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Anaesthetic management for caesarean section of a parturient with a known difficult airway and closed spinal dysraphism

R. Katz, C.L. McCaul
Department of Anaesthesia, Rotunda Hospital, Dublin, Ireland

ABSTRACT
Many anaesthetists consider patients with existing neurological deficits, untreated spinal pathology or those having undergone major spinal intervention to be precluded from undergoing neuraxial anaesthesia. While this is partly rooted in fears of litigation there is also a lack of consensus of the best practice in the anaesthetic management of these patients.
We present our management of a parturient who attended our institution, having a number of anaesthetic complexities including a known difficult airway, spinal fusion and persistent spinal cord tethering. She successfully underwent delivery under neuraxial blockade for the delivery of her fourth child.
We believe that by undergoing a thorough multidisciplinary clinical evaluation, including the extensive use of neuroimaging and ultrasound, it may be possible to plan and perform safe neuraxial anaesthesia.

Keywords: Neuraxial anaesthesia; Scoliosis; Harrington rods; Spinal dysraphism; Spinal cord tethering

Case report

We present the case of a 36-year-old para 3, gravida 2^{+1} woman who presented for the delivery of her fourth child. She had undergone a two-stage scoliosis repair using Harrington rods, inserted from the sixth cervical to the second lumbar vertebrae at the age of 12. She had associated closed spinal dysraphism, requiring multiple surgeries to de-tether her spinal cord at the fifth lumbar and first sacral levels. Neurologically she had persistent unilateral left leg numbness, however bladder, bowel and motor function were subjectively normal.

Obstetrically her first two pregnancies were normal, having delivered spontaneously without neuraxial blockade. Her third pregnancy, however, was complicated by the diagnosis of a heterotopic pregnancy requiring laparoscopy. Intubation was difficult, with two failed attempts using an Airtraq video laryngoscope and ultimately, she was intubated using a McCoy laryngoscope. She was documented as a Cormac and Lehane grade three view.[1] Her remaining viable pregnancy was a delivery by emergency caesarean section at 28 weeks' gestation, due to concerns about an evolving uterine scar dehiscence. This was performed under general anaesthesia following an awake fibreoptic intubation. Unfortunately, due to neonatal prematurity, this child did not survive past 36 hours. Our patient described the whole event, including awake fibreoptic intubation, as "horrible".

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Correspondence to: Dr. R. Katz, Department of Anaesthesia, Rotunda Hospital, Parnell Square East, Dublin 1, Ireland.
E-mail address: stackskatz@gmail.com

Anaesthetic management

This patient was assessed at our high-risk anaesthetic clinic. She had reduced neck extension, poor mouth opening of 2 cm and a Mallampati score of 4.[1] Thyromental distance was 6.5 cm and prognathism was normal. Examination of her back revealed a scar from the C6 to the L2 vertebrae, corresponding to her previous scoliosis repair; and a scar overlying the L5/S1 vertebral levels, from her previous spinal cord

Fig. 1 Picture of our patient's back showing a midline and left-sided thoracotomy scar from Harrington rods insertion (white arrows). Also visible is a scar overlying the L5–S1 levels from spinal cord de-tethering surgeries (grey arrow). Skin abnormality is visible over the lower lumbar and sacral region (yellow arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

de-tethering surgery (Fig. 1). She indicated a preference for regional anaesthesia if feasible, due to the traumatic events of her last delivery.

Following discussion at our joint high-risk multidisciplinary team meeting a decision was made that she should undergo an elective caesarean section. Anaesthetic planning was more challenging for a number of reasons. Her airway was known to be difficult and her previous fibreoptic intubation had been psychologically traumatic. She had complex spinal anatomy as a consequence of her primary pathology, previous surgical interventions and persistent cord tethering with neurological symptoms. Finally, her airway history would make emergency or rescue general anaesthesia difficult.

