pre-operatively, 49.1cm/s (29.3) post-operatively, and 119cm/s (8.8) at follow-up. Data were plotted on the age and gender specific gait centiles (Figure 1).
CONCLUSION:Preferred walking velocity of children with lipoma falls within normal range for age. Progressive symptoms are associated with slowing of gait compared to peers; sometimes accompanying urological deterioration. The anticipated reduction in walking speed post-operatively improves over time, however subtle changes in walking performance in individual children are lost in an heterogeneous cohort. The GOS-ICH PGC allow individual changes to be tracked against expected developmental trajectories, and Z-scores allow for further analysis.

Keywords: paediatric, spinal lipoma, gait, velocity, centiles

NS-002

Assessing the importance of urodynamic investigation in children with lumbosacral lipoma

Lindy May
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OBJECTIVE:To assess the importance of urodynamic investigations in the management of children with lumbosacral lipoma (LSL) with regard to both their clinical status, and their Health Related Quality of Life (HRQL).
MATERIAL-METHODS:The urological function of 54 children with LSL was assessed using renal ultrasound and standardised Bladder Function Assessment (non invasive and if indicated, invasive studies) The HRQL of the same 54 children with LSL and neurogenic bladder was assessed using a standardised assessment tool.
RESULTS:Changes identified in results from urodynamic studies have guided management strategies including the decision for surgery.The results from the HRQL assessments have identified that disturbances in urinary function are associated with a reduced HRQL.
CONCLUSION:Regular Urodymanic assessment identifies the abnormal but stable status of bladder function in children with LSL, verses a deterioration which may herald the presence of tethered cord. Assessing the HRQL of this group of children helps target management strategies to address the issues often associated with a disturbance in sphincter function

Keywords: Urodynamic, lumbosacral lipoma, Health Related Quality of Life

NS-003

Comparison of Post-Operative nursing care of children following a Selective Dorsal Rhizotomy

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OBJECTIVE:Nottingham Childrens Hospital began performing SDR's in November 2010, initially only for Ambulant Spastic Diplegic patients, where the baclofen pump had failed /not beneficial and none compliance. Since 2018 all SDR's fitting the criteria for CTE process are funded by NHS England.NCH patients only remain an inpatient for 3 days following SDR surgery. They are encouraged to mobilise on the morning the day after surgery and are discharged the next day following a physiotherapy assessment. The physiotherapy is continued in their own home as an outpatient with community physiotherapist. Parents are also encouraged to play an active role in the child's physio after they are given specific exercises from NCH physio. Other centres keep their post op SDR patients flat, and nursed flat for the first 48 hours post procedure and remain an inpatient for 5 days before they are discharged to a hotel for up to 2 weeks for further hospital physio. This indicates a wide variation in the post-operative care between national centres and the need for standardised guidelines based on the best interests of the patient and their clinical outcomes.
MATERIAL-METHODS:data collection and patient interviews.
RESULTS:Nottingham Childrens Hospital found that patients benefitted from a shorter inpatient stay as they were more comfortable and relaxed in their home environment. Over 150 procedures have been performed after which there were no leakages and only 1 reported case of infections. The outcomes were comparable across all centres regardless of the post op management.
CONCLUSION:This highlights that the practice at NCH resulted in a more positive patient experience and is financially beneficial to the hospital and their families due to reduced length of stay. It is for this reason that NCH's practice should be considered as basis for a National guideline

Keywords: Post operative, selective dorsal rhizotomy,

NS-004

Tethered Cord

Bindu Peters
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OBJECTIVE:To discuss the operative room nursing role of a child who presented with a tethered cord.
MATERIAL-METHODS:Discuss the Pre,Intra and Post op care of patients diagnosed with Tethered spinal cord. Will review images, positioning and the monitoring needed to care for these patients in the OR. The nursing role will be highlighted in this presentation.
RESULTS:The operating room nurse plays a crucial role during the intraoperative phase. Communication with all members regarding positioning, allergies and potential issues that may arise is key.
CONCLUSION:The operative nurse plays a key role in the management of neurosurgical patients during all phases of care.

NS-005

Does neurological improvement continue following closure of open spina bifida- early results from tertiary Paediatric neurosurgical center?

Katie Herbert, Katherine Newport
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OBJECTIVE:At our tertiary centre we have established a multidisciplinary team (MDT) clinic to review all our patients operated for open Spina bifida at 3 months of age. We have documented changes in bladder emptying over this period in some patients. Our primary outcome was lower limb neurological function at 3 month of age and shunt insertion rate.
MATERIAL-METHODS:All patients with closure of meningocele and myelomeningocele (MMC) in the newborn period were reviewed in the combined neuro-urology MDT clinic. The neurological progress, bladder and bowel behaviour were all reviewed, with spinal motor level being formally reassessed by an independent physiotherapist. Spinal motor level at 3-month review was compared to that at discharge. Data presented as spinal motor level (interquartile range), and compared by Wilcoxon matched-pairs test, $P<0.05$ taken as significant.
RESULTS:There were 37 new patients referred in 2 years. 26 were MMC patients, who had neonatal repair surgery. 13 required ventriculo-peritoneal shunt (VPS): 5 VPS were performed during the same admission as the dysraphism repair, 8 subsequently at follow up. 15 had paired data available for analysis of spinal motor level. In MMC patients the spinal level was significantly lower from L3 (L2-5) at initial assessment to L4-5(L3 to S1) 3 months later, $p<0.01$.
CONCLUSION:The neurological level following back closure significantly improves over 3 months post-operatively. This has implications in terms of changing neurology especially affecting bladder drainage, needing reassessment. It also has implications for the improvement observed in fetal surgery for open spinal dysraphism.

NS-006

Collaborative working across the North East England

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OBJECTIVE: Paediatric Neuroscience Networks February 2012. Within the North East, the Operational Delivery Network was established as an effective way of promoting united working across the three tertiary units, Newcastle, Leeds and Sheffield. The group aim was to improve the patient and family experience through standardisation of patient care, provide peer support, education and clinical supervision, the development and implementation of Region wide guidelines across the North East of England.
MATERIAL-METHODS:Group membership includes ward managers and the network lead nurse. Terms of reference were agreed and a rolling agenda established including staffing, education, national priorities, benchmarking, NORCESS and ODN updates, case reviews, patient and parent experience and clinical supervision.
RESULTS:Achievements over the last 3 years include:
• 4 Regional Paediatric Neuroscience Nurse Education days
• Implementation of PNBG Neurosurgical Competency Documents
• The development and implementation of a regional EVD guideline
• The sharing of good practice such as frequent inpatient parent forums.
• Complex case reviews, enabling shared learning and improving practice region wide.
CONCLUSION:Future plans include the development of paediatric neurology competencies and the development of sub groups for individual areas of care has been identified. The "time out" for meetings has a direct impact on ward teams allowing members to regroup, focus, restructure and return to teams revitalised and motivated driving forward new innovative gold standard care for paediatric neuroscience patients, families and staff. The ongoing success is dependent upon the support of individual Trusts to acknowledge the importance of the group and releasing managers to attend.

Keywords: "Collaborative" "benchmarking" "clinical supervision"

NS-007

Burden among caregivers of children with ventriculo-peritoneal shunt

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OBJECTIVE:The low quality of life (QOL) among children with ventriculo-peritoneal (VP)shunt can result burden among their caregivers. Instead of significant development in the technology and design of VP shunt systems, shunt malfunctioning have been reported which further increases the morbidity and decreases the QOL of patients. Present study was conducted to assess the caregiver burden among caregivers of children with VP shunt.
MATERIAL-METHODS:An exploratory study was conducted to identify the QOL of children with VP shunt and its impact on burden among their caregivers. A total of 31 patient-caregiver pairs were selected through consecutive sampling technique. Consent was taken from the caregivers and ethical approval was obtained from Institute Ethics Committee. Structured interview of the caregivers was done using standard tools like hydrocephalus outcome questionnaire (HOQ) and modified caregiver strain index (MCSI).
RESULTS:Findings showed that mean age of children was 11.51 ±4.26 years and that of caregivers of children was 40.87±8.24 years. Mean score of QOL based on hydrocephalous outcome questionnaire was 143.05±43.72 (out of 212) among children underwent VP shunt. Among all four domains, cognitive domain was mostly affected among children with VP shunt. Severe burden was reported by 16% of the caregivers, moderate burden was reported by more than half of the caregivers (52%) and mild burden was reported by 32% of the caregivers of children with VP shunt. Caregiver burden was increased with low QOL of children ($p<0.001$).
CONCLUSION:The study concludes that children with VP shunt have low QOL, where cognitive domain of QOL was most affected. All caregivers of patients experienced mild to moderate caregiver burden which was influenced by poor QOL of patients. Hence appropriate nurse led interventions and holistic management by healthcare team is essential to improve QOL of patients with VP shunt and to reduce burden among caregivers.

