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Ultrasound-aided unilateral epidural block for single lower-extremity pain

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Abstract
We report an ultrasound-aided unilateral epidural block, employed in two patients, to provide better analgesia and motor function for lower-extremity pain. The patient in case 1 was a 72-year-old woman who suffered pain arising from *Herpes zoster* rash on the left leg (the second lumbar nerve area). A left-dominant continuous unilateral epidural block was performed to reduce her pain. After confirming the L2/3 epidural space and needle direction using ultrasound imaging, epidural cannulation was performed. Continuous infusion of 4 ml·h^{-1} of 1% lidocaine through the epidural catheter eliminated the herpetic pain in the left leg, maintaining motor function and normal sensation in her right leg. The patient in case 2 was a 35-year-old man whose complaint was postoperative pain in his left knee during passive movement. Dependent-side (left-side) dominant ultrasound-aided continuous unilateral epidural block, the same procedure as that used in case 1, was performed at the L3/4 intervertebral space. His left knee pain was clearly reduced, with partial paralysis, but motor function in his right leg was completely normal during the continuous epidural block with 4 ml·h^{-1} of 0.2% ropivacaine. Ultrasound imaging around the epidural space facilitated effective unilateral epidural block for single lower-extremity pain in both patients. This technique could decrease possible side effects and improve patient satisfaction during continuous nerve block by maintaining motor function and sensation in the nondependent side.

Key words Epidural block · Ultrasound · Pain clinic · Side effect · Unilateral

Introduction

Continuous lumbar epidural block is the standard technique for treating lower-extremity pain (e.g., postoperative pain and intractable pain) and it is known to provide better analgesia for knee pain than intravenous patient-controlled analgesia or peripheral nerve block [1–3]. However, unexpected epidural block, such as that due to the malposition of an epidural catheter [4], or uncomfortable paralysis of the nondependent side [2,5] decrease patient satisfaction and could increase hospital stay. Hogan [6] reported that a variety of catheter tip positions and spread patterns of local anesthetics could relate to the area of the epidural block.

In the present case reports we describe a novel technique, ultrasound-aided unilateral epidural block (unilat-epi), employed to reduce pain on the dependent side and to maintain motor function on the nondependent side.

Case reports

Case 1

A 72-year-old woman visited our hospital because of *Herpes zoster* rash on the left lower extremity (the second lumbar nerve area). She had consulted a dermatologist 2 days after the herpetic vesicles had appeared. In spite of treatment with an intravenous antiviral drug (aciclovir 750 mg·day^{-1}) and an oral nonsteroidal anti-inflammatory drug, severe pain (7–9 points on a 0 to 10 verbal rating scale) remained in the affected area. She was, therefore, referred to our pain clinic service during her hospital stay. Her past medical history did not preclude continuous epidural block, and after obtaining her informed consent, we considered that ultrasound-aided unilat-epi with a catheter was necessary for further pain relief. Left-dominant unilat-epi was performed with the patient in the left lateral position. The puncture point on the skin was determined by ultrasound imaging (Micro MAXX with C60e 2–5 MHz curved probe; SonoSite, Bothell, WA, USA). Firstly, the correct epidural space was identified by counting from the sacral

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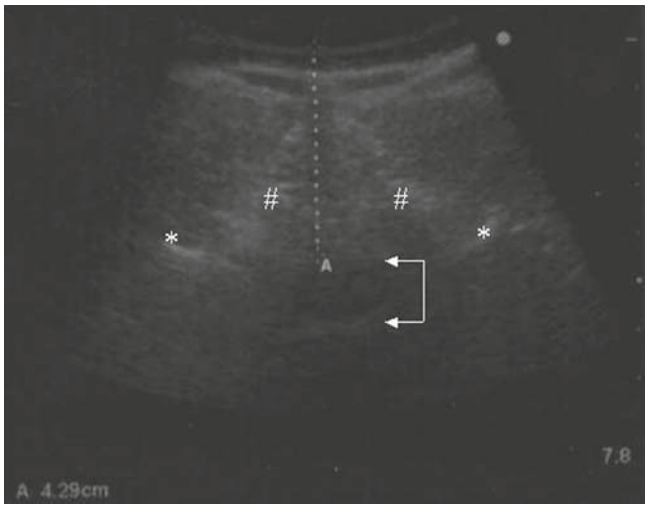

Fig. 1. Short-axis ultrasound imaging at the L2/3 intervertebral space. The vertebral process (*asterisks*), facet joint (*hash symbols*), and subarachnoid space (*arrows*) are observed. The distance from the skin to the dura matter is 4.29 cm (*dotted line*)

