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A plantar flexion response to nerve stimulation indicates needle misplacement in the epidural/spinal space during psoas compartment block

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Abstract
We report two cases of plantar flexion due to epidural misplacement of the needle during psoas compartment block, providing a response feedback for needle position during this procedure. In one case, the response occurred contralaterally, and in the other bilaterally. In the first patient, the cause of contralateral plantar flexion could not be determined and no injection was made. In the second patient, the anterior-posterior-fluoroscopic image showed that the tip of the needle was placed at the midline of the column. At this point, 3 ml of radiopaque medium was injected, and it diffused throughout the epidural space. Subsequently, single-shot epidural anesthesia was achieved by injection through this needle.

Key words Psoas compartment block · Epidural/Spinal anesthesia · Nerve stimulation · Plantar flexion

Introduction

Psoas compartment block (PCB), the posterior approach to the lumbar plexus, is a commonly used anesthesia technique, and in combination with sciatic nerve block, represents an alternative to general anesthesia for patients undergoing leg surgery. In addition, PCB by means of patient-controlled regional analgesia techniques achieves a good quality of postoperative analgesia [1]. Some authors, however, have recently reported unintentional neuraxial blocks with PCBs [2–5]. Therefore, to safely perform this block, proper positioning of the needle or catheter is essential. One of the suggested methods for correct placement of the needle or the catheter is the use of nerve stimulation. However, an accurate assessment of the response to the stimulation is critical in order to identify correct placement of the needle or catheter. Here we report two cases demonstrating plantar flexion responses to nerve stimulation following misplacement of the needle into the epidural space during PCB.

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Case 1

A 48-year-old, 48-kg, 154-cm-tall man, American Society of Anesthesiologists (ASA) physical status I, presented for left knee arthroscopy and was scheduled for a combination of single-shot psoas compartment and sciatic nerve blocks. After routine monitoring and sedation with 2 mg i.v. midazolam, the patient was placed in the right lateral decubitus position. The insertion site was identified 3 cm below the intercrestal line and 3 cm lateral to the interspinous line, as described by Pandin et al. [6]. After disinfection and local skin infiltration, a 100-mm-long 22-gauge insulated needle (Stimuplex D; B. Braun, Melsungen, Germany) was inserted perpendicular to all planes, using a peripheral nerve stimulator. The needle was advanced until bone contact and then redirected in a cephalad direction.

A response of the peroneal muscles and plantar flexion were observed in the contralateral leg. The responses continued at 0.3 mA at a depth of approximately 7 cm. These contractions would have been inconsistent with lumbar plexus distribution even if they had been on the ipsilateral side. The block had been administered by a fourth-year resident, and a senior anesthesiologist was called. The cause of the contraction could not be identified, and the needle was therefore retrieved and redirected by the senior anesthesiologist as described above but slightly laterally. This time, the expected quadriceps muscle contraction was observed. After a 3-ml test dose, 30 ml

0.5% levobupivacaine was administered in divided doses, followed by a sciatic block with 20 ml 0.375% levobupivacaine. Complete sensory and motor block was obtained and the surgery was completed uneventfully.