Keywords: hydrocephalus, ventriculo-peritoneal shunt, quality of life, domains, caregiver burden

NS-008

The Role of Neurosurgery Nurses in Transitioning Youth with Hydrocephalus to Adult Healthcare

Cathy Cartwright
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OBJECTIVE:Children with hydrocephalus are growing to adulthood with a need to transition to an adult provider at age 18-22. There are 5,000 – 6,000 youth in the United States with hydrocephalus requiring transition to the adult health care system annually, but oftentimes successful transition does not occur due to barriers with patients and families, the healthcare system, and providers. Most adult neurosurgical practices are not designed to provide longitudinal care for patients with hydrocephalus. This results in a significant healthcare gap for patients with hydrocephalus.
MATERIAL-METHODS:To address these challenges the Hydrocephalus Association convened a transition summit in February 2017, inviting over 60 stakeholders to raise a call to action and set 5-10 year goals for transitioning youth with hydrocephalus throughout the US and Canada. Attendees included patients and their parents, neurosurgeons, neurologists, primary care physicians, nurses, social workers, and health system administrators.
RESULTS:This presentation will discuss the white paper describing barriers from the perspective of various stakeholders and strategies to overcome those barriers. A structured plan for purposeful transition is needed such as Got Transition (www.gottransition.org). This model has six core elements and starts at age 12 by introducing the topic of transition and progressively increasing the youth's responsibility for their healthcare through the teen and early adult years. If the youth is cognitively impaired, a responsible adult can learn resources for smooth transition.
CONCLUSION:Neurosurgery nurses should be aware of the importance of early discussion about transition and how to utilize the six core elements and other Got Transition resources in their practice.

Keywords: hydrocephalus, health care transition, youth, longitudinal care

NS-009

Nurse Led - Hydrocephalus shunt protocols

Jody Oconnor
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OBJECTIVE:Purpose Shunt infection is a major problem in paediatric neurosurgery. Our institution introduced a mandatory shunt protocol with the aim of reducing infection rate. Nursing - The Neurosurgery NP team led with the creation, initiation and monitoring of protocol.
MATERIAL-METHODS:Methods A retrospective cohort study including consecutive patients undergoing permanent shunt operations (primary insertion and revision) across two study periods: 3 years immediately prior (2009–2012) and 3 years immediately after (2012–2015) protocol introduction. Nursing - audits and analysis, MDT liaison.
RESULTS:Results Eight hundred nine operations in 504 children were identified (442 pre-protocol, 367 post). Overall infection rate decreased from 5.43% (24/442) pre-protocol to 3.27% (12/367) post-protocol, which did not reach statistical significance. For primary shunt insertions, infection rate reduced from 3.63 to 2.55%, whilst for revisions, it reduced from 6.83 to 3.81%Nursing 3-6 monthly M+M presentations.
CONCLUSION:Conclusion The protocol reduced overall infection rate in primary and revisionThe NP team is in a prime position to take the led on shunt protocols as they cover, pre op, peri-operative and post operative care.

Keywords: Hydrocephalus, Shunts, Shunt Protocol, Nursing

NS-010

Management of hydrocephalus in Craniosynostosis – A different ball game altogether

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Birmingham Women's and Children's NHS Foundation Trust, Birmingham, UK

OBJECTIVE:Hydrocephalus with craniosynostosis is well recognised, especially in syndromic multisuture craniosynostosis. The aetiology is multifactorial. While diversion procedures are reliable in treating non-synostotic hydrocephalus, they can be less reliable and even unhelpful as primary procedures

in craniosynostosis. We present our experience in the management of hydrocephalus in the presence of craniosynostosis.
MATERIAL-METHODS:Of the 1169 craniosynostosis patients treated in our unit over the last 12 years, 169 (14%) had syndromic craniosynostosis; 21 of these had hydrocephalus (N=21). We divided them into two groups, and compared their outcomes. Group A – Those who had CSF diversion as a primary procedure prior to calvarial expansion procedures (N=8). Group B – Those who underwent calvarial expansion procedure as a primary procedure with or without subsequent CSF diversion (N=13).
RESULTS:Group A were associated with increased complications when compared to Group B (87% vs 8%). Majority of these complications were a consequence of CSF diversion procedure and sometimes resulted in a delay in definitive treatment or required multiple calvarial remodeling interventions.
CONCLUSION:Hydrocephalus in craniosynostosis is a different entity to non-synostotic hydrocephalus. If possible primary treatment should address craniosynostosis rather than hydrocephalus. Further monitoring should be undertaken to evaluate the need for further calvarial surgery or a CSF diversion. This may avoid the need for any CSF diversion procedure and their associated side effects.

NS-011

Evaluating the Quality of Care for a Paediatric Nurse-led Hydrocephalus Clinic

Sarah Kvedaras
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OBJECTIVE:Traditionally annual reviews for children with a ventricular peritoneal shunt in-situ took place in a consultant outpatient clinic. In 2011, the nurse-led hydrocephalus clinic was set up to redirect patients to the care of the clinical nurse specialist (CNS). The literature states the CNS has high level skills to support a particular client group and can undertake clinics to support patients along a care pathway. Further to this they provide patient-centred holistic care. The aim of the clinic set up was to reduce waiting times by freeing up spaces in the consultant clinic. Also to provide a specialist holistic service for the client group to receive their annual review.
MATERIAL-METHODS:The project aim is to evaluate the quality of care offered within the nurse-led clinic. This involved examining clinical audit data regarding clinic uptake and patient waiting times into the neurosurgical outpatient service. A parent satisfaction survey has also been undertaken between January and April 2019.
RESULTS:Waiting times for the consultant outpatients clinics have reduced by two weeks between 2011 and 2018 however, there is not clear evidence this is due to the introduction of the nurse-led clinic. Attendance in the clinic has grown significantly from 10 patients in 2011 to 64 patients in 2017/2018. Parent satisfaction surveys were completed by 15 families, these demonstrated high satisfaction with the clinic which meets the needs of the parent and child, offering holistic service.
CONCLUSION:The positive parental feedback from the nurse-led clinic demonstrates a high level of satisfaction. The feedback shows that families feel listened to by the CNS, with information provided that parents could understand clearly. With over 60 patients seen per year in the nurse-led service, a significant number of consultant clinic appointments have been freed up due to the nurse-led service. Clinic capacity is up to 80 spaces per year so further analysis needs to take place to examine DNA rates for the clinic.R&D approval was sought and granted for this project by Cardiff University and Cardiff and Vale UHB.

Keywords: CNS

NS-012

An exploration of the appropriateness of the Glasgow Coma Scale as an assessment tool for ascertaining the conscious level in children under 2 years old from a nursing perspective

Rebecca Cooper
Children and Young Person's Integrated Cancer Service, Nottingham University Hospitals Trust, Nottingham, United Kingdom.