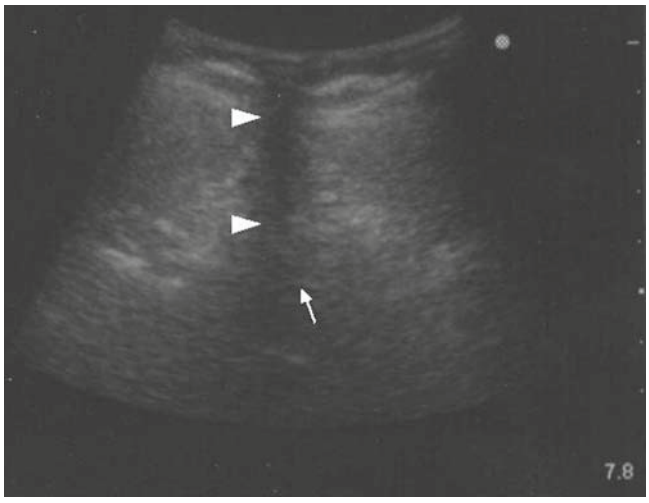

Fig. 2. Puncture imaging for unilateral epidural block. The acoustic shadow of the metal hemostat tip on the skin (*arrowheads*) reaches the left (dependent) side of the dura mater (*arrow*) on the ultrasound imaging

to the lumbar region on the median longitudinal view. In this patient, we determined that the L2/3 intervertebral space was the optimum puncture point. Next, neuraxial structures, including the dura mater, subarachnoid space, vertebral body, ligamentum flavum, transverse process, and facet joints, were visualized in the transverse view. The distance from the skin to the left side of the dura mater at the L2/3 level was measured by ultrasound imaging (Fig. 1). Finally, the puncture point was determined using a metal hemostat; the tip of the metal hemostat was inserted between the ultrasound probe and the skin, and the point where the acoustic shadow of the metal tip reached the left side of the dura mater at the L2/3 level was marked on the skin (Fig. 2). The ultrasound probe was removed and an 18-gauge epidural needle was inserted on the skin at the marked point and advanced in the direction of the acoustic shadow (almost parallel to the sagittal section). Epidural puncture was confirmed by the usual loss-of-resistance technique. An epidural catheter was inserted 4 cm into the epidural space. Four milliliters of contrast medium was injected through the catheter and was confirmed on fluoroscopy to be distributed in the left-side dominant block of the epidural space from the L1 to the L4 level (Fig. 3), with the same distribution as the loss of cold sensation. Following the continuous infusion of 1% lidocaine at 4 $ml \cdot h^{-1}$ through the epidural catheter, the herpetic pain was eliminated and the left leg was paralyzed. However, the right leg was almost normal in that loss of cold sensation and motor dysfunction was minimal, and the patient could walk on a pair of crutches during the time she received the continuous epidural block. Adverse effects such as urinary retention,

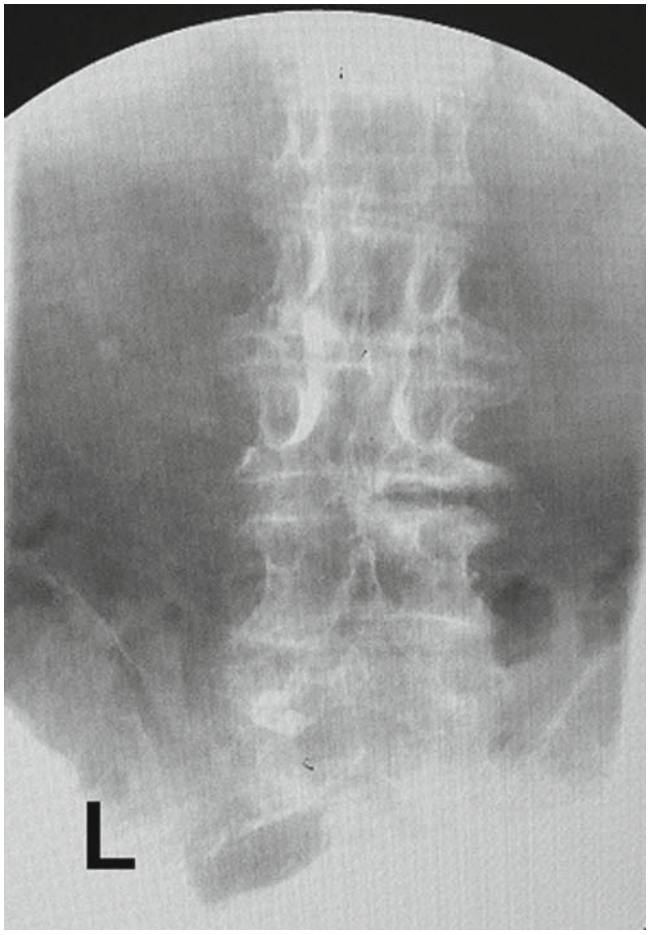

Fig. 3. Fluoroscopic imaging of the left-side (*L*) dominant epidural block in case 1. The contrast medium is distributed from L1 to L4 on the left side and only to L3 on the right side