We reviewed her recent magnetic resonant imaging (MRI) scans in collaboration with neuroradiologists. This confirmed instrumentation down to the level of L2, with the conus medullaris lying at the lower border of L3 (Fig. 2) with associated spinal cord tethering (Fig. 3). For comparison, normal imaging of her spinal cord, with the absence of tethering, could be seen at L1 (Fig. 4). Normal nerve roots of the cauda equina were documented distal to this and cerebrospinal fluid (CSF) volume was normal. Normal posterior entry points and epidural spaces were noted from L2 to L5 vertebrae.

We elected to use a combined spinal-epidural technique to provide the ability to both prolong or extend the spread of the block. If primary or secondary failure of neuraxial anaesthesia was to occur or if the patient were to experienced paraesthesia, there would be conversion to general anaesthesia. Our patient was to be fasted, with ranitidine and metoclopramide administered. Our "Plan A" was to use a McGrath or McCoy laryngoscope for intubation, a McCoy having been used previously to successfully intubate her. The "Plan B" was to perform an awake fibreoptic intubation through a second generation supraglottic airway device (SAD). Failing that it was known that both face mask and SAD ventilation were possible. Lastly, preparation was made for an emergency cricothyroidotomy.

Our patient underwent a planned elective caesarean section with an uneventful insertion of a combined

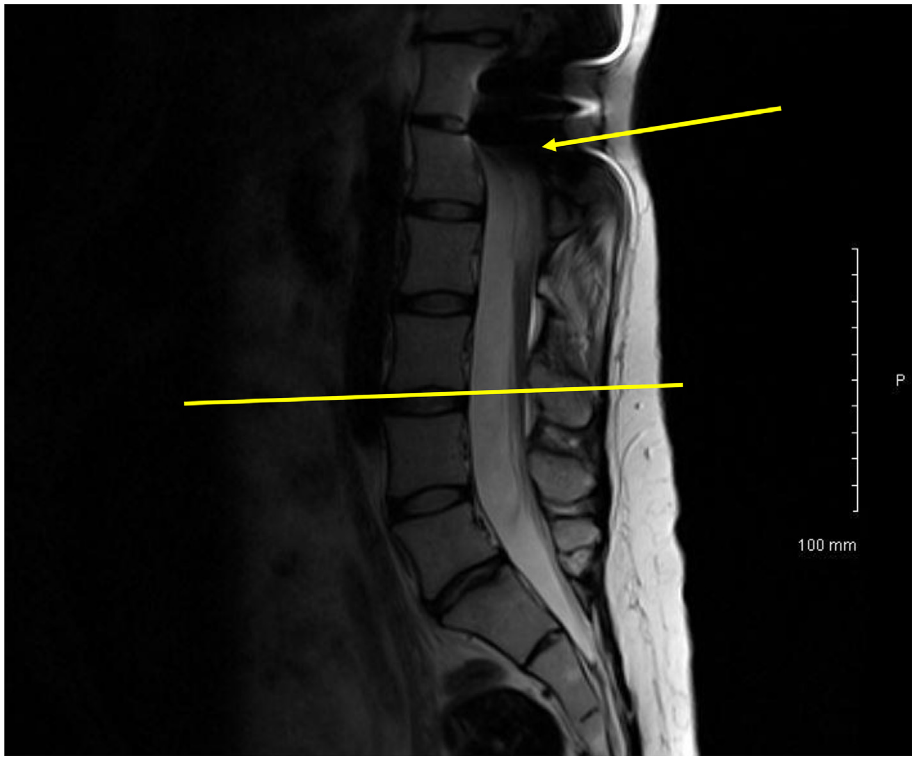

Fig. 2 T2 weighted sagittal magnetic resonance image showing the conus medullaris lying at the inferior border of the body of the L3 vertebra. Visible distortion of the image from instrumentation is noted above the upper border of L1 (yellow arrow). The yellow line corresponds to the axial image in Fig. 3. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

