# Spinal Cord Trauma During Subarachnoid Anesthesia for Cesarean Delivery: A Case Report

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Spinal cord trauma can occur during subarachnoid blockade and can result in significant morbidity for the patient. Careful attention to lumbar insertion level is essential to prevent injury. (A&A Practice. 2019;12:452–4.)

Spinal anesthesia is the most commonly used anesthetic for cesarean delivery in the United States, with over 1.258 million cesarean deliveries performed in 2015.[1] Spinal anesthesia is remarkably safe, but serious complications do occur, albeit with a very low incidence. We present a case of spinal cord trauma secondary to a misidentification of lumbar spine level in a parturient undergoing cesarean delivery at term. Written consent was obtained from the patient for publication of this report.

## CASE DESCRIPTION

The patient was a 21-year-old, G1 P0 parturient, admitted to the labor ward at 37 weeks, 5 days estimated gestational age after examination revealed increasing blood pressure and irregular uterine contractions. Further examination showed persistent labile blood pressure and reassuring fetal heart rate monitoring but several spontaneous decelerations. She subsequently failed an oxytocin challenge test. As the fetus was felt to be viable, and due to the presence of the decelerations, a primary cesarean delivery was scheduled.

Medical history revealed a diagnosis of intractable cluster headaches and complex partial seizure disorder. She had stopped all medications on becoming pregnant, without any problems. Her medical history was otherwise unremarkable. On physical examination, weight was 188 lb, height was 5′1″, and blood pressure was between 134 and 145/78–88 after admission. Her airway was Mallampati class 2. A spinal anesthetic was planned for delivery.

In the operating room, the patient was placed in the sitting position. According to the anesthesia record, lumbar puncture was performed by a certified registered nurse anesthetist at the L3–L4 level with a 24-gauge Sprotte needle. No anesthesiologist was present. On advancement of the needle, the patient reported she screamed and felt a sensation like "…the lower half of her body was on fire." Hyperbaric bupivacaine 0.75%, 10.5 mg, was injected after free flow of cerebrospinal fluid was obtained, resulting in adequate surgical anesthesia and resolution of the pain. A viable male infant was delivered. Apgar scores of 8 at 1 minute and 9 at 5 minutes were recorded.

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The patient's recovery in the postanesthesia care unit was uneventful. Approximately 3 h after placement of the spinal anesthetic, however, the nursing notes state that the patient was complaining of 10/10 pain in both legs, described as "burning, electrical pain, very sensitive to touch, unable to tolerate sheets on legs." The obstetrician and the attending anesthesiologist who signed the intraoperative record were notified. The patient received IV steroids and ketorolac, as well as hydromorphone and lorazepam.

On the first postoperative day, the lower extremity pain was largely unchanged. She was unable to stand or walk, and neurologic consultation was obtained. The neurologist confirmed hyperesthesia of the lower extremities bilaterally. Despite her inability to stand unaided, individual muscle testing at bedside indicated strength was maintained. Magnetic resonance imaging of the thoracic and lumbar spine was performed. The magnetic resonance imaging revealed a "slightly expansile fluid intensity focus" within the distal spinal cord at the L1–L2 level, measuring 2 cm long and 0.4–0.5 cm in diameter (Figures 1 and 2).

The patient received an extended course of IV steroids and physical therapy. A second magnetic resonance imaging performed 4 days after delivery noted "low-lying conus" at the L3–L4 level and the lesion "perhaps" slightly decreased in size. Over several days, the hyperesthesia improved somewhat. She was discharged 7 days after delivery, ambulating with a walker.

Because of continued difficulty ambulating and lower extremity weakness, a malpractice claim was filed alleging negligence by the anesthesia provider. Expert witness

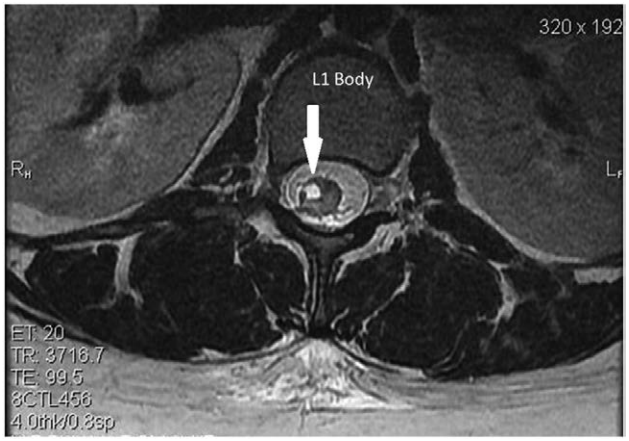


**Figure 1.** Transverse magnetic resonance imaging of the patient's spinal cord at the level of the L1 vertebral body postpartum. The arrow indicates the bright lesion within the substance of the spinal cord.