hypotension, nausea, and other uncomfortable sensations were not observed. The patient was completely satisfied with this pain treatment for 10 days, after which the epidural catheter was removed.

Case 2

A 35-year-old man who had undergone left knee arthroscopy and chondroplasty 5 days previously suffered from postoperative pain during passive movement rehabilitation. An epidural catheter was placed at the L3/4 intervertebral space to treat the postoperative pain. Dependent-side (left-side) dominant ultrasound-aided unilat-epi was performed in the same manner as in case 1. Ten minutes after the epidural administration of 4 ml of 1.5% lidocaine with epinephrine 1 : 200 000, the left leg was paralyzed, although motor function was almost normal in the right leg. Analgesia to pin prick was obtained from T12 to L5 on the left side and from L2 to L3 on the right side. He felt no pain at rest and mild pain on passive movement. His left leg was partially paralyzed, but motor function was completely normal in the right leg while 4 $ml \cdot h^{-1}$ of 0.2% ropivacaine was continuously infused through the epidural catheter. The epidural block caused no adverse effects.

Discussion

Singh [7] first reported unexpected unilat-epi in 1967, and this unusual phenomenon has occasionally been reported since that report [8,9]. Authors reporting unilat-epi have generally done so in the context of unsatisfactory epidural analgesia and have suggested that factors such as slow injection, median septum or adhesions, and the position of the catheter tip might contribute to the unilat-epi. Hogan [6] observed epidural catheter tip positions on computed tomography and concluded that a far-lateral catheter position, which is not rare, commonly caused unilat-epi. However, to the best of our knowledge, intentional unilat-epi to treat single lower-extremity pain has not been performed previously. It has been reported that ultrasound imaging could be helpful in accurately placing an epidural catheter or spinal anesthesia [10,11].

We developed these ultrasound techniques establishing the present technique, which enabled both of the patients described in the present report to maintain motor function with minimal sensory loss on the nondependent side, while decreasing the pain score on the dependent side. In both patients, although epidural septum or adhesions could not be observed on ultrasound imaging or fluoroscopy, we used epidurography to confirm the position of the catheter tip on the dependent side of the spinal canal and to confirm the unilateral spread of the contrast medium. We emphasize that this ultrasound-aided technique caused the position of the epidural catheter tip to allow the far lateral and asymmetrical spread of local anesthetics to the dependent side. This asymmetrical spread finally caused differences in the block effects between the dependent and nondependent sides. The two cases we have described demonstrated the accuracy of ultrasound imaging in performing unilat-epi. Regarding technique, it is important to ensure symmetrical body positioning during the ultrasound scanning and epidural puncture. Once left-right symmetrical ultrasound imaging of the epidural space was obtained, the puncture point and direction were easily determined. The lateral spread of the solution in the present patients was also attributed to the slow injection of local anesthetic with a continuous infuser system.

Peripheral nerve block is another method of providing analgesia to the operated side. Some reports have demonstrated that continuous peripheral nerve block caused fewer side effects than epidural anesthesia [12]. However, large amounts of local anesthetics are needed for peripheral nerve blocks, and catheterization is often difficult. When compared with the standard epidural technique, continuous unilat-epi using ultrasound imaging maintained normal function on the nondependent side and accomplished predominant anesthesia on the dependent side [13]. Unlike peripheral nerve block, unilat-epi can block not only the femoral nerve area but also the lateral femoral cutaneous nerve, obturator nerve, and sciatic nerve areas with the use of a single catheter. Furthermore, it is expected that the disadvantages of the standard epidural block (resulting from the wider spread of local anesthetic), such as hypotension and motor dysfunction of the nondependent limb, would possibly be decreased by employing unilat-epi. It is also possible to prevent motor dysfunction on the dependent side by using local anesthetics at lower concentrations than those we used in the two patients we have described.

We conclude that ultrasound imaging around the lumbar epidural space facilitated effective unilat-epi for single lower-extremity pain. This technique may decrease the side effects of the standard epidural block and improve patient satisfaction during continuous epidural block.

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