Case Reports/Case Series

Cesarean delivery under ultrasound-guided spinal anesthesia, in a parturient with poliomyelitis and Harrington instumentation

[Accouchement par césarienne sous rachianesthésie par échoguidage chez une parturiente souffrant de poliomyélite et ayant des tiges de Harrington]

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Purpose: To describe the anesthetic implications, and management of a medically complex parturient, who presented for Cesarean delivery (CD). The patient had poliomyelitis complicated with severe kyphoscoliosis, which had been treated with extensive spinal surgery. We used ultrasound guidance to facilitate successful spinal analgesia and anesthesia.

Clinical features: A 27-yr-old woman, with a history of poliomyelitis and moderate restrictive lung disease secondary to kyphoscoliosis, presented at 38 weeks gestation for elective CD because of cephalopelvic disproportion. The woman had Harrington rods *in situ* from the level of the second thoracic vertebra, to the level of the fourth lumbar vertebra. Ultrasound guidance enabled one intervertebral space to be visualized (L5-S1), 3 cm from the expected spinal midline, and spinal anesthesia was performed at this interspace without any complications. A healthy infant was delivered, and the mother recovered uneventfully.

Conclusions: Spinal anesthesia can be effectively performed in patients with poliomyelitis and severe kyphoscoliosis, that has been treated with extensive Harrington instrumentation. To facilitate regional techniques in such patients, bedside ultrasound may be greatly beneficial in identifying the correct spinal interspace.

Objectif *: Décrire les implications anesthésiques et la prise en charge d'une parturiente complexe d'un point de vue médical et admise pour un accouchement par césarienne. La patiente souffrait de poliomyélite compliquée d'une cyphoscoliose sévère qui avait été traitée avec plusieurs interventions chirurgicales rachidiennes. Nous avons eu recours à l'échoguidage pour faciliter une analgésie et anesthésie rachidiennes réussies.*

Éléments cliniques *: Une femme de 27 ans présentant des antécédents de poliomyélite et une maladie pulmonaire restrictive modérément grave, conséquence d'une cyphoscoliose, a été admise à 38 semaines de grossesse pour un accouchement par césarienne programmé en raison de disproportion céphalopelvienne. La femme avait des tiges de Harrington in situ allant de la deuxième vertèbre thoracique à la quatrième vertèbre lombaire. L'échoguidage a permis de visualiser un espace intervertébral (L5-S1) à 3 cm de la ligne rachidienne médiane attendue et une rachianesthésie a été réalisée dans cet espace sans complications. La mère a accouché d'un nourrisson sain et a récupéré sans complications.*

Conclusion *: La rachianesthésie peut être réalisée avec succès chez les patients souffrant de poliomyélite et de cyphoscoliose grave dont le dos a été instrumenté de manière importante avec des tiges de Harrington. Dans le but de faciliter des techniques d'anesthésie régionale chez de tels patients, l'échoguidage au chevet peut s'avérer très utile pour déterminer l'espace intervertébral correct.*

CAN J ANESTH 2008 / 55: 9 / pp 606–611

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Competing interests: None declared.

Accepted for publication March 28, 2008.

Revision accepted May 22, 2008.

ACUTE poliomyelitis, as a disease entity, has virtually been eliminated in the Western world due to a successful vaccination program. However, it is estimated that there are between 250,000 and 350,000 survivors of acute poliomyelitis in the United States[1] and over 17,000 in Canada.[2] Over 10,000 new cases of poliomyelitis have been reported globally since the year 2004, and many of these patients are of child-bearing age.[3]

Patients with polio may suffer from sequelae of the acute illness and may develop chronic neurological and respiratory complications related to the long-term effects of their disease. Kyphoscoliosis is associated with poliomyelitis in 12% of cases, and may be severe enough to cause life-threatening respiratory compromise. Spinal surgery, with the use of Harrington rods, is often used to partially correct the spinal deformity, and these rods may be left *in situ*. In such patients, regional anesthesia may be particularly challenging. Recent evidence, however, suggests that ultrasound might be a useful tool for the guidance of regional blocks in such patients.[4,5] At our hospital, ultrasound has been routinely used for the last three years for placement of neuraxial blocks in the obstetric population.

We report a case of a pregnant woman presenting for elective Cesarean delivery (CD) who had poliomyelitis and severe kyphoscoliosis that had been treated previously with extensive spinal surgery. We describe the anesthetic management of her case, and discuss the related peer-reviewed literature. Written consent was obtained from the patient for the publication of this case report, along with the radiological images and photographs.