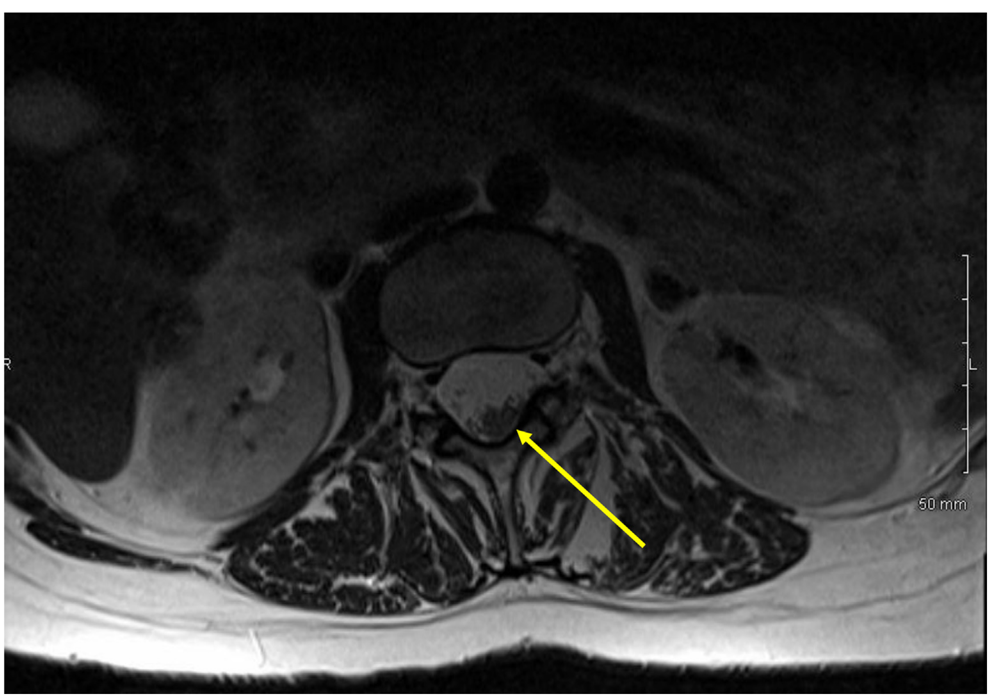

Fig. 3 T2 weighted axial magnetic resonance image through the inferior body of L3 showing cord tethering by means of anchoring to more superficial structures at this level (yellow arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

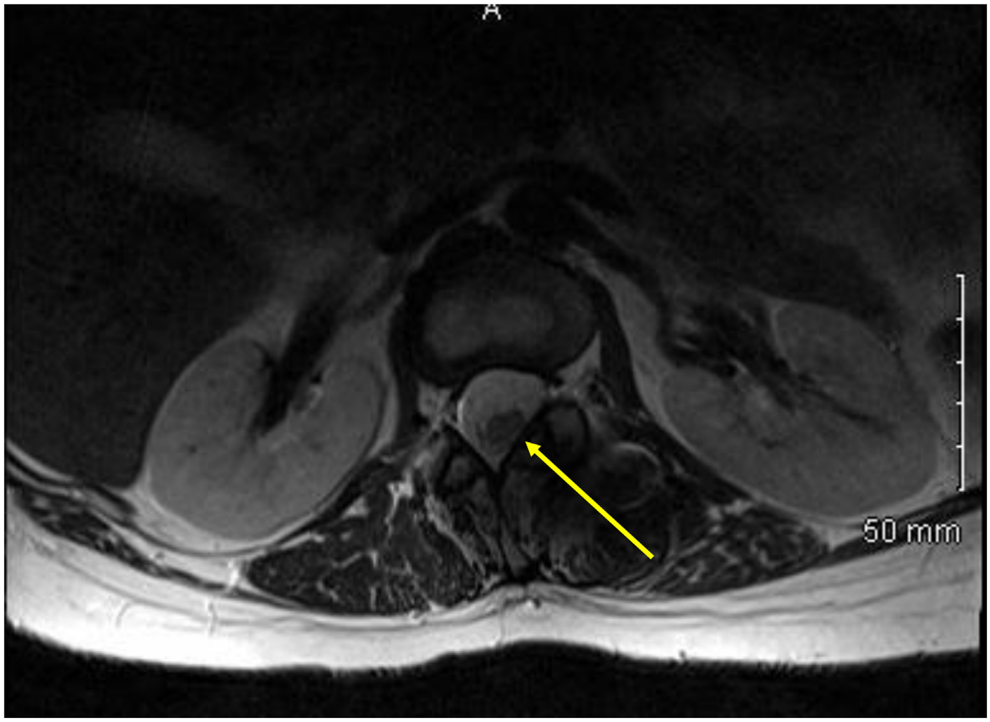

Fig. 4 T2 weighted image through the lower border of L1 showing absence of cord tethering, with no evidence of anchoring at this level (yellow arrow). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