OBJECTIVE:Despite multiple studies that assess whether the Glasgow Coma Scales (GCS) is appropriate in a clinical setting (Trauma, 2011) and others that assess the nurses using the scale (Mattar et al, 2013), there is a lack of literature based on the opinions of the nursing staff using the GCS as part of their everyday work.
Therefore, the objectives of ascertaining nursing staffs' opinions were;

• Identification of commonality and/or disparity of perceptions of the ease of use of the GCS.
• Identififfication of commonality and/or disparity of perceptions of the appropriateness of the GCS on paediatrics under two years of age.
• Identification of differing perceptions relating to whether any improvements can be made to the GCS.
MATERIAL-METHODS:This study explored the nurses' views on the use of the GCS in paediatric patients, using a self-completed questionnaire.
RESULTS:Results of the study demonstrated that nursing confidence was lower in assessing paediatrics under 2 years old than paediatrics over 2 years old. Although the nursing staff felt that the GCS provided some guidance on ascertaining a patient's coma score, they had to rely on their own judgement to perform the assessment. This resulted in discrepancies in assessment scores between nurses which the nurses felt would affect patient care. The results of the study highlighted a lack of nursing knowledge regarding the availability of other assessment tools and a requirement for more research into GCS.
CONCLUSION:This study found that although the nursing staff has confidence in their own assessment of a child's conscious level, there are often discrepancies in nurses scorings, due to the requirement to use their own judgements alongside the scale scorings. This suggests the Glasgow Coma Scale is failing as a standardised way to describe the level of consciousness of paediatrics under 2 years old with consistent good inter-rater reliability (Rowley et al, 1991).

Keywords: Glasgow Coma Scale

NS-013

Perioperative Nursing Experience of 20 Cases of Ischemic Moyamoya Disease Treated by Combined Vascular Bypass Surgery

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OBJECTIVE:To explore the perioperative nursing points of combined vascular bypass surgery in children with ischemic Moyamoya disease.
MATERIAL-METHODS:A retrospective review of clinical data of 20 children (2.5-9 years old, mean 2.5 years old, 11 cases of TIA, 7 cases of cerebral infarction) with ischemic Moyamoya disease treated with vascular bypass surgery (Direct vascular reconstruction + Indirect revascularization) and an analysis of their perioperative nursing process and main nursing measures.

RESULTS:One of 20 patients had postoperative transient ischemic attack and improved within two weeks; one patient developed epilepsy on the second postoperative day, and massive contralateral cerebral infarction on the eighth day; one patient developed epilepsy after one month of discharge and improved after taking antiepileptic drugs. All other children were followed up after 6 months, and the symptoms of ischemia were significantly improved.
CONCLUSION:Close observation of changes in patients' physical condition, prevention and early detection of complications, well perioperative care (blood pressure management, access management, medication management, psychological care, etc.) can effectively reduce transient ischemic attack and help improve the quality of life of child patients.

Keywords: Ischemic Moyamoya disease in children; Combined vascular bypass surgery; Nursing.

NS-014

A qualitative approach to identifying patients and carers experiences receiving their chemotherapy on the neurosciences ward

Grace Elizabeth Marston
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OBJECTIVE:OBJECTIVE: To identify patient and/or carer experience on receiving chemotherapy on a neuroscience. To identify if it is beneficial to the patient not to transition to the oncology ward. A qualitative approach of a questionnaire and face to face interview.
BACKGROUND: At Nottingham Children's Hospital (NCH) patients of brain tumours are cared for on the same neurosciences ward and receive their chemotherapy there. In other centres nationally brain tumour patients are transitioned to oncology wards after surgery. Rational: To identify if being cared for on the same ward is more beneficial for the patients/carers and if it improves outcomes of better discharge and emotional/psychological effects.
MATERIAL-METHODS:METHOD: A questionnaire to be sent to patients who have received neurosurgical input and received chemotherapy over the past year (February 2018-February 2019). Due to continuation of care and improved patient experience of knowing the team of people.
RESULTS:Initial results identify a preference for treatment to be continued on the neurosciences ward. Positives and negatives were identified from receiving chemotherapy on the neurosciences and oncology ward. The benefit of continued rehabilitation with experienced neuroscience nurses and the knowledge of recognising neurological deterioration was a comfort to patients and their families. All results will be further explored.
CONCLUSION:The overall preference from parents is to continue care on the neurosciences ward due to familiarity. Another factor is due to the complexity of brain tumours and variety of complications not associated with other forms of cancer there is a probability symptoms that could be misidentified.

Keywords: neuro-oncology, transition, chemotherapy,

NS-015

Pediatric cranial vault reconstruction, best practice from nursing perspective

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OBJECTIVE:The purpose of this paper is to discuss the comprehensive approach to the cure and treatment's pathway on the pediatric patient with both syndromic and non-syndromic craniosynostosisFocusing on two main issues:-Prevention of the negative surgical outcomes (i.e. blood loss, pain), throughout both pharmacologic treatments with use of morphine and fentanyl for breakthrough pain, and non pharmacologic interventions such as: creation of a comfortable environment for the patient both pre and post surgery, support to parents throughout all the treatment's steps-Central role of the nursing on two different roles: liaison between the patients, their family and the surgical team, and provider of direct care and technical reference (instrumentations and implants) within the theater, to be considered as key factors for a successful treatment.
MATERIAL-METHODS:treatment's pathway on the pediatric patient with both syndromic and non-syndromic craniosynostosis.
RESULTS:-Prevention of the negative surgical outcomes (i.e. blood loss, pain), throughout both pharmacologic treatments with use of morphine and fentanyl for breakthrough pain, and non pharmacologic interventions such as: creation of a comfortable environment for the patient both pre and post surgery, support to parents throughout all the treatment's steps.
CONCLUSION:-Central role of the nursing on two different roles: liaison between the patients, their family and the surgical team, and provider of direct care and technical reference (instrumentations and implants) within the theater, to be considered as key factors for a successful treatment.

Keywords: syndromic,non-syndromic,craniosynostosis,nursing role

NS-016

The National Paediatric Neurosurgery Benchmarking Group: Paediatric Neurosurgical Nurse Competency Framework

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OBJECTIVE:The National Paediatric Neurosurgery Benchmarking Group (PNBG) is a group of paediatric neuroscience nurses who network, share research, devise evidence based practice guidelines, and benchmark care provision against specified standards. A standard set out in the NHS England 'Children's Neuroscience Networks (for the neurosurgical Child) Specification Standards' states that paediatric neurosurgical patients should be cared for by paediatric registered nurses 'appropriately trained in paediatric neurosurgery'.What constitutes 'appropriately trained' and how to quantify this?
MATERIAL-METHODS:A BPNG open discussion concluded the need for a nationally recognised composition of specialist standards, which would render a paediatric nurse 'neuro competent'. Competency booklets would best fulfil this role, providing an opportunity for education and training - thus enhancing nurses' knowledge and skills and in turn, provision of care. The BPNG developed 6 competency booklets. The knowledge and theoretical component of the competency framework was to be assessed in levels 1-3, beginner, intermediate and advanced. The clinical skills are assessed in levels 1-5 according to the national competency levels. Each

competency is divided into 3 parts – Underpinning knowledge & Theory, Clinical skills & Discharge planning.Audit of uptake, effectiveness, and perceived relevance to clinical practice of initial competency documents [by service users] was undertaken and guided subsequent content..
RESULTS:Completed competencies include; anatomy and physiology of the brain and spine, hydrocephalous, brain tumours, head and spinal injury, endocrine, spinal dysraphism and spinal surgery. Utilisation is varied across centres and includes:
• Information source
• Education Framework
• Incorporation in annual appraisal
• NMC revalidation.
• National standardisation of care
• Cross speciality education source
CONCLUSION:Development continues, aligned with medical advancements and changes in clinical practice. This is reflected in the responsibilities of the PNBG and is clarified in the terms of reference. Future aspirations of the project include accreditation with an allied university and sharing the competencies internationally.

Keywords: nursing, neurosurgical, competencies, paediatirc

NS-017

History of Craniopagus Twins and the Nursing Role

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OBJECTIVE:To discuss a series of Craniopagus Twins consulted and/or treated by Montefiore Medical Center. To discuss Nursing Implications, Roles and responsibilities.
MATERIAL-METHODS:Review of 10 cases of conjoined twins, discuss management including surgical, medical and nursing outcomes.
RESULTS:Careful selection of cases, a staged approach to separation along with diligent nursing care can predict a successful outcome in these cases.
CONCLUSION:Nursing is in integral part of the overall management of Craniopagus twins throughout all phases of care. Preparation the nursing staff is key to providing confidence and knowledge to manage these rare cases.

