

An inadvertent subarachnoid injection reversed by cerebrospinal fluid lavage for the treatment of chronic low back pain

A case report

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Abstract

Rationale: We present a case of high spinal anesthesia after inadvertent injection of local anesthetics and corticosteroids into the subarachnoid space during attempted epidural injection. Cerebrospinal fluid (CSF) lavage is a suitable method for treatment.

Patient concerns: A 45-year-old woman presented with posterior thigh, leg, and ankle pain for >6 months and was treated with epidural injection. Five minutes after the third time of epidural injection, the patient complained loss of sensation and muscle strength in the lower extremities and abdominal area.

Diagnoses: A high spinal anesthesia was confirmed by the patient loss of sensation and muscle strength in the lower extremities and abdominal area.

Interventions: CSF lavage was performed for treatment.

Outcomes: After CSF lavage, the patient gradually returns to normal sensory and motor functions of lower limbs. On the fourth day, the patient sensed her physical function restoring gradually and was discharged uneventfully. At 4-month follow-up, the patient could have normal activities without obvious subsequent complications and any pain.

Lessons: We conclude that CSF lavage could be a helpful maneuver to clear lidocaine and betamethasone and avoid potential nerve damage caused by an unintentional intrathecal injection during an epidural injection for the treatment of chronic low back pain.

Abbreviations: CSF = cerebrospinal fluid, EKG = electrocardiogram, HR = heart rate, MRI = magnetic resonance imaging, NIBP = noninvasive blood pressure, SpO₂ = saturation of pulse oxygen.

Keywords: betamethasone, cerebrospinal fluid lavage, chronic low back pain, complications, epidural injections

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1. Introduction

In recent years, chronic low back pain has become a major cause of disability in the elderly patients, resulting in significant economic, social, and health care problems. Chronic low back pain is a multifactorial disorder with many possible etiologies, including pathologies from intervertebral discs, facet joints, ligaments, fascia, muscles, and nerve root dura as tissues capable of transmitting pain in the low back. While epidural injections continue to be controversial regarding their effectiveness, indications, and approaches, they are one of the most commonly performed interventions in treating chronic low back pain.^[1] Epidural steroid injection (ESI/transforaminal TESI; approximately 9 million ESI performed in the US per year) is simple but not without complications.^[2] Neurological complications including intracranial hypotension, subdural hematomas, and 6th cranial nerve palsies/double vision. Cervical dural punctures solely attributed to cervical ESI (CESI), uniquely risked monoparesis or quadriplegia due to intramedullary spinal cord injections or injury, or stroke due to intravascular vertebral artery injections.^[3] Here, we report an inadvertent injection of corticosteroids into the subarachnoid space during an epidural injection for the treatment of low back pain. The patient was immediately treated with CSF lavage and without obvious subsequent complications.

2. Case report

A 45-year-old woman presented with posterior thigh, leg, and ankle pain for >6 months. Physical examination demonstrated that the right lower extremity of the straight leg raising test was positive, and the pain radiated into the leg below the knee and occurred at an elevation <70°. Lumbar magnetic resonance imaging (MRI) showed L₄₋₅ intervertebral disc herniation and dural sac compression. The patient didn't respond to conservative treatment and then underwent 2 caudal epidural injections. After the first treatment, the patient's posterior thigh pain was noticeably relieved and the pain in the other parts was also reduced by half. The second treatment was poorly effective, and the patient was ready to undergo the third treatment with lumbar epidural injections.