FIGURE 1 Photograph of the patient's back showing the extent of surgical scarring and the insertion point for spinal anesthesia.

Case report

A 27-yr-old primigravida, with a history of poliomyelitis and moderate restrictive lung disease secondary to kyphoscoliosis, presented for an elective CD at 38 weeks of gestation. She had been diagnosed at two years of age, with poliomyelitis. The disease left her with residual neurologic deficits in her right leg and both arms. Her medical history was significant for severe thoraco-lumbar kyphoscoliosis (Cobb angles, T5–T11; right-sided curve of 98°; and T12–L4, left-sided curve of 88°) (Figure 1), for which she underwent surgery at the age of 14 yr. Harrington rods were inserted from the level of the second thoracic vertebra to the level of the fourth lumbar vertebra and remained *in situ* at the time of the planned CD. Prior to pregnancy, she had known moderate restrictive lung disease; however, she had reasonable exercise tolerance, as evidenced by her ability to walk up to 1 km, without any shortness of breath. Her exercise tolerance had decreased as the pregnancy progressed, but her pulmonary function tests remained essentially unchanged from pre-pregnancy levels. She denied any symptoms of orthopnea or paroxysmal dyspnea, and she had no symptoms suggestive of cardiovascular instability. She had no bulbar symptoms.

On physical examination, the woman was of small stature; 140 cm tall, and weighing 39 kg. She had marked thoraco-lumbar kyphoscoliosis and was unable to flex her cervical or lumbar spines due to the presence of Harrington rods. She had limited movements in both upper limbs, with fixed flexion of her right arm, and she had difficulty in either extending or flexing her left arm. Her motor power was reduced in both upper limbs (3/5) and in her right leg (3/5). There was no sensory deficit. Examination of the respiratory system was normal, with breath sounds equal bilaterally, and no adventitial sounds were present on chest auscultation. Examination of the cardiovascular system was unremarkable. Airway examination revealed a Mallampati score of 1, but there was limited neck exten-

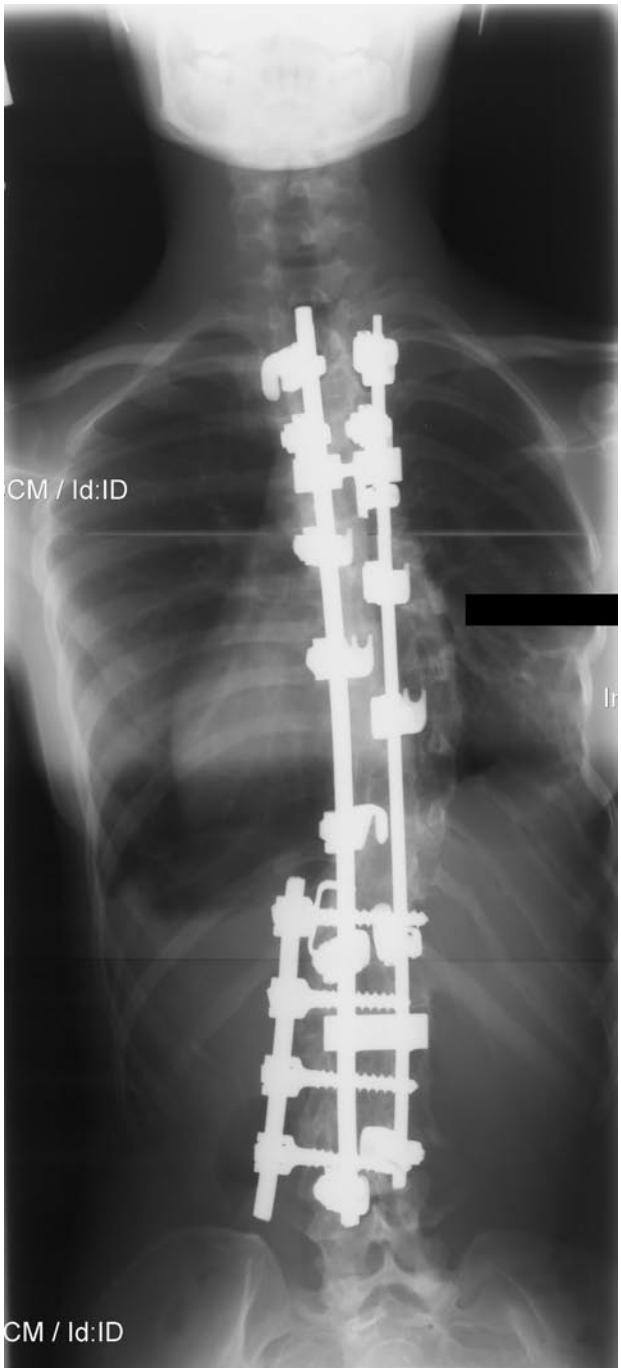

FIGURE 2 *x-ray*, showing location of the Harrington rods.