Keywords: Craniopagus Twins

NS-018

Nursing Care Around the World, Different Names Same Game

Theresia Alex
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OBJECTIVE:To compare and contrast various nursing roles around the world.
MATERIAL-METHODS:An analysis of the nursing job description from different countries were analyzed and compared to determine similarities and differences in care.
RESULTS:Standard nursing care is universal, however there are various levels of nursing that vary from country to country. Basic nursing skills were similar for entry level nursing, once job descriptions were analyzed for specialized and higher education positions the role began to var.
CONCLUSION:Nursing has grown over the few decades and the role is evolving around the world this presentation will focus on the nurse processes that guide care in the US. We will compare to nursing care in various countries.

NS-019

Note keeping across surgical specialities at a regional paediatric centre

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OBJECTIVE:Medical note keeping is an essential part of healthcare. It is integral to maintain medical continuity of care, patient safety, and ensures accurate medical communication. It is increasingly important for research, audit, coding and medico-legal purposes. The CRABEL score (2000) was devised to help standardise medical entries. The core elements consist of initial admission clerking, subsequent entries, consent and discharge communication.
MATERIAL-METHODS:We audited the quality of note keeping at Birmingham Children's Hospital across the surgical specialities. This was a retrospective audit. Consent was obtained from all surgical divisions. Notes of 10 randomly selected patients from each discipline were carefully screened and scored against the CRABEL score. Nursing and allied health care staff scored out of 60 points for medical entries as the other components did not apply. The results of the first audit were presented to management, and fed back to each surgical discipline. Thereafter a reaudit was conducted to close the loop.
RESULTS:The initial audit took place in 2015. Issues noted were poor filing of paper notes and records not being available at the time of clinical entry. This was re-audited and the results were compared which are as follows: Nursing and allied health care staff were significantly better than then medical staff (81.6% vs 63.7%) in 2015. Both groups noted a generous improvement in overall quality of records from 2015 to 2019, medical staff went from 63.7% to 90.4% and nursing / allied health care staff went from 81.6% to 94.9%.
CONCLUSION:Medical note keeping needs to be continually validated for its quality to ensure best patient care. With the use of electronic patient records (EPR), most of the CRABEL score criteria can be electronically stamped, ensuring mandatory fields and optimising record keeping. Furthermore EPR can be integrated into surgical operation notes, observation chart documentation and discharge letters.

Keywords: Note keeping

List of posters presented at 47th ISPN Annual Meeting

Poster Session 1: Monday, 21 October 2019

Pub Number	Topic	Title	Presenter	Country
PP-001	Craniofacial Surgery	Why do metopic sutural synostoses angulate? The concept of nasion-sutural complex and its implication on the management of hypotelorism- Early results and proof of concept	Suhas Udayakumaran	India
PP-002	Craniofacial Surgery	Craniofacial distraction osteogenesis with rigid distractors for the treatment of syndromic craniosynostoses. a fifteen-year experience in a single center	Ricardo Santos De Oliveira	Brazil
PP-003	Craniofacial Surgery	Fronto-orbital Advancement and Posterior Cranial Vault Expansion using Distraction Osteogenesis in Patients with Multiple Craniosynostosis	Muhammad Kamil	Japan
PP-004	Craniofacial Surgery	Combining Preoperative Erythropoietin and Intraoperative Tranexamic Acid Reduces Transfusions in Sagittal Craniosynostosis Surgery	Albert Tu	United States
PP-005	Craniofacial Surgery	Multi-directional Cranial Distraction Osteogenesis (MCDO) procedure for scaphocephaly	Masahiro Kameda	Japan
PP-006	Craniofacial Surgery	Problems in instrumentation of Syndromic Craniovertebral Junction anomalies	Natarajan Muthukumar	India
PP-007	Craniofacial Surgery	The efficacy of complementary neurosurgical treatement in prevention of neurological complication of osteopetrosis	Federico Di Rocco	France
PP-008	Craniofacial Surgery	Asymmetric Postoperative Intracranial Hypertension on a Complex Craniosynostosis After Endoscopic Single Coronal Suturectomy with contralateral early closure: a case report	Santiago Candela Canto	Portugal
PP-009	Craniofacial Surgery	Efficacy of the LeFort IV osteotomy for syndromic craniosynostosis	Tomoru Miwa	Japan
PP-010	Craniofacial Surgery	Late presentation of black children with isolated sagittal synostosis to craniofacial service	Ning Zhu	United Kingdom
PP-011	Craniofacial Surgery	The decision making of less invasive surgical indication in craniosynostosis using the ratio of grey matter and white matter volume to cerebrospinal fluid and vessel volume between pre and post operation	Hirokazu Nakatogawa	Japan
PP-012	Craniofacial Surgery	Local Experience on the Long-Term Outcome of Cranial Vault Reshaping Surgery in Craniosynostosis Patients: A Case Series	Fadzlishah Johanabas Rosli	Malaysia
PP-013	Craniofacial Surgery	Familial scaphocephaly and a novel variant in FGFR2	Federico Di Rocco	France
PP-014	Craniofacial Surgery	Experience in the treatment of patients with non-syndromic cranio-synostosis based on MCCH	Boris Oleynikov	Russia
PP-015	Craniofacial Surgery	evaluating the improvement of developmental delay using new version of K-type developmental inspection for mild trigonocephaly	Takayuki Inagaki	Japan
PP-016	Craniofacial Surgery	Surgical procedures of non-syndromic sagittal craniosynostosis by the type of cranial shape	Daiki Senda	Japan
PP-017	Craniofacial Surgery	Reconstructive surgery following decompressive craniectomy for traumatic and non-traumatic raised intracranial pressure: A 15-year experience of a single centre	Marina Pitsika	United Kingdom
PP-018	Craniofacial Surgery	The use of CAD-CAM for craniosynostosis: Custom surgical adjuncts	Pasquale Gallo	United Kingdom
PP-019	Craniofacial Surgery	A Comparison of Techniques for Cranial Vault Reconstruction Between Syndromic and Nonsyndromic Coronal Synostoses	Jared Paul Golidtum	Philippines
PP-020	Craniofacial Surgery	Fronto-nasal meningoencephalocele: Study of 4 cases in the Department of Paediatric Neurosurgery, National Institute of Neurosciences and Hospital, Bangladesh	Muhammad Arif Hossain	Bangladesh
PP-021	Craniofacial Surgery	The impact of multidisciplinary team in craniosynostosis surgery. Complications' analysis before and after a strict protocol. Comparison between two periods (2014-2016 and 2017-2019)	Alexandre Casagrande Canheu	Brazil