After an intravenous access was established, the patient was placed in a right lateral position. Continuous hemodynamic monitoring was initiated including noninvasive blood pressure (NIBP), heart rate (HR), electrocardiogram (EKG), and saturation of pulse oxygen (SpO₂). The area of the spine was prepped with povidone-iodine 3 times and draped in a sterile fashion. Skin anesthesia was achieved using 3 mL of lidocaine 0.5% over the respective injection site. A 16 gauge Tuohy needle was slowly inserted and advanced into the epidural space using loss of resistance to saline at the L₃₋₄ level. At the loss of resistance (needle passing the ligamentum flavum), there was an involuntary twitch of the patient's left thigh. After negative aspiration for blood or CSF was confirmed, a combination of sterile solution of 20 mL (2% lidocaine 60mg, betamethasone [Diprosan] 7mg, and normalsaline) was slowly injected into "epidural space." When the patient turned to the supine position, she complained of loss of sensation and muscle strength in the lower extremities and abdominal area. Her vital signs remained stable (NIBP was 135/78 mmHg, HR was 82 bpm, and SpO₂ was 98%). The anesthesia level was checked at T₈ for the motor blockade and T₅ for the sensory block. Subarachnoid injection was therefore suspected. The patient was administered with CSF lavage immediately. 37° C warm normal saline was used for CSF lavage. The corresponding CSF was extracted following each injection of 10 mL normal saline, with the extracted fluid respectively stored in a 10 mL tube (Figs. 1 and 2). After 130 mL of the fluid was exchanged, the patient reported that her plantar sensation and muscle strength of lower limbs partly recovered. Furthermore, her muscle strength of lower limbs recovered to grade 3 and she was able to urinate while the total injected normal saline of 180 mL and the extracted fluid 170 mL. The CSF lavage lasted for 40 minutes. During the whole process, the patient preserved consciousness, verbal fluency, and stable vital signs. Then a lumbar MRI performed and no obvious abnormality was found, excluding edema or injury of spinal cord and nerve roots. Six hours after the procedure, her muscle strength of lower limbs returned to grade 4.

Twenty hours after the CSF lavage, the patient had normal sensory and motor functions of lower limbs, without nausea, vomiting, or headache. The vital signs were stable, muscle strength returned to grade 5. She began to eat and urinate but without defecation. On the third day, the patient complained of neck muscles pulling, shoulders back swelling painfully, right thigh pulling while sitting, but urinating and sleeping well, no defecation. On the fourth day, the patient suffered from fluctuating headache in bilateral temporal regions, back swelling

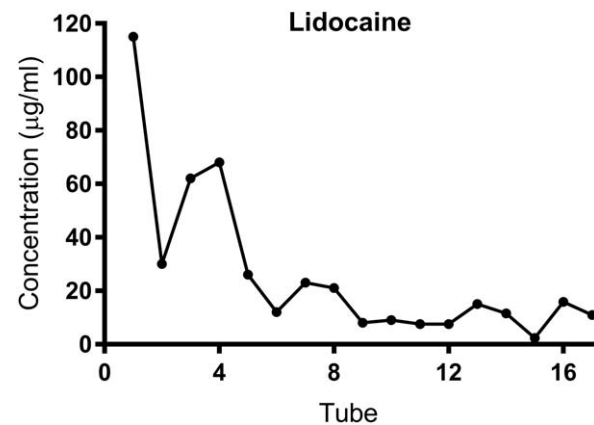


Figure 1. Cerebrospinal fluid concentration of lidocaine in tube 1 to 17. Determined with Dionex U3000 high performance liquid chromatograph system.

painfully, and swallowing discomfortably. After defecation, the patient sensed her physical function restoring gradually, except for headache. One month later, the headache disappeared. Four months later, the patient could have normal activities without any pain.

3. Discussion

Epidural injection remains the most popular nonoperative method for the treatment of chronic low back pain for many decades. The most commonly used drugs are steroids and local anesthetics. Although the underlying mechanism of action of ESI and local anesthetic injection is not well understood, it is believed that the achieved neural blockade alters or interrupts nociceptive input, the reflex mechanism of the afferent fibers, self-sustaining activity of the neurons, and the pattern of central neuronal activities.^[4] Furthermore, corticosteroids have been shown to reduce inflammation by inhibiting either the synthesis or release of a number of pro-inflammatory mediators and by causing a reversible local anesthetic effect.^[5] Local anesthetics have also been described to provide short-to long-term symptomatic relief based on alteration of various mechanisms including excessive