spinal-epidural technique utilising ultrasound at the L4/5 level. A full dose of 12 mg of 0.5% hyperbaric bupivacaine, 15 μg of fentanyl and 100 μg of preservative-free morphine was given, producing surgical anaesthesia to T3. A healthy, 3.26 kg female baby was born. No intra-operative epidural boluses were required and there were no complications noted postoperatively.

Discussion

With a prevalence of 0.2 to 10 per 1000, spinal dysraphism has numerous implications for the provision of peripartum anaesthetic care.[2] With a high incidence of failure and complications following central neuraxial blocks, a recent review of 67 parturients with spinal dysraphisms revealed complications in 36.5% of the epidural group and in 80% of the spinal or combined spinal-epidural cases.[3] As noted in our patient, corrective de-tethering surgery frequently does not result in ascent of the conus and re-tethering is common, although this may be asymptomatic.[4] Most importantly, these caudal neural elements are more likely to be posteriorly placed within the spinal canal, increasing the vulnerability to spinal cord injury from direct needle trauma during neuraxial placement.[5]

Our patient also underwent thoracic scoliosis repair, using a metallic frame to help correct the abnormal curvature by distracting the concave side. This was then stabilised with autologous bone grafts utilising the patient's own spinous processes, to ultimately create a fused spine.[6] Distorted surface anatomy from postoperative scarring, a lack of palpable spinous processes, and the presence of bone grafts, all made the performance of any type of neuraxial blockade technically challenging.[7] Not only did these factors affect our ability to safely access the epidural or intrathecal spaces but they can also affect local anaesthetic spread within the epidural space, making it difficult to estimate the correct dosage of local anaesthetic. This placed our patient at an increased risk of dural puncture[7] and incomplete or patchy block.[8,9]

In terms of success rates of neuraxial anaesthesia in parturients with scoliosis, a retrospective review of 117 scoliosis patients (uncorrected n=24 and corrected n=93) identified that two-thirds of these patients were managed successfully with a neuraxial technique.[10]

However, what was not described was the rate of successful, reliable conversion from epidural analgesia to surgical epidural anaesthesia. This conversion rate may be higher in women with spinal instrumentation. The study noted that, 90% of the time, block difficulty or inadequacy was related to an epidural technique. Therefore, alternatives to traditional epidural analgesia such as single shot-spinal, continuous spinal or combined-spinal epidural anaesthesia should be considered if there is no risk of injuring the spinal cord. With these techniques the intrathecal space has not been as directly affected by the previous spinal surgery and the spread of local anaesthetic is more reliable.[11] In one prospective observational study of 17 women with scoliosis who delivered by elective caesarean section under a subarachnoid block, only one required conversion to general anaesthesia – from a continuous spinal anaesthetic.[12] The other 16 women were successfully managed with a combination of single shot spinal, combined spinal-epidural or continuous spinal anaesthesia.

The approach to neuraxial planning in patients with repaired scoliosis, spinal dysraphism and previous cord de-tethering should be individualised. Firstly, a full clinical examination should be performed, to detail both the extent of any neurological deficit and any surgical scars. Secondly, a thorough review of old orthopaedic and neurosurgical notes should be performed, to help determine the extent of any instrumentation, spinal fusion and bony defects. Finally, neuroimaging is vital in determining exactly what level any instrumentation and fusion ends or if there are any anatomical abnormalities such as a low-lying conus medullaris or cord tethering. It also determines if there is an intact ligamentum flavum, which may be discontinuous where there is bony dysraphism.