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PP-022	Craniofacial Surgery	Anterior Cranial Remodeling and Unilateral Orbital Advancement using the modified buttress technique in a Nigerian child with left Coronal Craniosynostosis: A case Report	Gyang Markus Bot	Nigeria
PP-023	Craniofacial Surgery	Intracranial hypertension in a craniosynostotic patient with telemetric ICP probe in situ, shows rapid resolution with posterior cranial distraction	Teddy Totimeh	United Kingdom
PP-024	Craniofacial Surgery	Preoperative Planning of Craniosynostosis Correction using 3D Printed Models	Luiza Narche	Brazil
PP-025	Hindbrain Hernia & Syringomyelia	For Decompression of Chiari Type 1 Malformations Length of Surgery Correlates with Length of Hospitalization	Paul Arthur Grabb	United States
PP-026	Hindbrain Hernia & Syringomyelia	Chiari I malformation in children. Our experience with the evaluation of a series of 91 patients	Carmine Mottolese	France
PP-027	Hindbrain Hernia & Syringomyelia	Acquired Chiari Malformations; Mechanisms of Hindbrain Herniation	Dale M Swift	United States
PP-028	Hindbrain Hernia & Syringomyelia	Surgical outcomes and morphometric backgrounds of pediatric Chiari type 1 malformation	Ryo Ando	Japan
PP-029	Hindbrain Hernia & Syringomyelia	Bony decompression without duraplasty for Chiari I malformation: long-term follow-up	Luca Massimi	Italy
PP-030	Hindbrain Hernia & Syringomyelia	C1-C2 Facet Joint Distraction with Allograft in Occipitocervical Fusion for An Iatrogenic Basilar Invagination in Chiari II	M. Burhan Janjua	United States
PP-031	Hindbrain Hernia & Syringomyelia	Chiari III Malformation: a Case Report	Alvi Aulia Rahmah	Indonesia
PP-032	Infection	Surgical Management of Spontaneous Paediatric Intra-cranial Suppuration. A Single Centre Experience	Milan Makwana	United Kingdom
PP-033	Infection	Resident microorganisms in the Neurosurgical theatre	Yasir Chowdhury	United Kingdom
PP-034	Infection	Surgical management of raised intracranial pressure secondary to otogenic infection and venous sinus thrombosis	Rhian Bevan	United Kingdom
PP-035	Infection	Surgical indication of decompressive craniectomy to severe brain edema associated with viral encephalopathy	Goichiro Tamura	Japan
PP-036	Infection	Subdural empyema in children: a cohort study	Fahid Tariq Rasul	United Kingdom
PP-037	Infection	Endoscopic Management Of Refractory Ventriculitis following Shunt Infection, Technical Note	Mahmoud Aly Abbassy	Egypt
PP-038	Infection	Surgical Techniques for Tuberculosis of the Cerebellum and Craniovertebral Junction in Children	Eric Paolo Palabyab	Philippines
PP-039	Infection	Endoscopic Ventricular washout with Drainage, Irrigation and Intraventricular Vancomycin Therapy (DRIIVT) in the Treatment of Ventriculitis: A case report and a proposed method of Treatment	Gyang Markus Bot	Nigeria
PP-040	Infection	Neonate brain abscess by Cronobacter spp: an emerging powdered infant formula's opportunistic pathogen	Barbara Albuquerque Morais	Brazil
PP-041	Infection	Endoscopic treatment of pyogenic ventriculitis in the paediatric population: a case series and reappraisal of the technique	Barbara Albuquerque Morais	Brazil
PP-042	Spine	Systematic Review of Spinal Deformities Following Selective Dorsal Rhizotomy	Paige Selvey	United States
PP-043	Spine	Pattern of non-congenital spinal conditions in Sudanese children	Abubakr Darrag Ahmed	Sudan
PP-044	Spine	A Learner's Experience in Managing Pediatric Spinal Tumors: A Case Series	Siaw Nee Low	Malaysia
PP-045	Spine	Instrumented Lumbosacral Fusion In Sacral Type III Fractures With Kyphotic Deformity In Children	M. Burhan Janjua	United States
PP-046	Spine	Surgical indication and outcomes for postoperative tethered cord syndrome in patients with Myelomeningocele	Dan Ozaki	Japan
PP-047	Functional	Magnetic Resonance-guided Laser Interstitial Thermal Therapy for the Treatment of Non-lesional Insular Epilepsy in Pediatric Patients: Thermal Dynamic and Volumetric Factors Influencing Seizure Outcomes	Chima O. Oluigbo	United States
PP-048	Functional	Deep brain stimulation for pantothenate kinase-associated neurodegeneration: a meta-analysis	Philippe De Vloo	United Kingdom

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PP-049	Functional	Dorsal nerve rootlets cutting comparison of different neuromonitoring protocol guided single-level laminectomy selective dorsal rhizotomy	Bo Xiao	China
PP-050	Functional	Effectiveness of cranial expansion to treat microcephalic pediatric patients with socio-emotional abnormality	Yanyan Wang	China
PP-051	Functional	Intrathecal Baclofen Therapy - Practical Approach: Patient selection and Adjusted Management	Liana Adani Beni	Israel
PP-052	Epilepsy	Treatment outcome of vagus nerve stimulation and/or corpus callosotomy for younger patients with severe drug-resistant epilepsy	Keisuke Ohtani	Japan
PP-053	Epilepsy	Comprehensive nursing experience of Epilepsy patients with intracranial electrode implantation	Huan Jin	China
PP-054	Epilepsy	Analysis of phase-amplitude coupling between fast and slow oscillations in scalp electroencephalography: Comparison with focal and generalized onset epileptic spasms	Yasushi Iimura	Japan
PP-055	Epilepsy	Frameless Robot-Assisted MRI-Guided Laser Insterstitial Thermal Therapy (LITT) for a Hypothalamic Hamartoma (HH) in a Pediatric patient. Surgical technique	Santiago Candela	Spain
PP-056	Epilepsy	Life-threatening secondary hemophagocytic lymphohistiocytosis following vagal nerve stimulator infection in a child with CHD2 myoclonic encephalopathy	Cristiano Parisi	Italy
PP-057	Epilepsy	Multinodular and Vacuolating Neuronal Tumor associated with Focal Cortical Dysplasia in a Child with Refractory Epilepsy: a case report and brief review of literature	Santiago Candela Canto	Portugal
PP-058	Epilepsy	Vagal Nerve Stimulation Surgery for medically refractory epilepsy: A case series study in a single institute	Kai Rui Wan	Singapore
PP-059	Epilepsy	A Review of Safety and Efficacy of Rapid Ramping Protocol for Vagus Nerve Stimulation in Children	Zubhair Tahir	United Kingdom
PP-060	Epilepsy	Usefulness of Intraoperative Ultrasound (IOUS) for Focal Cortical Dysplasia (FCD) and its histopathological correlation in epilepsy surgery in pediatric patients	Santiago Candela Canto	Spain
PP-061	Epilepsy	Vagus nerve stimulation for severely disabled children with medically refractory epilepsy	Takamichi Yamamoto	Japan
PP-062	Epilepsy	Pediatric Epilepsy surgery. An analysis of seizure and surgical outcome 170 cases treated over 17 years period	Dattatraya Muzumdar	India
PP-063	Epilepsy	Epileptogenic Lesions in Pediatric Patients	Javier Terrazo Lluch	Mexico
PP-064	Epilepsy	A struggle with seizures, developmental and aggression- is there a cause? A Case Report	Ben Walters	United Kingdom
PP-065	Epilepsy	Pediatric Intracranial Arteriovenous Malformations and Epilepsy: A Case Series and Review of the Literature	Rebecca Y Du	United States
PP-066	Epilepsy	A Case Report of a Cerebellar Gangliocytoma which Presented Intractable Epilepsy just after Birth	Tae Kyun Kim	Japan
PP-067	Epilepsy	Functional cortico-subcortical reorganization after surgical hemispheric disconnection for intractable epilepsy	Thomas Blauwblomme	France
PP-068	Epilepsy	Surgical treatment of the pediatric refractory epilepsy generated by hemimegalencephaly: a clinical epidemiological study	Felipe Issa Chodraui	Brazil
PP-069	Epilepsy	Long-term follow-up of children who have undergone vagus nerve stimulation for intractable epilepsy	Anna Oviedova	United Kingdom
PP-070	Hydrocephalus	Hydranencephaly complicated by central diabetes insipidus: report of two cases and systematic review of literature	Abdelsimar Tan Omar	Philippines
PP-071	Hydrocephalus	Surgical approaches for the treatment of trapped fourth ventricle (review of literature and &role of neuroendoscopy)	Mohamed Mohsen Amen	Egypt
PP-072	Hydrocephalus	Extracranial outflow of gold particles in cerebrospinal fluid	Takuya Akai	Japan
PP-073	Hydrocephalus	Standardized treatment of preterm infants with post-hemorrhagic hydrocephalus at a single institution	Tracy M Flanders	United States
PP-074	Hydrocephalus	Modern Titanium and Silicone Shuntvalve Implants and internal Tissue Obstructions by arachnoid extracellular Matrix Membranes	Hans Christoph Ludwig	Germany
PP-075	Hydrocephalus	Giant Virchow-Robin spaces causing obstructive hydrocephalus-case report	Ruslan Yunusov	Azerbaijan