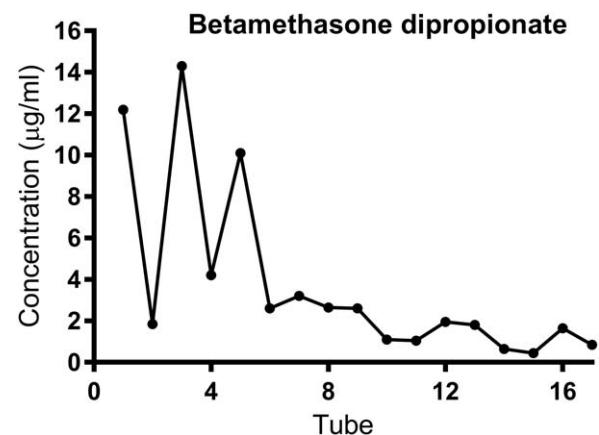


Figure 2. Cerebrospinal fluid concentration of betamethasone dipropionate in tube 1 to 17. Determined with Dionex U3000 high performance liquid chromatograph system.

nociceptive process, excessive release of neurotransmitters, nociceptive sensitization of the nervous system, and phenotype changes.^[6] The most critical complication of epidural local anesthetic injections is the total spinal anesthesia, the incidence of which is about 0.03% to 0.1%.^[7] In this patient, 60 mg lidocaine was unintentionally injected into the subarachnoid space. The patient remained awake during the whole process, with stable vital signs and anesthesia level, largely because the lidocaine dose is too small to cause the total spinal anesthesia. Clinically, the dose of lidocaine for spinal anesthesia is generally 60 to 120 mg for the lower abdomen and lower limb operations. In addition, Van Zundert et al^[8] demonstrated that a constant 70 mg dose of subarachnoid lidocaine produced the same pinprick level of analgesia, degree of motor block, and duration of spinal anesthesia in spite of being injected over an extremely broad range of concentrations (0.5–10%) and volumes (0.7–14 mL). And the relatively fixed level of anesthesia was about T₄ to T₅, which is similar to that in this reported case. We believed that, in this case, a high spinal but not a total spinal anesthesia was the most likely explanation for the patient's signs and symptoms.

To prevent potential neurotoxicity caused by the drugs straying into the subarachnoid space, the patient was immediately treated with CSF lavage. Numerous studies including clinical researches, case reports, and in vitro and in vivo experiments confirmed that lidocaine had intrinsic neurotoxicity and that it was more neurotoxic than other commonly used local anesthetics. The estimated risk of lidocaine neurotoxicity of about 1 in 200 for continuous spinal anesthesia and of about 1 in 1300 for single-injection spinal anesthesia was clinically significant in the context of modern anesthesia practice.^[9] It was reported that a single spinal injection of lidocaine might cause transient neurological symptoms (TNS), with occasional cauda equina syndrome occurring.^[10] Cauda equina syndrome is a permanent disability, which is characterized by varying degrees of urinary and fecal incontinence, sensory loss in the perineal area, and motor weakness in the legs. The possible mechanism of its occurrence is that nonhomogeneous mixing of the lidocaine within the subarachnoid space resulted in exposure of the cauda equina to high concentrations of lidocaine, which contributed to irreversible nerve damage.^[11] However, TNS is manifested with unilateral or bilateral anterior or posterior thigh pain, perhaps extending to the calf, together with back pain, with no motor weakness and neurological abnormalities. In this situation, non-steroid anti-inflammatory drugs are the first-line therapy. The pathogenesis of TNS remains unclear,^[12] and lidocaine spinal anesthesia has been identified to be important predictors of the development of TNS. It is prudent to use low dose of lidocaine (maximum 60 mg in subarachnoid cavity).

