CASE REPORT

Spinal Cord Injury in a Child Caused by an Accidental Dural Puncture with a Single-Shot Thoracic Epidural Needle

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Case Report

A 9-yr-old boy (height, 132 cm; weight, 26 kg) was admitted to the hospital for an emergency appendectomy. His medical history was unremarkable. General anesthesia was induced without muscle relaxants. After intratracheal topical anesthesia was performed with 4% lidocaine spray, the child was maintained with 100% oxygen by mask in the sniffing position under spontaneous respiration for 1 min. Intubation was then achieved. Anesthesia was maintained with spontaneous ventilation during surgery. A 22-gauge Tuohy epidural needle was inserted at the T10-11 interspace in a left lateral position. An anesthesiologist with 3 yr of experience and under observation by a supervisor inserted the needle into the midline to an approximate 30-mm depth using the technique of hanging drop. However, clear, not bloody, free-flowing cerebrospinal fluid was confirmed, and the needle was withdrawn immediately. The needle was then repositioned at the T10-11 interspace again using the techniques of hanging drop and loss of resistance. Five milliliters of 0.25% bupivacaine were given without any change in vital signs.

The operation was performed without incident. Vital signs were stable, and there was no wound pain when the child was awakened. However, because he complained of a heaviness and numbness in the right leg, he was transferred to the recovery room and observed.

On the first postoperative morning, the child still complained of right anterolateral thigh tenderness and right anteromedian shin pain. Neurological examination confirmed that there was a right leg numbness involving the L4 to S1 lumbar segments and left leg numbness (L2). However, there was no movement disorder of the lower extremities. The next day, the clinical findings had not changed. From the third postoperative day, neurological symptoms gradually improved. On the fifth day, T1 and T2 weighted magnetic resonance imaging (MRI) scans were performed and showed an area of low signal (T1) and high signal (T2) from the lower level of T10-12. There was no blood in the spinal cord, surrounding tissue, or epidural space. This was thought to be edema (Fig. 1) and to be causally related to the dural puncture by the needle.

Neurological symptoms returned slowly but progressively and were assessed regularly by a consultant neurologist. On the tenth postoperative morning, the child was discharged from the hospital, and a weekly consultation with a neurologist was begun. The neurological symptoms were completely resolved on the fiftieth postoperative day. Fifty-five days after the injury a second MRI demonstrated a lessening of the edema.

Discussion

There are benefits and limitations when combining regional techniques with general anesthesia in children. These aspects, and whether or not block placement in an anesthetized child is a reasonable and safe technique, have been much discussed (1). In most cases, general anesthesia is induced before proceeding to the regional block. Anesthetized patients cannot report paraesthesia, a warning sign of a needle or catheter's proximity to the spinal cord (2–4). When epidural anesthesia is to be administered after the induction of general anesthesia, it is particularly important to evaluate the risk benefit ratio of the regional anesthetics. It is now generally accepted that it is impractical and unsafe to place blocks in a terrified, awake, moving and crying child (5). There is a report suggesting that thoracic epidural puncture in anesthetized children should be restricted to patients with severe illness and undergoing extensive thoracoabdominal surgery and administered by practitioners who have considerable expertise in both adult thoracic epidural and pediatric lumbar epidural techniques (6). However, in our hospital, it is conventional practice that the placement of a thoracic epidural anesthesia, which carries certain risks including infection, be instituted for a healthy child even for a minor lower abdominal procedure. This is done because we believe that epidural anesthesia is an effective method for perioperative pain relief and that it can offer more regional and specific pain relief than inhaled anesthetics and opioids in both children and adults. Small volumes of local anesthetic will be adequate if the level of epidural puncture is matched to the area involved in the surgery. Another advantage of epidural

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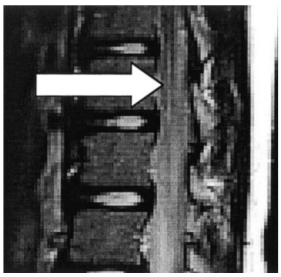
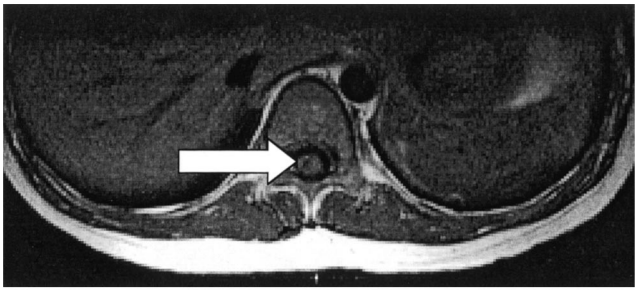


A.