Case 2

A 72-year-old, 88-kg, 164-cm-tall woman, ASA physical status III, presented for repair of a left femur fracture. She had been diagnosed with diabetes mellitus, hypertension, class III heart failure (according to the New York Heart Association functional classification system), and serious chronic obstructive lung disease. She was scheduled for combined spinal epidural anesthesia (low spinal anesthesia [i.e., spinal anesthesia in which the level of sensory denervation extends to the tenth or eleventh thoracic dermatome] for surgery and epidural catheter for postoperative analgesia). With the patient in the right lateral position, an attempt was made to identify the lumbar epidural space at the L4–5 interspace, using a midline approach with an 18-gauge Tuohy needle and the loss-of-resistance technique with saline. Because the epidural space could not be identified with a midline approach, a paramedian approach was tried. The epidural space was identified at that time, but we were unable to obtain cerebrospinal fluid through the spinal needle. An epidural catheter was inserted into the space, and after a negative test dose with 3 ml 2% lidocaine with epinephrine (5 $\mu g \cdot ml^{-1}$), 5 ml 0.5% levobupivacaine was injected. However, anesthesia was not obtained. Thus, we administered a combination of PCB and sciatic block. For PCB, the needle was inserted as described above. After bone contact was obtained at a depth of 5 cm, the needle was withdrawn slightly and advanced further in a cephalad direction (Fig. 1). Bilateral contractions of the peroneal muscles and plantar flexion were observed at a depth of approximately 8 cm and bilateral plantar flexion continued at 0.3 mA. After negative aspiration, a test injection of 3 ml 2% lidocaine with epinephrine (5 $\mu g \cdot ml^{-1}$) was injected. Neither tachycardia nor spinal anesthesia was observed. To determine the cause of the peroneal contraction, an anterior-posterior fluoroscopic image of the columna vertebralis was taken. This image indicated that the tip of the needle was at the midline of the column. Three milliliters of radiopaque medium was injected and it dispersed throughout the epidural space (Fig. 2). We opted for single-shot epidural anesthesia, due to time pressure. After a negative aspiration, 7 ml 0.5% levobupivacaine was injected through the stimulating needle. Twenty minutes after the injection, the bilateral sensory block levels were T10; the surgery was started and completed uneventfully.

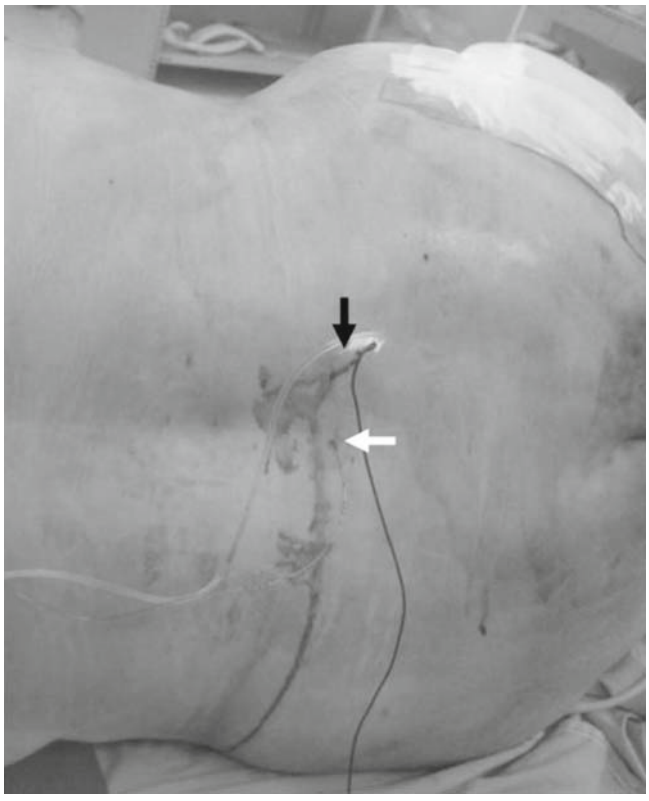

Fig. 1. The positions of the patient, the epidural catheter (*white arrow*), and the needle directed at the psoas compartment (*black arrow*)

Discussion

Inadvertent central neuraxial block is a well-described complication of the posterior approach to lumbar plexus block [2–5]. Although this type of complication is relatively rare, inadvertent epidural or spinal injections of large volumes of local anesthetic may be detrimental, especially in patients who have critical comorbidities (which provide the indication for the peripheral block in the first place). Therefore, the possibility of central injection must always be considered when attempting lumbar plexus block. To avoid accidental central blocks, strict precautions are necessary, such as approach in the sagittal plane, and 3–5 cm lateral to the interspinous line [6,7]. However, these precautionary measures may not always be feasible. For example, it may be difficult to identify the landmarks, due to anatomical variation, deformation, obesity, or improper positioning of the patient. The use of electrical stimulation is advised for proper placement of the needle or catheter for regional anesthesia. At the same time, proper assessment of the response to the stimulation is crucial or mandatory in order to identify misplacement of the needle or catheter.

