Poster Session : P23

Initial dose audit results obtained from a high resolution DBT System in a Symptomatic Setting

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Cork University Hospital has just commissioned the first of three new high resolution digital breast tomosynthesis (DBT) systems for use in its Breast Imaging Unit (BIU). The Hologic 3Dimensions DBT incorporates new detector technology which enables rapid acquisition of higher-resolution 3D images. Results presented by the national breast screening programme indicate that the average breast dose from 3D exposures can exceed 2D exposures by up to 30%. A dose audit of the new DBT unit was performed to assess the impact of 3D imaging on the breast dose of the symptomatic population attending CUH. The dose audit used the exposure data from at least 50 examinations and dose calculations were performed using NCCPM breast dose survey software. Breast dose was calculated in terms of the mean glandular dose (MGD) for each 3D image in accordance with Dance et al. Dose audit results from the new DBT system were found to be similar to values obtained by the national screening programme. DBT breast dose performance was evaluated by comparing the average MGD of a standard-sized breast with the national DRL for 3D breast imaging established by the screening programme. Dose performance of the new DBT system was thus found to be acceptable, providing justification for clinical use.

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Poster Session : P24

Objective evaluation of imaging performance using a commercially available spherical lesion anechoic phantom

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The nature of ultrasound imaging makes it challenging to perform quantitative quality control tests representative of clinical performance. IPEM Report No. 102 outlines several different tests which monitor aspects of the systems performance likely to affect the clinical efficiency following deterioration and change. Such tests include measurement of axial and lateral resolution, slice thickness, contrast resolution and low contrast penetration using ultrasound phantoms. Such phantoms consist of cylindrical objects and wire filaments embedded within homogeneous tissue-mimicking material. The ability of an ultrasound system to resolve the contrast difference between the cylindrical targets and background is regarded as an indicator of imaging performance; however, cylindrical targets are not necessarily representative of the clinical situation where ellipsoidal or spherical lesions may be considered more appropriate. To date, spherical lesion target phantoms have been produced in specialist research laboratories and are, thus, not widely available. Accordingly, this study sought to examine a relatively new commercially available anechoic spherical lesion phantom to determine its efficacy for objective evaluation of performance change. Several modern medical ultrasound systems were tested using the Gammex RMI 408 Spherical Lesion target phantom, containing 2mm and 4mm diameter anechoic spherical targets located within one plane throughout the phantom depth. A Matlab® program was used for automatic objective image quality analysis. Preliminary results will be presented on the automated objective evaluation, metric repeatability and reproducibility. Simulated probe faults will be used to establish test efficacy and the results will be compared to traditional QA testing.

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Poster Session : P25

Estimating I-131 Thyroid Uptake from Tc-99m scintigraphy: Implication for calculated I-131 Therapy Activities in Benign Thyroid Disease

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For benign thyroid disease, pre-therapeutic radioiodine (131I) dosimetry is recommended given that higher quality of care can be achieved by personalised radioiodine patient treatment (Salvatori and Luster 2010). Pre-therapeutic dosimetry evaluates the 131I kinetics of the thyroid, and calculates 131I uptake (131IU) function, which is used to calculate the radioiodine-therapy administered activity. Thyroid technetium-99m (99mTc) scintigraphy also forms part of patient diagnosis and 99mTc uptake (99mTcU) can be estimated from this scan. Studies have demonstrated the use of 99mTcU to estimate the 131IU and, hence, eliminate the need for 131IU assessment (Smith et al. 1990; Gorur et al. 2009; Szumowski et al. 2016); however, the question remains as to whether 99mTcU may accurately reflect 131IU or whether results in an uncertain prescribed 131I therapy activity. Accordingly, 131IU with 99mTcU datasets were compared for a patient cohort examined between 2012 and 2018. The factors affecting 99mTcU accuracy, including demographic data and laboratory thyroid function test, were analysed. The study sample comprised 133 patients (100 women and 33 men) diagnosed with Graves' disease (55%), multi-nodular goitre (21%) and toxic nodules (25%). Results showed the correlation between 99mTcU and 131IU is significantly more pronounced in men than women ($R^2 = 0.90$ vs. $R^2 = 0.27$, respectively). The study could not estimate 131IU based on 99mTcU. It was shown that other investigated parameters affected the correlation between the two. It demonstrates how the use of 99mTcU alone, in place of 131IU, would lead to significant over and underestimation of 131I therapy activities.

