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Identification of the lumbar intervertebral level using ultrasound imaging in a post-laminectomy patient

Masanori Yamauchi[1], Eiji Honma[2], Mitsuko Mimura[2], Hiroki Yamamoto[2], Emi Takahashi[2], and Akiyoshi Namiki[1]

[1] Department of Anesthesiology, Sapporo Medical University School of Medicine, S1 W16, Chuo-ku, Sapporo 060-8543, Japan
[2] Department of Anesthesia, Nippon Telegraph and Telephone East Corporation Sapporo Hospital, Sapporo, Japan

Abstract
A spinal block was performed in a post-laminectomy patient, using both ultrasound imaging and X-ray imaging. Ultrasound imaging clearly identified the L3/4 intervertebral level, the spinal canal, the corpus vertebrae, and the dura mater. Using ultrasound imaging, we measured the distance from the skin surface to the dura mater (39 mm). A 25-G needle for the spinal block was accurately advanced into the spinal canal with the use of X-ray imaging (43 mm from the skin to the subarachnoid space). We report here that ultrasound imaging was useful for performing a spinal block in a post-laminectomy patient in whom there was anatomical change around the spine.

Key words FF bypass · Laminectomy · Spinal block · Ultrasound · X-ray

Introduction

It is technically difficult to perform spinal anesthesia in patients with obesity, edema, or scoliosis. X-ray and ultrasound imaging have been used to perform lumbar puncture in such situations [1–3]; however, these techniques are still not common. We performed spinal anesthesia in a post-laminectomy patient with the assistance of ultrasound imaging. In this report we introduce and discuss the suitability of ultrasound imaging for use in post-laminectomy patients.

Case report

An 80-year-old man, in whom lumbar spinal decompression surgery had been performed for lumbar spinal canal stenosis, was scheduled to have a femoro-femoral arterial graft bypass (FF bypass) because of arteriosclerosis obliterans (ASO). A spinal cord stimulation system had been implanted 3 years previously to treat numbness and in tense pain caused by the spinal canal stenosis and ASO. The electrode tip and the pulse generator were positioned in the T11-L1 vertebral level and in a left lower abdominal subcutaneous pocket, respectively. Resection of spinous processes and laminectomy had been performed in the L3-5 spinal area. An anesthesiologist was unable to determine the optimum level for subarachnoid puncture by palpation in this patient. Because of the patient's restrictive lung dysfunction (% vital capacity [VC], 75%) and his request, a subarachnoid block, using ultrasound and X-ray imaging, was selected as anesthesia for the FF bypass. He had no premedication before the induction of anesthesia. We prepared both the X-ray imaging apparatus and an sultrasound machine (Sonos 5500; Philips Electronics, Eindvohen, The Netherlands) in the operating room. The patient was comfortably placed in the prone, Hall-frame position. First, his lumbar spine was scanned by the ultrasound, using a 5-MHz curved array probe placed in a sagittal plane over the sacral area, and the L3/4 intervertebral level was identified using the method of Furness' et al. [1]. In brief, from the buttock crease as a starting position, the probe was moved toward the lower lumbar vertebrae on the midline. The ultrasound imaging showed the sacrum as a waving continuous hyperechoic (white) band, whereas each of the residual L3-5 laminae was seen as a hyperechoic area with a posterior black shadow. The number of transverse processes was also confirmed from L5 to L3. With the L3/4 intervertebral space showing at the center of the ultrasound screen, the section was turned to a transverse view. A point on the skin at the center of the ultrasound probe was marked by the tip of a metal hemostat as the L3/4 intervertebral space (Fig. 1). The distance from the skin surface to the dura mater was measured as 39 mm on the ultrasound image. Then, the