With respect to the use of MRI during pregnancy, currently there are no known risks to the mother or fetus,[13,14] while the safety of MRI in patients with spinal metallic implants and devices has been thoroughly investigated using fields of 3 Tesla (T) and less.[15] Based on these results, almost all spinal implants and devices are considered safe or conditionally acceptable in MRI examinations.[16]

Finally, in cases with cord tethering, determination of the exact level of neuraxial block using ultrasonography is important. Even in healthy volunteers, anaesthetists incorrectly identify the lumbar interspaces 71% of the time.[17] The use of ultrasound imaging in those patients who have had previous back surgery has been shown to help identify the correct interspinous spaces, appropriate angle of insertion and accurately identify the epidural space.[18,19] Algorithms to guide neuraxial anaesthetic techniques in scoliotic patients have been proposed and utilise both neuroimaging and ultrasound correlation in neuraxial planning.[20]

Obstetric patients with spinal dysraphisms, scoliosis or those who have undergone previous spinal surgery remain challenging to manage. With ever increasing litigation worldwide and no consensus on best practice, there is often reluctance to perform neuraxial anaesthesia for these patients. However, as we have shown in this case, with careful multidisciplinary preoperative assessment, neuraxial anaesthesia can be performed. Each management plan needs to be tailored to the individual patient, aided by neuro-imaging and ultrasound imaging to help plan and execute safe neuraxial anaesthesia, as a neuraxial technique in this population is not only challenging but also potentially unsafe.[21] Based on the assessment and planning, labour analgesia options can be discussed and information provided about realistic expectations for the success of any proposed anaesthetic, the risks involved and the likely outcomes.

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Multimodal general anesthesia approach for Ex Utero Intrapartum Therapy (EXIT) procedures: two case reports

E. Dinges, J. Heier, C. Delgado, L. Bollag
Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, WA, USA

ABSTRACT
High-dose volatile anesthesia is the most common method of achieving uterine relaxation for Ex Utero Intrapartum Therapy (EXIT) procedures. Other methods employ nitroglycerin for additional uterine relaxation with or without remifentanil for additional fetal analgesia. We report a combination approach including one minimum alveolar concentration of volatile anesthetic plus nitroglycerin and remifentanil infusions, to provide timely uterine relaxation under general anesthesia for both mother and fetus, during two EXIT procedures.

Keywords: Ex Utero Intrapartum Therapy; General anesthesia; Regional anesthesia; Transversus abdominis plane block

Introduction

Ex Utero Intrapartum Therapy (EXIT) procedures are performed when the fetus has a severe airway abnormality potentially compromising ventilation at birth, or more rarely severe cardiothoracic abnormalities.[1] Different anesthesia strategies for EXIT procedures have been described. The largest published series used two to three minimum alveolar concentration (MAC) volatile anesthetic to achieve uterine relaxation,[1] while others used nitroglycerin infusions (0.5–1.5 μg/kg/min) for optimal uterine relaxation under neuraxial anesthesia.[2] Fetal analgesia and immobility has been typically achieved by intramuscular fentanyl and neuromuscular blockers,[1] but some substituted remifentanil.[3] One report combined two approaches, using one MAC volatile anesthetic with nitroglycerin.[4] We report two cases using a combination of three techniques: one MAC volatile anesthetic, nitroglycerin, and remifentanil to provide concurrent uterine relaxation, maternal anesthesia and analgesia, and fetal analgesia and immobility.

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Correspondence to: E. Dinges, Anesthesiology and Pain Medicine, University of Washington, 1959 NE Pacific Street, Box 356540, Seattle, WA 98195, USA.
E-mail address: edinges@uw.edu

Case reports

Case 1

A 65 kg, 32-year-old gravida 3 para 2 woman presented at 35 weeks' gestation. Maternal history included scant prenatal care, psychosocial disarray, unstable housing, intimate partner violence, methamphetamine and heroin use, depression, anxiety, hepatitis C with undetectable viral load, and polyhydramnios requiring multiple amnioreductions. Fetal anomalies included severe micrognathia, narrow oropharynx and larynx, situs inversus, and low-set ears. Prior to delivery, obstetric, obstetric anesthesiology, pediatric anesthesiology, and pediatric otolaryngology teams held planning sessions and assembled necessary equipment.