Diprospan is compound betamethasone injection and each injection contains soluble betamethasone sodium phosphate (considered as betamethasone 2 mg) and slightly soluble betamethasone dipropionate (considered as betamethasone 5 mg). Currently, the safe use of intrathecal 1 to 3 mg betamethasone has been reported in cancer patients for pain relief, which may be related to decreases in CSF concentrations of IL-8 and PGE₂.^[13] The safe use of intrathecal betamethasone has also been reported in patients after lumbar disk surgery and in an animal experiment.^[14,15] Nevertheless, previous reports involved safe application of intrathecal betamethasone were small-dose (1–3 mg). This case may be the first report concerning intrathecal injection of higher doses betamethasone (7 mg). There are several arguments regarding the safety of intrathecal injection of steroids. And neurotoxic complications such as arachnoiditis and

meningitis have been reported.^[16] Although it is believed that additives, such as antioxidants and preservatives, that are present in the injected solution, rather than the steroids themselves, may cause neurotoxicity when administered intrathecally.^[17] Latham reported that the injection of 5.7 mg intrathecal betamethasone in sheep did not show obvious neural pathological changes,^[15] but ≥ 11.4 mg intrathecal betamethasone injection exhibited a dose-dependent neurotoxicity. Given that the volume of CSF in the sheep is approximately one-third of that in humans, the author suggested that small doses (up to 11.4 mg) of betamethasone injected intrathecally in humans are unlikely to cause nerve injury, but that the risk of nerve injury increases substantially with higher doses.^[15] In this case, the patient was immediately treated by CSF lavage after 7 mg betamethasone strayed into the subarachnoid space. As shown in Figs. 1 and 2, the concentration of lidocaine and betamethasone dipropionate dropped nearly to nil after 9 to 10 times of CSF wash. Accordingly, the patient's sensory and motor functions gradually returned to normal status. However, drug recovery also depends on drugs diffusibility and lipid solubility.^[18] Because betamethasone sodium phosphate is an instantly soluble material, rapidly dissolving in the CSF, we did not measure its concentration changes.

The main benefit of CSF lavage is that it removes and dilutes a drug that has been inadvertently injected into the intrathecal space, limiting the possibility of the drug to have neurological damage. There are numerous publications advocating CSF lavage as an effective method for reversing high and total spinal anesthesia and managing inadvertent intrathecal injection of excessive or neurotoxic drugs.^[19–22] Normal saline,^[23] lactated Ringer solution,^[19] and Plasma-Lyte have previously been used for CSF lavage.^[24] In this case, sterile, preservative-free normal saline (Na 154 mEq L⁻¹; osmolality, 308 mOsm L⁻¹; pH 5.5) was used to replace the CSF because of its ready availability. However, perfusion of the cerebral ventricles with large volumes (400–1000 mL) of normal saline produces central nervous system side effects, such as headache and fever, but does not increase the overall morbidity.^[23,24] To minimize potential nerve damage induced by drugs, we injected 180 mL normal saline for CSF lavage, which may be involved in the patient's post-dural puncture headache. The volume, rather than the type of perfusate, used is probably the critical factor. Our results suggested that about 100 mL of normal saline for CSF wash may have been able to substantially remove the intrathecal drugs. Nevertheless, the maximum safe volume of exchanges of CSF with saline replacement needs further study. Therefore, prior to beginning the procedure, the operator should weigh the potential risks and benefits of CSF exchange, select the type of solution, and limit the volume to be exchanged.

4. Conclusion

We show that CSF lavage can be used successfully to manage an inadvertent subarachnoid injection and avoid potential nerve injury resulted from lidocaine and high-dose betamethasone in patients with chronic low back pain. If neurotoxic drugs (may be potential neurotoxicity or unknown neurotoxicity) was suspiciously injected to subarachnoid space, CSF lavage should be considered and carried out as soon as possible, to alleviate potential complications and nerve damage.

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Author contributions

Xiaodi Sun and Yinbing Pan helped design the study. Shijiang Liu and Yinbing Pan helped conduct of the study. Xiaodi Sun, Shijiang Liu, and Cunming Liu helped collect the data. Xiaodi Sun, Jijun Xu, Jie Sun, and helped analyze the data. Xiaodi Sun and Shijiang Liu were a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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