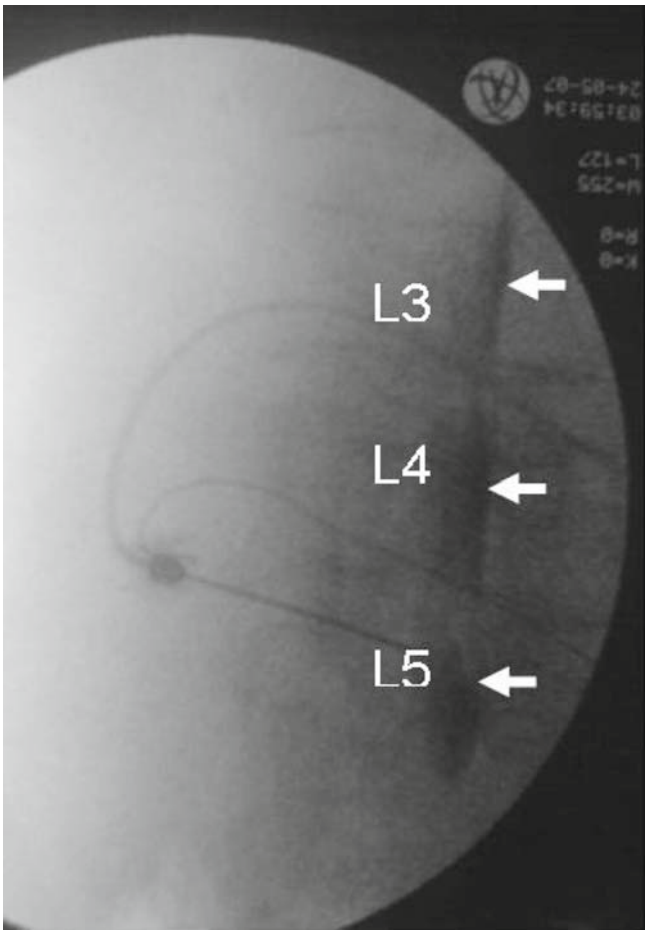

Fig. 2. Anterior-posterior fluoroscopic image of the columna vertebralis. The tip of the needle at the midline of the column and the typical spreading of the radiopaque medium throughout the epidural space (*arrows*) are shown

Here we report contralateral and bilateral plantar flexion following epidural stimulation. The presence of contralateral plantar flexion in these patients was fortunate; we observed only contralateral flexion in the first patient and bilateral plantar flexion in the second one. A contralateral muscular response during stimulation of the lumbar plexus is an obvious warning sign of improper placement. However, had we observed only an ipsilateral plantar flexion, it may not have served as a noticeable indication of needle misplacement. So, there is no doubt that the contralateral response is an indication of epidural/spinal placement. However, only an ipsilateral response itself can be caused by stimulation of the sacral plexus originating from lumbar nerve root 4 to sacral nerve root 3, especially the L4 spinal roots [8]. Therefore, only an ipsilateral response may suggest needle misplacement to the L4 spinal root, although the possibility of epidural/spinal misplacement cannot be denied.

Both cases we have reported support the use of the Tsui test. Tsui et al. [9,10] suggested an objective method using electrical stimulation to correctly identify epidural catheter placement. The position of the epidural catheter tip would be confirmed by monitoring the contraction of skeletal muscle, using nerve stimulators.

It may not be possible to be sure whether the responses seen in our two patients originated from the epidural needle misplacement or from a subarachnoid location. Both of these factors cause a similar response, though a difference in threshold currents has been reported [11], and it is well known that aspiration of cerebrospinal fluid is not inevitably observed, so subarachnoid misplacement also had to be considered, and a spinal test dose had to be done before changing the technique to epidural anesthesia. As well as the aspiration and spinal test dose, fractionated dosing is essential.