B.

Figure 1. Spinal magnetic resonance image (MRI) on the fifth postoperative day. (A) T2-weighted sagittal image. The arrow indicates a high-density area around T12. (B) T1-weighted axial image. The arrow indicates a low-density spot at T12.

anesthesia compared with inhaled anesthetics and opioids is that it has less suppression of bowel movements. Epidural anesthesia allows abdominal surgery to be performed without the need for muscle relaxant drugs thus giving excellent perioperative spontaneous ventilation and reducing the need for postoperative intensive care and additional analgesic or sedative drugs.

Spinal cord damage is usually because of trauma from the needle, an epidural hematoma, fluid collection (7), ischemia from an artery injury or spasm, or an epidural abscess. Spinal cord nerve damage can also occur as the result of arachnoiditis from the injection of a neurotoxic substance, a mistakenly injected drug, or one that contains a preservative. We used 0.25% bupivacaine that contains additives as preservatives (p-hydroxybenzoic acid propyl ester 0.8 mg and p-hydroxybenzoic acid methyl ester 0.2 mg in 1 mL of 0.25% bupivacaine hydrochloride). Hence, these preservatives may have immigrated to the subarachnoid space and could have caused an inflammatory response, which led to arachnoiditis or spinal edema. At first we suspected that the neurological symptoms were caused by meningitis from the preservatives or arachnoiditis from the increased risk of epidural placement in a case with the potential for bacteremia. However, headache, nuchal rigidity, and positive Kernig sign were not noted, and the patient became afebrile on the third postoperative day. In our case, from the patient's history (the absence of back pain and tenderness) we could exclude an epidural abscess, and there was no evidence suggestive of an epidural abscess or fluid collection. From the clinical complaints, which indicated sensory deficits in only a small area, spinal cord ischemia from an artery injury or spasm could be excluded. In Mayall and Calder's case (8), surgical exploration revealed a hematoma. It was impossible to say precisely from the appearance in the MRI scan whether there was edema or hematoma, and we did not perform a surgical exploration. However, we considered that it was an edematous change for four reasons. First, despite the reduction of the lesion, the density of signals did not change in the second MRI from both the T1 and T2 signals in the first MRI scan. Second, the signal in the lesion was uniform in the second MRI scan; however, it would not have been uniform two months after such damage if it was a hematoma because the signal of the circumferential lesion would have changed in quality by the absorption. Third, the symptoms would have been more widespread and would not have disappeared if it were a hematoma. And fourth, it is extremely rare to find a hematoma in the absence of a coagulation abnormality.

There are certainly technical points to consider, such as the increased risk of epidural placement in the same interspace after an accidental dural puncture using local anesthetic, which contains preservatives. Cord edema was seen at T10-12. It might have been because the edema spread from T10-12 or the needle insertion was actually at T11-12, although the anesthesiologist thought it was at T10–11. In our case, the neurological symptoms were completely resolved because in the spinal region there was edema, not hematoma. How the spinal cord was actually injured directly by the epidural needle despite having a free flow of cerebrospinal fluid remains unknown. However, because there has been no reported case of a spinal cord injury during thoracic epidural anesthesia in a child with MRI images, we reported the case as a lesson and a reminder that spinal cord injuries can occur with the placement of a thoracic epidural under general anesthesia in a child.

MRI scanning is now considered the preferred method to confirm a diagnosis and location of any spinal trauma, and it is also useful for observation and follow-up in cases of spinal damage. The test is costly but noninvasive and easily performed. Our case indicates that a MRI scan should be performed as soon as possible in any patient with a dural puncture who complains of neurological symptoms.

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