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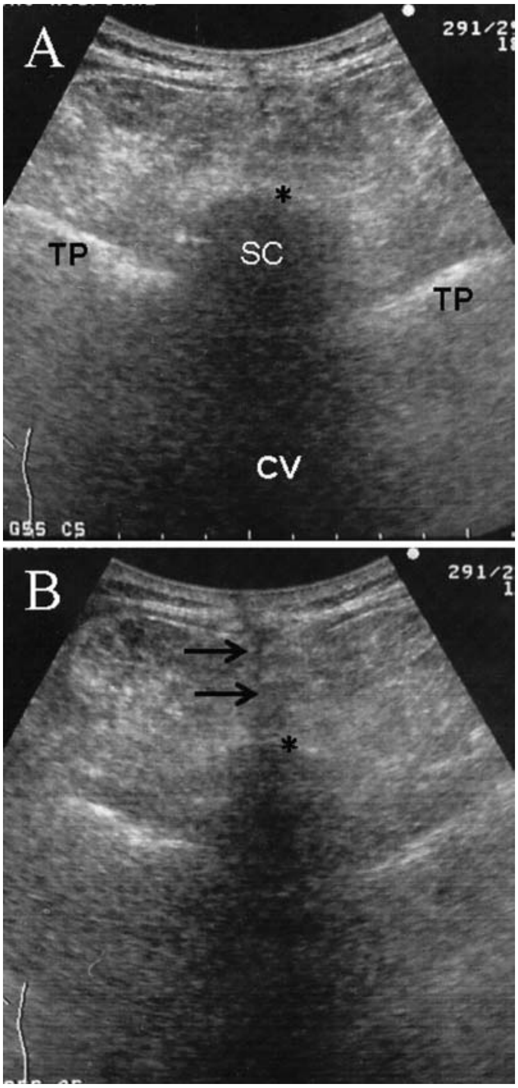

Fig. 1. **A** Ultrasound imaging of L3/4 intervertebral space. *TP*, Transverse process; *SC*, spinal canal; *CV*, corpus vertebrae; *asterisk on the white band*, dorsal dura mater. **B** Ultrasound imaging of posterior black shadow (*arrows*), using a metal hemostat. The tip of the hemostat was placed at the center of the ultrasound probe to indicate a suitable puncture point

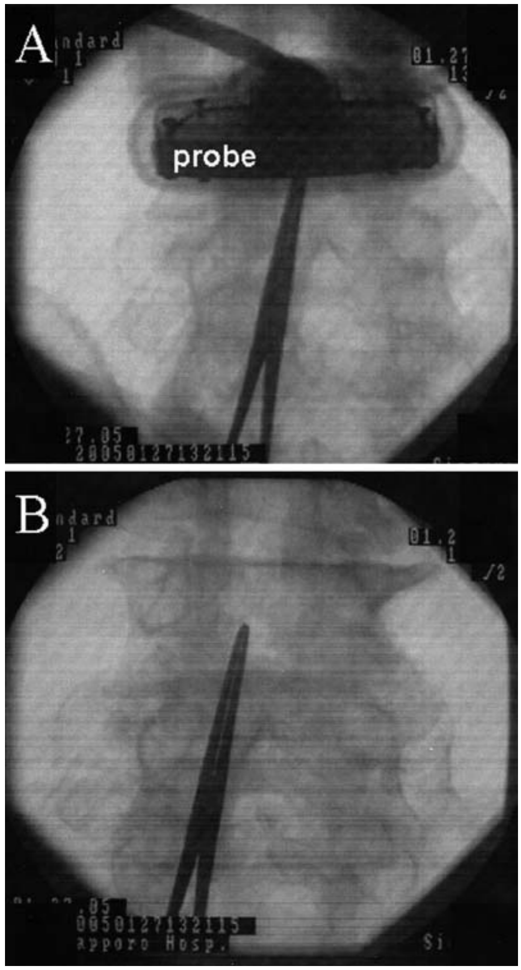

Fig. 2. X-ray imaging of the metal hemostat and the ultrasound probe to confirm whether or not identification of the L3/4 intervertebral space by ultrasound imaging was correct. **A** The tip of the metal hemostat, which would indicate the L3/4 intervertebral space shown in Fig. 1B, was under the ultrasound probe. **B** The ultrasound probe was removed, and the X-ray imaging proved that the tip of the hemostat was accurately showing the L3/4 intervertebral space