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PP-076	Hydrocephalus	Shunting focus: a review of ventriculoatrial shunts in paediatric practice	Isobel Pilkington	Ireland
PP-077	Hydrocephalus	Ventriculoperitoneal shunt associated complications in pediatric patients	Abubakr Darrag Ahmed	Sudan
PP-078	Hydrocephalus	Abnormal Distal Ventriculoperitoneal Shunt Catheter Migration	Amr Farid Khalil	Egypt
PP-079	Hydrocephalus	Transfontanellar Ultrasound-Guided Intraventricular Neuroendoscopy for Loculated Posthemorrhagic Hydrocephalus: a case report and technical notes	Santiago Candela Canto	Portugal
PP-080	Hydrocephalus	Management of sub-dural hygroma following endoscopic third ventriculostomy in pediatric population	Sushant Kumar Sahoo	India
PP-081	Hydrocephalus	Implementation and learning curve of neuroendoscopic lavage in neonates – the Düsseldorf experience	Thomas Beez	Germany
PP-082	Hydrocephalus	Hyponatremia after neuro endoscopic wash for ventriculitis	Shighakolli Ramesh	India
PP-083	Hydrocephalus	Diving Inside a Newborn Brain: A Report on Endoscopic Washout for Intraventricular Hemorrhage in Two Term Newborns	Fadzlishah Johanabas Rosli	Malaysia
PP-084	Hydrocephalus	Our experience in the diagnosis and treatment of complications after liquor shunting operations	Matvey Livshits	Russia
PP-085	Hydrocephalus	Analysis of the effectiveness and reliability of programmable valves of liquor shunting systems in children	Boris Oleynikov	Russia
PP-086	Hydrocephalus	Current Management of Hydrocephalus as Practiced by Saudi Neurosurgeons	Abdulrahman Sabbagh	Saudi Arabia
PP-087	Hydrocephalus	Slit Ventricle Syndrome Management Among Neurosurgeons in Saudi Arabia	Abdulrahman Sabbagh	Saudi Arabia
PP-088	Hydrocephalus	Methods of Management and Prevention of Shunt Infection Amongst Neurosurgeons in Saudi Arabia: a Cross-sectional Study	Abdulrahman Sabbagh	Saudi Arabia
PP-089	Hydrocephalus	Blake's pouch cyst in children about three cases and literature review	Mohamed Safouane Ben Achour	Algeria
PP-090	Hydrocephalus	Can image guided ventricular catheter placement across the midline provide a favourable alternative to endoscopic septum pallucidotomy in cases of foramen of Munro obstruction?	Samir A. Matloob	United Kingdom
PP-091	Hydrocephalus	Left ventriculo-atrial shunt a case report and a literature review	Mohamed Safouane Ben Achour	Algeria
PP-092	Hydrocephalus	Shunt nephritis post ventriculoatrial shunt in a 9 years old girl: a case report and a literature review	Mohamed Safouane Ben Achour	Algeria
PP-093	Hydrocephalus	Ventriculoatrial shuntswhen and why and what complications can be encountered	Mohamed Safouane Ben Achour	Algeria
PP-094	Hydrocephalus	A case series of peritoneal cerebrospinal fluid pseudocyst and review of literature with proposed management algorithm	Ghaida Mustafa Fatani	Saudi Arabia
PP-095	Hydrocephalus	Ventriculosubgaleal shunts in infants as an interim salvage procedure – 10 years experience at a single institution with a large cohort	Kaushik Sil	India
PP-096	Hydrocephalus	Use of ProGav2 adjustable differential pressure valve with gravitational unit in paediatric population: a single centre experience	Benedetta Pettorini	United Kingdom
PP-097	Hydrocephalus	Ventricular-subarachnoid stenting in low-birth-weight newborns with post-hemorrhagic hydrocephalus	Oleg Vladimirovich Volkodav	Russia
PP-098	Hydrocephalus	Hydrocephalic somatically associated syndrome in preterm infants	Oleg Vladimirovich Volkodav	Russia
PP-099	Hydrocephalus	Clinical analysis of the duration of mechanical lung ventilation in preterm infants with hydrocephalus	Oleg Vladimirovich Volkodav	Russia
PP-100	Hydrocephalus	Endoscopic choroid plexus cauterization with ventricular lavage for shunt infection in hydranencephaly	Kenichi Nishiyama	Japan
PP-101	Hydrocephalus	The role of neuroendoscopy in post-hemorrhagic hydrocephalus in the preterm infants	Alexandre Casagrande Canheu	Brazil
PP-102	Hydrocephalus	Aseptic catheter obstruction histology from pediatric hydrocephallum shunts: serial cases	Eduardo Jucá	Brazil
PP-103	Hydrocephalus	Ventriculomegaly in children: nocturnal ICP dynamics identify pressure compensated but active hydrocephalus	Martin Ulrich Schuhmann	Germany

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PP-104	Hydrocephalus	Post-traumatic Hydrocephalus Associated With Occipitocervical Ligamentous Injury	M. Burhan Janjua	United States
PP-105	Hydrocephalus	Success Rate of Endoscopic Third Ventriculostomy for Treatment of Hydrocephalus in Pediatric Brazilian Population at São Paulo Hospital: A Retrospective Study	Iracema Araújo Estevão	Brazil
PP-106	Hydrocephalus	Endoscopic resection of a thalamic tumour presenting with obstructive hydrocephalus	Dan Odhiambo Ochieng	United Kingdom
PP-107	Hydrocephalus	Management of abdominal CSF pseudocysts related to VP shunts	Christos Chamilos	Greece
PP-108	Hydrocephalus	Internal validation of Endoscopic third ventriculostomy success score in our series of 164 patients. Can we predict outcomes of our patients?	Shighakolli Ramesh	India
PP-109	Hydrocephalus	Intraventricular adenoviral delivered CRISPR/Cas9 disruption of aquaporin 1 as a novel treatment for hydrocephalus: translation from the eye to the brain	Will Singleton	United Kingdom
PP-110	Hydrocephalus	Impairment of surface righting and cliff avoidance is associated with neuronal death in the sensorimotor cortex of neonatal hydrocephalic mice	Matthew Temitayo Shokunbi	Nigeria
PP-111	Hydrocephalus	How accurate is manual segmentation to determine ventricular volume?	J. Gordon Mccomb	United States
PP-112	Hydrocephalus	Early post-operative distal shunt malfunction following ventriculo-peritoneal shunting in infants: with vs without peritoneal purse-string suturing	Abubakar Mohammed	Nigeria
PP-113	Other	Intracranial Hypotension Caused by a Spontaneous Spinal Leakage of Cerebrospinal Fluid in a Patient Carrying a ventriculo-peritoneal Shunt	Abdallah Salemdawod	Germany
PP-114	Other	Raised intracranial pressure (ICP) decreases cerebral blood flow volume (CBFV) in pediatric patients	Susanne R Kerscher	Germany
PP-115	Other	Neonatal cleidocranial dysostosis presenting with subdural hematoma after a vaginal birth	Shohei Nagasaka	Japan
PP-116	Other	Outcomes of decompressive craniectomies in non-traumatic raised intracranial pressure in the paediatric population: a single centre experience in 14 years	Marina Pitsika	United Kingdom
PP-118	Other	The utility of brain biopsy in paediatric cryptogenic neurological disease	Sebastian Miguel Toescu	United Kingdom
PP-119	Other	Non-Oncological Paediatric Biopsies - A Single Centre 11 Year Experience	Oliver Richards	United Kingdom
PP-120	Other	Endoscopic intraventlicular tumor resection using the "Wet-field" technique to avoid postoperative subdural fluid collection; A case report	Ayako Iijima	Japan
PP-122	Other	Arachnoid cysts in the Paediatric population - A completely benign entity?	David Low	Singapore