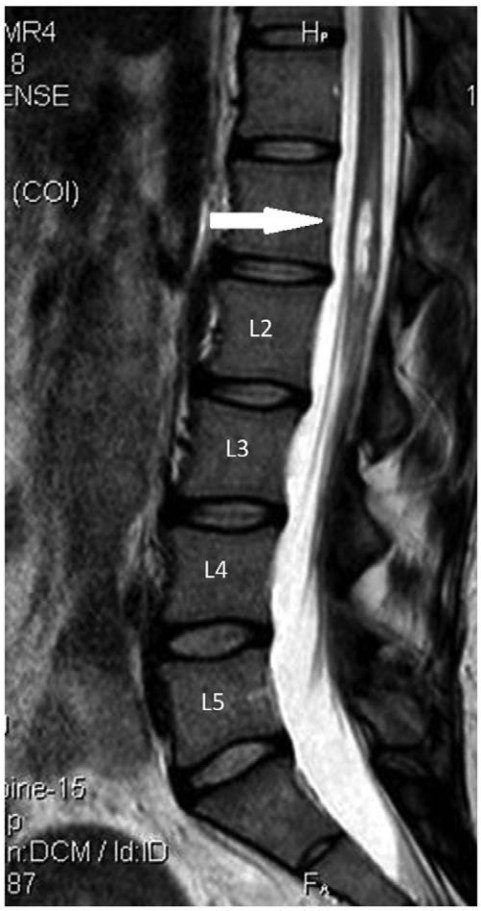


**Figure 2.** Longitudinal magnetic resonance imaging of the patient's spinal cord postpartum. The lumbar vertebral bodies are numbered. The arrow indicates the bright lesion in the substance of the spinal cord.

consultation was sought by both the plaintiff's and defendants' attorneys. Despite attempts at pretrial settlement, the case proceeded to jury trial.

At trial, a plaintiff's expert opined that placement of the spinal needle at the L1–L2 interspace, as evidenced by the location of the spinal lesion on magnetic resonance imaging of the spinal cord, violated the standard of care of subarachnoid blockade for cesarean delivery. This testimony was based on: (1) failure to accurately identify the level of insertion of the spinal needle, and (2) had the needle actually been placed at the L3–L4 level, the standard of care would not have been breached, and injury to the spinal cord would have been extremely unlikely.

Experts for the defense contended that the patient's previously unidentified low-lying spinal cord and tethering made the complication inevitable and unforeseeable. Testimony was offered that, given the tethering of the cord noted on magnetic resonance imaging at upper limit of L3, it would have been impossible to not impale the spinal cord, even if the needle had been accurately placed at L3–L4.

Following further testimony regarding the patient's likelihood of continued disability and requirements for continuing medical care, the jury returned a verdict in the plaintiff's favor.

## DISCUSSION

While spinal cord injury associated with spinal anesthesia is uncommon, it has been previously documented. Reynolds[2] documented 7 cases of direct injury to the spinal cord secondary to spinal needle insertion, all of which occurred in the United Kingdom. From the United States, no such reports are available. In a review of obstetric malpractice claims, Davies et al[3] found no cases involving direct spinal cord trauma. The database used by Davies et al[3] was composed of cases voluntarily submitted by U.S. malpractice insurance carriers and was not comprehensive. For a number of reasons (including fear of medico-legal liability), reports of anesthesia complications may not appear in the literature. Thus, the actual incidence of this complication is unknown.

Traditional anatomy texts most often state that the adult spinal cord extends caudally to the level of the L1–L2 vertebral interspace, although this is often also qualified as an "average" finding.[4,5] Recent publications have challenged this characterization. Using magnetic resonance imaging, Kim et al[6] determined the caudal limit of the conus medullaris in 690 patients and found it extended as far as the L2–L3 interspace. Broadbent et al[7] found the cord terminated below L1 in 19% of patients studied.

Current recommendations state that lumbar puncture be performed at the L2–L3 interspace or lower to avoid impingement on the spinal cord. Unfortunately, clinical identification of lumbar interspaces, even by experienced anesthesiologists, is difficult. Using clinical landmarks, Broadbent et al[7] found that anesthetists correctly identified the level of lumbar interspaces in only 29% of patients and incorrectly identified an interspace level that was actually 1–4 interspace levels higher in 51%. Whitty et al[8] reported the correlation between anesthesiologists' clinical identification of lumbar spinal level and the ultrasonographically determined identification. Agreement between clinical and ultrasonographic identifications was found in only 55% of postpartum patients. In 32% of patients, clinical identification of the spinal level was at least 1 interspace higher than the ultrasonographic identification.