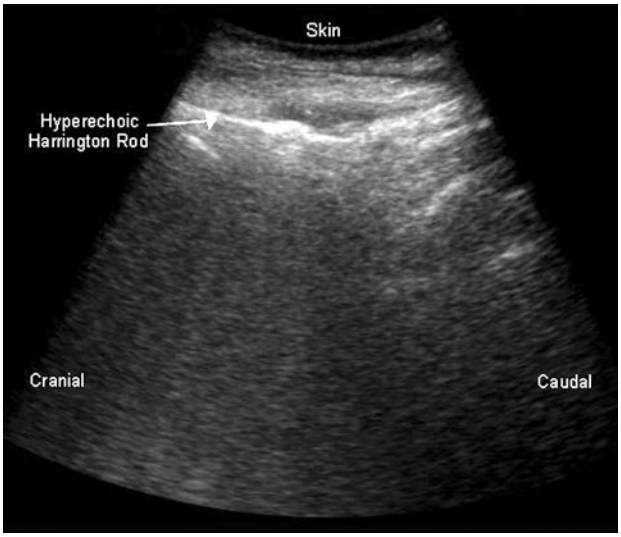

FIGURE 3 Ultrasound image in the longitudinal plane showing the hyperechoic Harrington rod.

sion and flexion. However, should the need occur, it was felt that tracheal intubation would not have been difficult.

Cardiac echocardiography, performed preoperatively, was essentially normal, with normal pulmonary pressures and normal left ventricular size and function. Pulmonary function testing revealed a restrictive lung deficit, with results on the day before surgery showing a forced expiratory volume of 1 L in one second (FEV_1) of 1.0 L, a forced vital capacity (FVC) of 1.1 L, and an FEV_1/FVC ratio of 91%.

An elective CD was planned, due to cephalopelvic disproportion and concerns regarding the ability of the patient to participate in the labour process, due to truncal and lower extremity weakness. After thorough discussion with the patient and the obstetrician regarding the risks and benefits of a regional anesthetic technique, including the risk of infection with underlying spinal instrumentation, and the concern for potential neurological deterioration, a spinal anesthetic was planned.

A 16G intravenous cannula was sited in a peripheral vein, and an infusion of Ringer's lactate solution was begun. The midline of the lower spine was impossible to palpate. An ultrasound scan (curved array probe 2–5 mHz, Sonosite®, MicroMaxx, Bothwell, WA, USA) of the lower back was performed in the operating room, in both longitudinal and transverse planes at different intervertebral levels, with the patient in the sitting position. Scanning in the longitudinal paramedian plane revealed a hyperechoic shadow of a spinal rod extending from T2–L4 (Figure 3) and an interspinous space at the L5–S1 level below the level of the rods (Figure 4). This was the only intervertebral space visible on ultrasound examination, as the L4–L5 space was obstructed by the lower end of the rod. Imaging in the transverse plane revealed the spinous process of L5 appearing as a hyperechoic signal underneath the skin, which continued as a long, triangular hypoechoic shadow (Figure 5). This

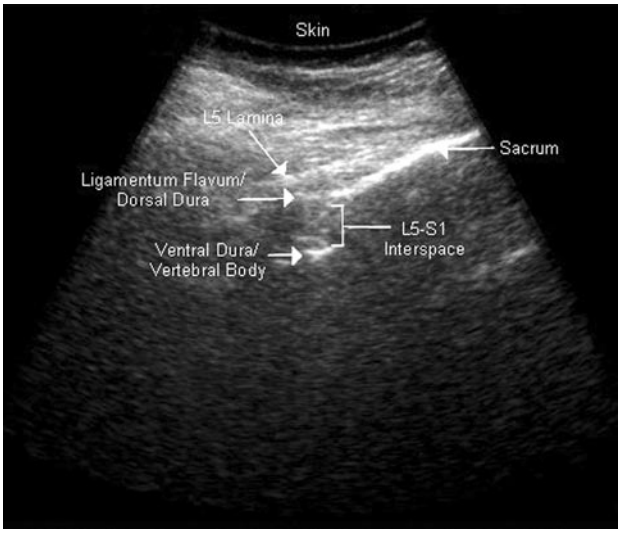

FIGURE 4 Ultrasound image in the longitudinal plane showing the sacrum, and the L5–S1 intervertebral space.