Poster Session 2: Wednesday, 23 October 2019

PP-123	Antenatal diagnosis and treatment	Case report: Complex Craniocervical junction (CCJ) malformation and displaced cerebellar tonsils following fetal repair of myelomeningocele	Conor Gillespie	United Kingdom
PP-124	Dysraphism	Closure of myelomeningocele defect using a keystone design perforator island flap	Cleiton Formentin	Brazil
PP-125	Dysraphism	Anomalies associated with paediatric lumbosacral lipoma	Hugo Layard Horsfall	United Kingdom
PP-126	Dysraphism	Locomotor activities and educational achievements in children with myelomeningocele	Tatsuki Oyoshi	Japan
PP-127	Dysraphism	Complex Tethered Cord	Natarajan Muthukumar	India
PP-128	Dysraphism	The feasibility of endoscopical treatment of a transethmoidal endonasal encephalocele in a newborn	Cristiano Parisi	Italy
PP-129	Dysraphism	An extreme rare assocaiation of mature teratoma with a lumber myelomeningocele: a case report	Mohamed Safouane Ben Achour	Algeria
PP-130	Dysraphism	Dermal sinus in children a series of 18 cases	Mohamed Safouane Ben Achour	Algeria
PP-131	Dysraphism	Diastematomyelia in children about 12 cases	Mohamed Safouane Ben Achour	Algeria
PP-132	Dysraphism	Filum terminale lipoma's: a 19 cases series	Mohamed Safouane Ben Achour	Algeria
PP-133	Dysraphism	Current concepts in treatment of Lipomyelomeningocele	Venkataramana Neelam Krishnan	India
PP-134	Dysraphism	Missed LDMs: An unfortunate cause for re-tethering of the spinal cord	Santosh Mohan Rao Kanangi	India
PP-135	Dysraphism	Decreased MEPs during subcutaneous dissection for untethering surgery of a 'true' lipomyelomeningocele: Aggravated traction of the spinal cord by release of the sac from the original nest	Kyung Hyun Kim	South Korea
PP-136	Dysraphism	Large congenital mature teratoma associated with chaotic spinal cord lipoma	Inthira Khampalikit	Thailand
PP-137	Dysraphism	Examination of the timing for an operation of terminal myelocystocele and its histopathological findings	Jun Kurihara	Japan
PP-138	Global Pediatric Neurosurgery	Helmet policies to prevent traumatic brain injury in pediatric populations: a systematic review	Rebecca Y Du	United States
PP-139	Global Pediatric Neurosurgery	Profile survey of the Chinese Pediatric Neurosurgeons	Wenjun Shen	China
PP-141	Innovation and technology	Intrinsic Brainstem Neurenteric Cyst: A novel management proposal	Pasquale Gallo	United Kingdom
PP-142	Innovation and technology	True FISP Cardiac Gated CSF Flow Dynamic Imaging of Chiari Malformation	Moise Danielpour	United States
PP-143	Innovation and technology	Tailored approach to more precision in neuroendoscopy - ultrasound, individualized anatomic coordinates, ventricular access guide, neuronavigation; a single center retrospective study	Andreas Schaumann	Germany
PP-144	Innovation and technology	Role of motor evoked potential (MEP) monitoring during surgery for tethered cord	Shibu Vasudevan Pillai	India
PP-145	Innovation and technology	BabyMARTYN: A pediatric neurosurgical training model	Claudia L Craven	United Kingdom
PP-146	Innovation and technology	A novel 3D-printed hybrid patient specific models for Neurosurgery simulation	Giselle Coelho	Brazil
PP-147	Innovation and technology	Assessment of a Pediatric mixed reality model for neuroendoscopical surgical training	Giselle Coelho	Brazil
PP-148	Other	Optical Coherence Tomographic (OCT) in the management of hydrocephalus and ETV success	Adrian Caceres	Costa Rica
PP-149	Neuro-Oncology	Synchronous Primary Brain Tumor in pediatric age group. Report on two cases and review of the literature	Mahmoud Taha	Saudi Arabia
PP-150	Neuro-Oncology	Clinical Sub-groups of Neurofibromatosis type 1 associated with brain lesions in pediatric age group	Mahmoud Taha	Saudi Arabia

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PP-151	Neuro-Oncology	Meningiomas in pediatric age group with no risk factors: Case series and pathological review based on the new WHO classifications of CNS tumors	Mahmoud Taha	Saudi Arabia
PP-152	Neuro-Oncology	Pediatric glioblastomas: clinical, radiological, therapeutic and prognostic study through a surgical series	Ghassen Gader	Tunisia
PP-153	Neuro-Oncology	Congenital glioblastoma: Study of a rare pathological entity	Ghassen Gader	Tunisia
PP-154	Neuro-Oncology	Pediatric pilocytic astrocytomas of the posterior fossa: study of a surgical series of 28 cases	Ghassen Gader	Tunisia
PP-155	Neuro-Oncology	One-year evolution of paraplegia. Is recovery possible through surgical treatment?	Amparo Saenz	Argentina
PP-156	Neuro-Oncology	Radiation induced brain tumors after radiotherapy for pediatric central nervous system lesions	Mohamed Mohsen Amen	Egypt
PP-157	Neuro-Oncology	Importance of neurocytic rosettes in intraventricular tumors with neuronal-glial features	Taku Uchiyama	Japan
PP-158	Neuro-Oncology	Intrinsic Brainstem Cystic Epidermoid: Case report and literature review	Denis Mutyaba	South Africa
PP-159	Neuro-Oncology	Cranial dermoid and epidermoid cysts in childhood: considerations in the management	Dieter Class	Germany
PP-160	Neuro-Oncology	Surgical Management of Choroid Plexus Tumors and Associated CSF Dynamics Changes in the First 36 months of Life. The Experience of a Single Institute	Mohamed Ahmed El Beltagy	Egypt
PP-161	Neuro-Oncology	Management of Brain Tumors Below 2 Years of Life; Experience of 115 Cases	Mohamed Ahmed El Beltagy	Egypt
PP-162	Neuro-Oncology	An interesting case of a child with rhabdoid tumour predisposition syndrome 1 presenting with two molecularly distinct atypical teratoid/rhabdoid supra-/infratentorial tumours	Friederike Knerlich Lukoschus	Germany
PP-163	Neuro-Oncology	Extremely rare tumors of the CNS in children. Our experience	Dan Aurel Nica	Romania
PP-164	Neuro-Oncology	Microscopic Vs Endoscopic Transsphenoidal Surgery Among Pediatric Pituitary Adenomas	Sivashanmugam Dhandapani	India
PP-165	Neuro-Oncology	Sporadic solid posterior fossa hemangioblastomas in the pediatric population: A case based update	Florencia Carla Ferraro	Germany
PP-166	Neuro-Oncology	Surgery for recurrent medulloblastoma: a single-institution experience	Kristian Aquilina	United Kingdom
PP-167	Neuro-Oncology	Deafness secondary to Pineal Tumor – case report and literature review	Rebecca Chave-Cox	United Kingdom
PP-168	Neuro-Oncology	Acute volume increase of pineal tumors after ETV and neuroendoscopic biopsy	Thomas Beez	Germany
PP-169	Neuro-Oncology	An Early Experience of Intra-operative Neuro-monitoring in Pediatric Brain and Spine Tumors	Prakash Shetty	India
PP-170	Neuro-Oncology	: Pediatric meningiomas. An analysis of surgical case series of 37 patients over last 32 years	Dattatraya Muzumdar	India
PP-171	Neuro-Oncology	Epithelioid sarcoma of the ventral craniocervical junction: Neurosurgical management of a rare entity in a 6-month-old infant	Marian Preetham Suresh	Germany
PP-172	Neuro-Oncology	Biopsy of brain stem tumors in pediatric practice. Complex approach for treatment	Matvey Livshits	Russia
PP-173	Neuro-Oncology	Pediatric Cushing's disease: Shift towards endoscopic endonasal surgery	Ashish Suri	India
PP-174	Neuro-Oncology	Dermoid cyst of the pineal region a case report and literature review	Mohamed Safouane Ben Achour	Algeria
PP-175	Neuro-Oncology	Surgical Management of Pineal Region Tumors in Pediatric Patients	Ulrich W. Thomale	Germany
PP-176	Neuro-Oncology	Brain tumors of infancy: our institutional experience	Nayuta Higa	Japan
PP-177	Neuro-Oncology	Recurrent Hemorrhage of a Primary Intracranial Choriocarcinoma PICC	Alya Hasan	Kuwait
PP-178	Neuro-Oncology	Outcome of Pleomorphic Xanthoastrocytomas treated in single institution	Abdulrazaq A Alojan	Saudi Arabia
PP-179	Neuro-Oncology	Treatment Outcomes for Pediatric Pineoblastoma: A single institute experience in Taiwan	Hsin Hung Chen	Taiwan
PP-180	Neuro-Oncology	Involvement of optic pathway in patients with neurohypophyseal germ cell tumor	Ai Muroi	Japan