We do not know the exact reason for the improper placement of the needles in the two patients reported here. Perhaps the approach may have been too medial, or important landmarks were poorly identified. According to trigonometric calculations, a 10° medial angulation to the sagittal plane will bring the needle tip about 1.4 cm closer to the spine at an 8-cm depth [5]. In fact, such a deviation cannot be excluded. This misplacement may be more likely with the more medial approach described by Pandin et al. [6], used in the present surgeries, than by the approach described by Chayen et al. [7]. In the method of Pandin et al., the puncture site is located 3 cm lateral to the interspinous line, 1 to 2 cm medial to the approach described by Chayen et al. In addition, in our case 2, the needle may have been advanced too far after contact with the transverse process of the lumbar vertebra (3 cm); 2 cm is advocated to prevent misplacement [3].

In addition, the achievement of "isolated lumbar plexus blockade", i.e., avoiding sacral plexus blockade, is especially important to prevent the postoperative onset of sciatic palsy after total hip arthroplasty in patients receiving continuous lumbar plexus blockade for postoperative analgesia. As is well known, sciatic nerve injury after total hip arthroplasty is not rare (incidence, 0.7% to 3.0% for primary surgery and 2.9% to 7.6% for revision surgery [12]). In such cases, early detection and rapid intervention may be essential for complete recovery. Some reports have demonstrated the value of proper and isolated lumbar plexus block to detect the early onset of sciatic palsy after total hip arthroplasty [13,14].

In summary, the two cases we have described demonstrate that a plantar flexion response to electrical stimulation during PCB is a useful warning sign for the misplacement of an epidural/spinal needle.

References

1. Ozalp G, Kaya M, Tuncel G, Canoler O, Gulnerman G, Savli S, Kadiogullari N. The analgesic efficacy of two different approaches to the lumbar plexus for patient-controlled analgesia after total knee replacement. J Anesth. 2007;21:409–12.
2. Gentili M, Aveline C, Bonnet F. Total spinal anaesthesia complicating posterior lumbar plexus block. Ann Fr Anesth Reanim. 1998;17:740–2.
3. De Biasi P, Lupescu R, Burgun G, Lascurain P, Gaertner E. Continuous lumbar plexus block: use of radiography to determine catheter tip location. Reg Anesth Pain Med. 2003;28:135–9.
4. Pousman RM, Mansoop Z, Sciard D. Total spinal anesthetic after continuous posterior lumbar plexus block. Anesthesiology. 2003; 98:1281–2.
5. Litz RJ, Vicent O, Wiessner D, Heller AR. Misplacement of a psoas compartment catheter in the subarachnoid space. Reg Anesth Pain Med. 2004;29:60–4.
6. Pandin PC, Vandesteene A, d'Hollander AA. Lumbar plexus posterior approach: a catheter placement description using electrical nerve stimulation. Anesth Analg. 2002;95:1428–31.
7. Chayen D, Nathan H, Chayen M. Lumbar plexus: a new posterior approach. Anesthesiology. 1973;45:95–9.
8. Meier G, Buettner J. Peripheral regional anesthesia. Stuttgart: Thieme; 2006.
9. Tsui BC, Gupta S, Finucane B. Confirmation of epidural catheter placement using nerve stimulation. Can J Anaesth. 1998;45: 640–4.
10. Tsui BC, Seal R, Koller J, Entwistle L, Haugen R, Kearney R. Thoracic epidural analgesia via the caudal approach in pediatric patients undergoing fundoplication using nerve stimulation guidance. Anesth Analg. 2001;93:1152–5.
11. Tsui BC, Wagner AM, Cunnungham K, Perry S, Deasai S, Seal R. Can continuous low current electrical stimulation distinguish insulated needle position in the epidural and intrathecal spaces in pediatric patients? Paedriatr Anaesth. 2005;15:959–63.
12. Stone RG, Weeks LE, Hajdu M, Stinchfield FE. Evaluation of sciatic nerve compromise during total hip arthroplasty. Clin Orthop. 1985;201:26–31.
13. Ben-David B, Joshi R, Chelly JE. Sciatic nerve palsy after total hip arthroplasty in a patient receiving continuous lumbar plexus block. Anesth Analg. 2003;97:1180–2.
14. Ozalp G, Canoler O, Tuncel G, Turgut S, Kadiogullari N. Sciatic nerve palsy after total hip arthroplasty in a patient receiving psoas compartment block for patient-controlled regional analgesia. J Anesth. 2006;20:251–2.