FIGURE 5 Ultrasound image in the transverse plane showing the spinous process.

signal assisted us in marking the midline of the spine. The caudal movement of the ultrasound probe enabled us to visualize the L5–S1 interspace with its structures; in particular, the ligamentum flavum and dura mater, the transverse processes, the articular processes, and the vertebral body (Figure 6). Once the best possible image of the interspace structures was captured, and with the transducer tip stabilized, a horizontal line was drawn across the points joining the midpoints of the right and left lateral surfaces of the probe. A vertical line was then drawn from the midline. Accordingly, the puncture site, which was about 3 cm lateral to the anticipated midline, was marked at the intersection of these two lines, as was the lowest level that the rods could be visualized on ultrasound scanning. The depth of the dorsal dura from the skin was measured as 4.0 cm (Figure 6). The best possible view of the L5–S1 interspace was obtained by holding the ultrasound probe perpendicular to the skin in the transverse plane (Figure 6) and; hence, the spinal needle was directed in this plane.

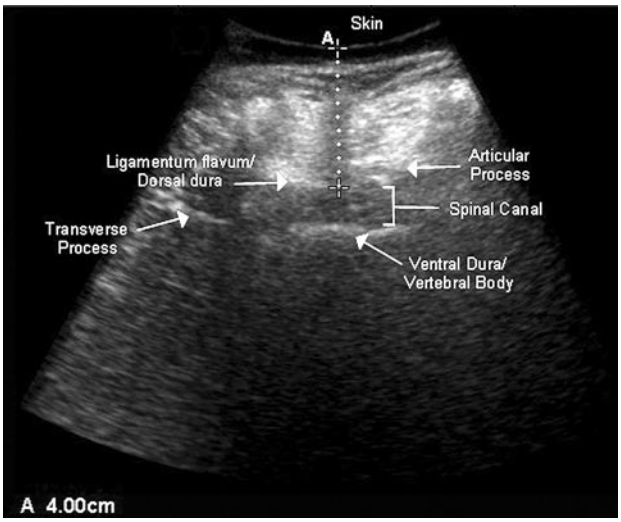

FIGURE 6 Ultrasound image in the transverse plane showing the L5–S1 intervertebral space.

On the first attempt, using a 27G Whitacre needle, the spinal needle was inserted at the L5–S1 interspace with the patient in the sitting position. Upon confirming the presence of clear CSF, hyperbaric bupivacaine 10.5 mg, with fentanyl 10 μg and morphine 100 μg were injected intrathecally. Within eight minutes, a sensory block to the T4 dermatomal level was achieved bilaterally, as assessed by cold touch and pinprick sensations. There were no clinically important alterations in blood pressure throughout the procedure, and vasopressors were not required. A healthy female infant was delivered 14 min after skin incision, with Apgar scores of 9 and 9, at one and five minutes, respectively. The motor block regressed four hours after the administration of the spinal anesthetic, and the sensory component of the block regressed by five hours. Both the mother and infant recovered uneventfully, without any postoperative complications. A follow-up of the mother, three months after the CD, showed no further deterioration in her neurological condition.

Discussion

This case illustrates several points: first, the benefit of ultrasound in the placement of a spinal block in a patient with abnormal spinal anatomy; second, the choice of anesthetic technique in pregnant patients with poliomyelitits; and third, the management of a pregnant patient with severe kyphoscoliosis, spinal surgery, and restrictive lung disease.

Poliomyelitis results from infection with a single-stranded RNA enterovirus which is transmitted by the fecal-oral route. Patients infected with the polio virus may later demonstrate neurologic symptoms such as asymetric flaccid paralysis. The overall estimated risk of paralytic polio in infected individuals is 1–2%.[6] Almost 50% of those with acute muscle weakness develop post-paralytic, permanent loss of motor function, affecting limbs and respiratory function.[7] During the past quarter century, a constellation of delayed neuromuscular symptoms, called "post-polio syndrome", has become recognized among aging polio survivors. The prevalence of the post-polio syndrome in the United States population is estimated to be in the hundreds of thousands. The most common symptoms are fatigue, pain, and new onset weakness thought to be related to a delayed deterioration of the motor neuron function.[8,9] Female survivors of polio have an elevated risk for pregnancy complications, operative delivery, and adverse perinatal outcomes.[10,11] Veiby *et al.*[10] noted that pre-eclampsia was significantly more frequent in patients with poliomyelitis, irrespective of maternal age or parity.