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PP-181	Neuro-Oncology	{Combined endoscopic approach in management of suprasellar craniopharyngiomas}	Salman Shaikh	India
PP-182	Neuro-Oncology	Resection and morbidity outcomes following paediatric ependymoma surgery	Mitchell T Foster	United Kingdom
PP-183	Neuro-Oncology	Cauda equina infected epidermoid cysts in pediatric age group, a report of five cases	Walid A Abdel Ghany	Egypt
PP-184	Neuro-Oncology	A Case Report, performing Surgical Treatment of Pediatric Cerebello-Pontine Angle Lipoma	Minami Sasaki	Japan
PP-185	Neuro-Oncology	Insights into the role of SRC in cerebellar tumors oncogenesis	Anaïs Chivet	France
PP-186	Neuro-Oncology	Ependymoma of Pineal Region. A Case Report	Sergey Abeshaus	Israel
PP-187	Neuro-Oncology	5-Aminolevulinic Acid Fluorescence Guided Resection of Ependymomas	Amisha Vastani	United Kingdom
PP-188	Neuro-Oncology	Endoscopic resection of a paraventricular ganglioglioma through tumour cyst	Bassel Zebian	United Kingdom
PP-189	Neuro-Oncology	Intracranial pleomorphic angiomatoid fibrous histiocytoma in a child	Hazel Sanghvi	United Kingdom
PP-190	Neuro-Oncology	Therapeutic outcomes of fourth ventricle tumors in 33 Chinese children via combined transvermian and telovelar approach	Kongbin Yang	China
PP-191	Neuro-Oncology	A single centre experience with paediatric anterior skull base tumours	Ajay Sinha	United Kingdom
PP-192	Neuro-Oncology	Congenital dermatofibrosarcoma protuberans: a unique presentation of a skin lesion with intraspinal association	Christos Chamilos	Greece
PP-193	Neuro-Oncology	A choroid plexus carcinoma excised completely from a young child leading to the diagnosis of the Li-Fraumeni syndrome in the other members of the family	Christos Chamilos	Greece
PP-194	Neuro-Oncology	Detection of blood circulating tumor cells in a patient with disseminated extraneural medulloblastoma. A unique clinical finding beyond all preclinical models	Christos Chamilos	Greece
PP-195	Neuro-Oncology	Fourth ventricle choroid plexus papilloma in an adolescent: A very uncommon location	Christos Chamilos	Greece
PP-196	Neuro-Oncology	Paediatric pilocytic astrocytoma of the conus medullaris(PACM): a case report and review of the literature	Charlotte Burford	United Kingdom
PP-197	Neuro-Oncology	Central Nervous System Tumors in Children. The Cuban Experience	Julio S. Brossard Alejo	Cuba
PP-198	Neurotrauma/Critical Care	Threshold for Decompressive Craniectomy in Children for Severe Head Injuries - An International Survey	Rachael Wybrew	United Kingdom
PP-199	Neurotrauma/Critical Care	Outcome of decompressive craniectomy in pediatric traumatic brain injury: Still a Pandora`s Box? – a meta-analysis	Ömer Can Yildiz	Germany
PP-200	Neurotrauma/Critical Care	Skull fractures in children less than 1 year old	Yui Nagata	Japan
PP-201	Neurotrauma/Critical Care	Shaken Baby Syndrome in Northern Finland	Niina Salokorpi	Finland
PP-202	Neurotrauma/Critical Care	Spine Trauma in children. Our experience	Dan Aurel Nica	Romania
PP-203	Neurotrauma/Critical Care	Ten Years of Paediatric Cranioplasties: The Leeds Experience	Alex Smedley	United Kingdom
PP-204	Neurotrauma/Critical Care	Impaired cerebral blood flow, cerebrovascular reactivity and common carotid artery velocity as physiological biomarkers of repetitive closed head injury	Andrew Reisner	United States
PP-205	Neurotrauma/Critical Care	Consideration on pathophysiologies in which abusive infantile ASDH becomes severe - What does the widespread LDA on CT mean? -	Young Soo Park	Japan
PP-206	Neurotrauma/Critical Care	Burst Fracture of the Skull in Infants- A Warning Note !	Ls Harishchandra	India
PP-207	Neurotrauma/Critical Care	Greenstick fracture-hinge decompressive craniotomy in infants	Hiroshi Yokota	Japan
PP-208	Neurotrauma/Critical Care	Survival after Cerebro-circulatory arrest in a child due to Post traumatic severe Intracranial hypertension	Krishnamurthy Sridhar	India

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PP-209	Neurotrauma/Critical Care	Epidemiology of Surgical Traumatic Brain Injury in Patients Younger than 16 Years at a Single Trauma Center in a Low/Middle-income Country Urban Center	Flavia Abreu	Brazil
PP-210	Neurotrauma/Critical Care	Cranial burst fracture: a propos of 2 cases	John Nute Jabang	Gambia
PP-211	Neurotrauma/Critical Care	Descriptive Epidemiologic Features of Paediatric head Injury: four years data from a trauma center	Muhammad Raji Mahmud	Nigeria
PP-212	Other	Vocal cord paralysis as a complication of supratentorial brain surgery: a case report	Marcia Cristina Da Silva	Brazil
PP-213	Other	Plantar Pressure in Spastic Cerebral Palsy Children	Renata Viana Brigido De Moura Jucá	Brazil
PP-214	Other	{The reconstruction of skull base defects in infants using pedicled nasoseptal flap- a review of four cases}	Salman Shaikh	India
PP-215	Other	Incidence and Causes of Perioperative Mortality After Primary Surgery for Intracranial Lesions in Black Lion Hospital, Addis Ababa, Ethiopia	Elam Mesfin Sebagades	Ethiopia
PP-216	Other	Foramina and venous drainages of the skull base in patients with Apert syndrome or other craniosynostoses	Masaaki Nishimoto	Japan
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PP-218	Other	Analysis of clinical-epidemiological characteristics and quantitative aspects of the 999 neurosurgeries performed in a reference pediatric neurosurgerys' hospital in Brazil	Eduardo Jucá	Brazil
PP-219	Other	Congenital Horner Syndrome Associated With Ipsilateral Internal Carotid Artery Hypoplasia	M. Burhan Janjua	United States
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PP-221	Other	Pediatric Arachnoid cyst- Case series with review of literature	Mihir Chawda	India
PP-222	Other	Long-term Outcome of Resective Epilepsy Surgery in Lennox-Gastaut Syndrome	Dong Seok Kim	South Korea
PP-223	Other	Evaluation of Endoscopic Thrid Ventriculostomy in children with Chiari II after the first ventricle peritoneal shunt failure	L. M. Furtado	Brazil
PP-224	Other	Radiology and clinical outcomes in trapped fourth ventricle treatment	L. M. Furtado	Brazil
PP-225	Evidence Based Pediatric Neurosurgery	Decompressive craniectomy for malignant ischemic stroke in children – An evidence-based approach	Thomas Beez	Germany
PP-226	Evidence Based Pediatric Neurosurgery	Predictors of outcome of management of paediatric head trauma in a tertiary health institution in North-Central Nigeria	Gyang Markus Bot	Nigeria
PP-227	Evidence Based Pediatric Neurosurgery	Predictors of outcome in paediatric brain tumour care at the national hospital Abuja	D. J. Alfin	Nigeria
PP-228	Vascular	A case of unusual course of vein of Galen malformation	Sung Kyoo Hwang	South Korea
PP-229	Vascular	Decompressive craniotomy for malignant middle cerebral artery stroke in children	Simone Peraio	United Kingdom
PP-230	Vascular	Treatment of ruptured intracranial aneurysm in the very young - case report and systematic review of the modern literature	Ann Kristin Schmitz	Germany
PP-231	Vascular	The optimal operation time for rapid progression pediatric Moyamoya disease	Wenjun Shen	China
PP-232	Vascular	Stereotactic Radiosurgery/Radiotherapy for Brain Arteriovenous Malformation in Children: a Single-centre 19-Year Review	Sui To Wong	Hong Kong
PP-233	Neurotrauma/Critical Care	Role of ICP Monitoring in Paediatric HI Early Experince	Karuppanan Bagathsingh	India
PP-234	Global Pediatric Neurosurgery	Prospective Study of Pediatrics Neurotrauma Surgery in Addis Ababa, Ethiopia: Clinical presentation, injury types and trauma causes	Tsegazeab Laeke	Ethiopia