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Poster Session : P26

GFR measurement for the living donor programme – An in-house software solution

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The National Renal Transplant centre performs over 50 Living Donor transplants per year. This process involved the donation of a kidney from a family member or friend. In order to assess an individual's suitability for a kidney donation they must undergo a series of

clinical tests. One of the tests involved is Glomerular Filtration Rate (GFR), GFR describes the flow rate of filtered fluid through the kidney. Currently the GFR procedure is calculated using the plasma sampling method. This is done with Cr51 EDTA or Tc99m DTPA using a NaI Gamma Counter. GFR measurements are typically used to determine the kidney function of patients who have End-Stage Kidney disease or those undergoing Cancer treatments. The living donor programme contains individuals who are assumed to have normal healthy kidney function and have GFRs within age appropriate ranges. In order to calculate GFR there are numerous combinations of complex equations and corrections to be applies to determine a normalised GFR. Our aim is to develop a user friendly method of calculating the GFR for the Living Donor Programme. This will involve analysing the current calculation method, which uses the slope intercept method and its corresponding corrections. This in-house solution will offer a more transparent and intuitive solution to the clinicians.

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Poster Session : P27

Use of Megavoltage (MV) Computed Tomography (CT) to account for anatomical variations during radiotherapy treatment

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In radiotherapy (RT) CT scans are used a) to outline tumour targets to ensure the prescribed radiotherapy dose is delivered correctly, b) to identify critical structures where the radiation dose needs to be restricted and c) in dose calculations to account for the anatomical variations (inhomogeneities) in the patient – for example lung, bone and tissue. At this clinic, kilovoltage CT (kV) scans are used for radiotherapy dose calculations in routine treatment planning (TP). Though the initial kVCT is useful for TP, patients undergoing RT sometimes lose weight which leads to changes in anatomical details with respect to the initial CT scan. As a result, the original dose calculation performed for the patient has been compromised. To account for the changed anatomy during treatment, a kVCT rescan can be ordered by the doctor. The aim of this project is to commission radiotherapy dose calculations using Megavoltage (MV) Cone Beam CT as part of routine treatment planning. In this project, a CIRS Rando head & neck phantom was used to directly calibrate the MV cone beam CT system. The Rando phantom was scanned with both kVCT and MVCT for the purpose of comparing dose calculations from the two systems. The Hounsfield Units to Relative Electron Density obtained from the MV scan was entered in the planning system. From the initial work, the kVCT and the MVCT calculations performed for simple photon fields match closely. The results obtained for a range of clinical plans will be presented.

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Poster Session : P28

New BNMS guidelines for measurement of glomerular filtration rate: To adopt or not?

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The British Nuclear Medicine Society (BNMS) has recently published new guidelines for the measurement of glomerular filtration rate (GFR). The new guidelines recommend replacing the "slope-intercept" (SI) method, which involves taking multiple blood samples, with a "single sample" (SS) method. The time that the single blood sample is withdrawn from the patient is chosen based on estimates of the patient's GFR, or the most recent GFR measurement where one is available. Whilst the single sample method would be less invasive for patients and entail less work for staff (sampling, counting etc.) there is a perception that single sample methods are generally less accurate and precise compared to multiple sample methods. By applying the new method to historical data from our facility we hope to verify that measurement of a single sample withdrawn at a carefully chosen time can yield results that are as valid as those obtained using the SI method. A retrospective study is carried out by applying the new method proposed by BNMS to data obtained from approximately 100 GFR studies undertaken at our facility over the past two years. The optimum sampling time is determined for each patient and a GFR based on the single sample method is calculated and compared to the value originally calculated based on the SI method.

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Poster Session : P29

Dosimetric effect of a change in breathing patterns between simulation and delivery on VMAT lung stereotactic body radiation therapy (SBRT)

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In radiotherapy planning, it is vital that the breathing patterns at simulation scan mimic treatment scenario as accurately as possible. A number of previous studies assumed that a patient has the same breathing trace shape at both simulation and treatment delivery. This is not always the case and this work was to evaluate the dosimetric effect of a change in breathing patterns between planning and delivery in lung volumetric modulated arc therapy (VMAT) stereotactic body radiation therapy (SBRT). A TrueBeam LINAC with 6MV flattened filter free (FFF) beams was used. A dynamic motion phantom with sinusoidal (reference) motion (20 mm diameter 'tumour'; period = 3 s; amplitude = 30 mm) underwent a 4D-CT scan. A treatment plan was created using Eclipse version 15.1 and optimised according to St Luke's protocol. The delivered plan was evaluated in five situations: using the same trace as simulation, using a modified trace which contained variabilities in amplitude (VA), using a modified trace which contained variabilities in period (VP), using a highly regular trace (RT), and finally using a highly irregular trace (IRT). Measurements were made with EBT-XD films and evaluated against convolved dose distribution using a gamma analysis of 3% dose difference and 2 mm distance to agreement. Results indicate that both sinusoidal and RT traces showed a high passing rate of more than 98%. However, there was more variability in passing rates for the irregular motion. Results and dosimetric analysis will be presented.

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