The patient we describe developed poliomyelitis as a child, with resultant severe kyphoscoliosis and moderate restrictive lung disease. Furthermore, she had partially-corrective spinal surgery, with extensive mechanical manipulation of her spine and the insertion of Harrington rods between spinal levels T2–L4. However, she did not have symptomatology suggestive of post-polio syndrome.

General anesthesia in this group of patients is associated with potential risks. Patients with polio may have limited respiratory reserve, and may not tolerate the stress of general anesthesia. Two case reports relating specifically to post-polio syndrome describe unanticipated respiratory failure postoperatively, the second of which resulted in cardiorespiratory arrest and subsequent cerebral injury.[12,13] In both cases, the respiratory failure was assumed to have been the result of oversedation with opioids. The response of polio patients to neuromuscular drugs may also be unpredictable. Succinylcholine may be associated with efflux of potassium from damaged motor neurons and end-plates so that, theoretically, it should be avoided. A recent case report, however, has described the feasibility of using succinylcholine in a patient with post-polio syndrome undergoing CD.[14] There is also evidence of increased potency of non-depolarizing muscle relaxants in patients with poliomyelitis and post-polio syndrome.[15] The patient described in our case had moderate restrictive lung disease, which might have complicated her postoperative course had general anesthesia been performed. Concerns included potential postoperative atelectasis, uncertain responses to neuromuscular medications, potential depressant effects of the anesthetic agents on the fetus, and patient concerns regarding her potential inability to breast-feed her baby after a general anesthetic.

In our case, the patient specifically requested a regional anesthetic technique, although, due to her spinal deformity, a regional technique was predicted to be challenging. The patient was informed of the potential technical difficulties in performing the spinal block, even with ultrasound assistance. She was made aware of the uncertainty of the effects of regional anesthesia on her underlying poliomyelitis and of the potential risk of infection, due to the presence of Harrington rods in her spine. An important consideration was the question as to the safety of regional anesthesia in patients with poliomyelitis.

No adverse effects have been reported due to regional anesthesia in patients with polio;[16] however, this does not necessarily preclude the risk of regional techniques. Although the number of healthy motor neurons, compared to damaged neurons in polio patients, cannot be assessed, it has been established that polio patients have fewer healthy motor units. These motor neurons may be more susceptible to drug effects; thus, theoretically at least, the toxic intrathecal concentration of local anesthetics may be lower in polio patients. Epidural anesthesia might prove technically difficult in the kyphoscoliotic obstetric population. Distortion of the spinal column and the epidural space in a post-spinal surgery patient can prevent either proper placement of an epidural catheter or uniform displacement of the local anesthetic solution.[11] Yeo *et al.*[4] described the use of ultrasound guidance to facilitate the placement of an epidural catheter with a resultant patchy epidural block, and, to ease the placement of an intrathecal catheter in a patient with Harrington rods. Visual details of the intervertebral space were not described, although these authors reported their use of one of the Harrington rods to estimate the midline. Ho *et al.*[17] identified 52 cases with epidural catheters sited in patients with Harrington rods, and they described most difficulties in the group of patients whose surgical scars extended to the L5–S1 levels. They concluded that lumbar epidural analgesia could be administered to patients with Har-

rington rods, although there is a greater likelihood of a difficult insertion, dural puncture, incomplete analgesia, and procedural failure. Spinal anesthesia may limit the problem of unpredictable drug spread, but it is difficult to judge the correct dose, using a single bolus technique, in this type of patient.[4]

Ultrasound-guided placement of epidural catheters has become popular over the last decade, and its use has been shown to improve the success of epidural insertions with anesthetic trainees.[18] A single screen method of ultrasound imaging in the transverse plane gives useful information about the anatomical structures located in the interspace, and ultrasound guidance has also been shown to be useful in identifying the epidural space in difficult situations, particularly in obese patients and those with abnormal spinal anatomy.[19] This information can be extrapolated to assist in potentially difficult spinal blocks.[5,19,20] The asymmetry of structures on the two sides of the spinal canal, mainly the articular and the transverse processes in the interspace as seen on the ultrasound image, can serve as a guide to determine the level of scoliosis. In our patient, in whom no anatomical landmarks were identifiable, and where it was impossible to flex the spine, we found ultrasound to be very useful to identify the lower end of the Harrington rods, as well as the only intervertebral space available for the placement of spinal block. Regional anesthesia, with the aid of ultrasound to localize the available intervertebral spaces, has not been reported previously in patients with such a degree of spinal deformity, and with prior surgical manipulation.

In conclusion, spinal anesthesia for CD is feasible in the parturient with poliomyelitis, and ultrasound imaging can greatly facilitate a spinal technique in the presence of severe kyphoscolosis and spinal instrumentation.

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