The "intercristal line" (a horizontal line across the highest points of both iliac crests) is sometimes used as a clinical landmark to determine lumbar spine interspace level. While often described as passing through the L4 vertebral body, it has been shown to be unreliable for lumbar interspace identification: Lee et al[9] found anesthesiologists' clinical determination of the intercristal line to be at the L2–L3 interspace or higher in 27% of cases. Margarido et al[10] found that, in pregnant women at term, the intercristal line determined clinically by palpation does not correspond to Tuffier's line (the intercristal line determined radiologically) and may intersect the spine up to 3 interspaces above L4 (Figure 3). Kettani et al[11] found that the intercristal line crossed the spine above the L4–L5 interspace in over 63% of patients.

This case report describes incorrect identification of the lumbar spinal level leading to spinal needle insertion at a level higher than intended. This resulted in direct trauma to the spinal cord. The patient complained of pain during needle insertion, which subsided during bupivacaine injection, probably due to the anesthetic effects

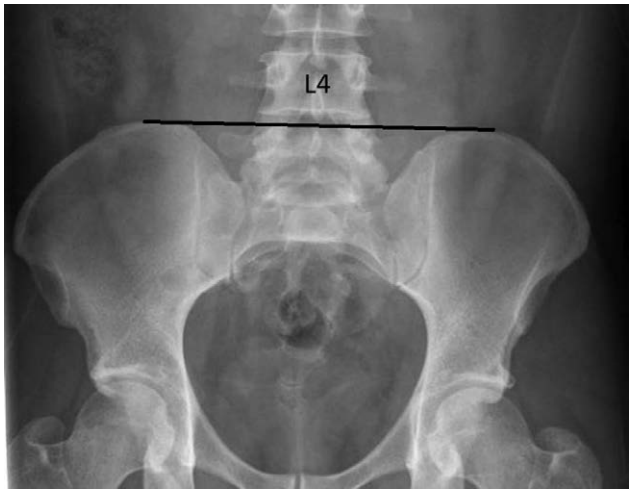


**Figure 3.** An anterior-posterior radiograph of a normal pelvis with "Tuffier's Line" superimposed. The line crosses the lumbar spine at the L4–L5 interspace. The clinically identified "intercristal line" is often claimed to correspond to this radiographic finding, although it has been found to be an unreliable landmark in pregnant patients at term.

of the local anesthetic. Although cord damage might be increased due to the pressure effects of fluid injection into the cord tissue, needle insertion alone appears sufficient to cause cord damage. In the series reported by Reynolds,[2] patients reported pain before injection, suggesting that tissue damage had already occurred. Needle repositioning after cord impingement may not reduce the risk of tissue damage.

Ultrasound-guided neuraxial blockade may improve spinal interspace identification. Randomized controlled trials have failed to demonstrate superiority over landmark-based techniques used by experienced anesthesiologists, although in obese patients with poor landmarks, ultrasonography was shown to be useful.[12] Ultrasound use has increased but requires considerable training before interspace identification becomes accurate,[13] and no surveys have been reported describing widespread use.

Abnormal anatomy in this patient (spinal cord tethering) may have increased the risk of cord damage due to unintended high needle placement. The incidence of spinal dysraphism is unknown,[14] but estimates based on small review series suggest a range of 0.05–0.25 per 1000 births.[15] Most patients with significant dysraphism that increases neuraxial block risk have neurologic signs and symptoms that appear before child-bearing age.[15] This patient had no neurologic complaints before or during pregnancy, so her low-lying conus or cord fixation was not previously discovered. Although needle placement at the level of L3–L4 might have caused direct spinal trauma, this seems quite unlikely, due to the arborization of her cauda equina at this level. Unintended placement at a higher level made the likelihood of cord damage much greater.

In summary, a case of direct trauma to the spinal cord in a parturient following incorrect identification of spinal vertebral level resulting in long-term disability is presented. It is important that anesthesiologists recognize that the intercristal line often crosses the lumbar spine of parturients at a level above the L4–L5 interspace. Given the additional limitations that anesthesiologists face in clinical determination of lumbar spinal level, when performing lumbar puncture for anesthesia or analgesia in parturients, puncture at the lowest adequate interspace is advised. ■

## DISCLOSURES

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**Contribution**: This author helped prepare the manuscript.
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