marked point was confirmed as the L3/4 intervertebral space by X-ray imaging (Fig. 2). A 25-guage needle was advanced perpendicularly from the marked point for subarachnoid puncture (confirmed by X-ray imaging). At the depth of 43 mm from the skin, clear cerebrospinal fluid was obtained through the needle. Hyperbaric 0.5% bupivacaine solution (3.5 ml) was injected. The patient was turned smoothly to the supine position, and the analgesic level was T8-S 10 min after the end of the injection. FF bypass for ASO was completed with the patient under sedation with propofol, without any complications. The operating and anesthesia durations were 2 h 55 min and 3 h 50 min, respectively.

Discussion

This is the first report describing the efficacy of ultrasound imaging for use in spinal anesthesia in a postlaminectomy patient. Although, in general, the L3-5 spinous processes are essential landmarks to identify the appropriate puncture point for spinal anesthesia, it was impossible to determine the appropriate subarachnoid puncture level by palpation in our patient. An appropriate puncture point was determined with the ultrasound imaging. To preserve lung function after the spinal anesthesia, we had considered that L3/4 was an appropriate puncture level, this being our usual puncture level. The L3-5 laminectomy had not prevented identification of the lumbar intervertebral level by the ultrasound imaging. Identification of the L5 vertebral level by showing the top of sacrum is the usual technique for ultrasound imaging [1]. We could easily number L3 and L4 by numbering the residual laminae and transverse processes during the ultrasound scan, and we were able to identify the appropriate puncture point with the metal hemostat landmark. The position of the needle for spinal block was confirmed by X-ray imaging to make doubly sure.

In the 1980s, Cork et al. [2] and Cùrrie [3] introduced ultrasound methods to localize the epidural space, and some subsequent studies reported the usefulness of ultrasound imaging for performing lumbar epidural block and peripheral nerve blocks [4–6]. In recent years, Grau et al. [7–10] assessed the efficacy of ultrasound imaging of the lumbar epidural space in pregnancy. They used a 5-MHz curved array probe and assessed the puncture depth, the number and time of puncture attempts, and the visible structures around the epidural space. They concluded that ultrasound imaging could facilitate epidural and spinal anesthesia, without any disadvantages. With ultrasound imaging sagittal and tranverse views can be quickly performed, and, therefore, one can accurately determine the distance from skin to lamina, the angle, and the optimal lumbar level at which to puncture. The ligamentum flavum, and the dorsal and abdominal sites of the dura mater are also observed by ultrasound imaging. The success rate of identification of the correct lumbar intervertebral level was higher by ultrasound imaging than by palpation [1,5]. In our patient, we could identify the intervertebral structures by ultrasound imaging. The preparation of the ultrasound imaging was easier than that of X-ray imaging. There are few disadvantages of ultrasound imaging for use with neuraxial blocks. The resolution of ultrasound imaging is less efficient for visualizing the fine structures of spinal bone than that of X-ray imaging, but is high enough to identify the surrounding structures [10,11]. The limitations of ultrasound imaging for a neuraxial block are that it cannot show the adult thoracic epidural space, which is highly shielded by the vertebral arch, and that it cannot be used to observe real-time needle tip insertion and epidural catheter scanning.

Although there are no supporting data, we believe that heparin administration should be avoided, immediately after neuraxial block, and if used, considered from a risk-benefit balance viewpoint. It would be prudent to delay the first dose of heparin after the block to minimize the chances of peridural bleeding. We did not administer heparin for 1 h after the needle placement, and we monitored neurological function after the operation until complete recovery from the spinal anesthesia, following the recommendation of the American Society of Regional Anesthesia 2003 [12]. We advanced the needle with the aid of X-ray imaging during the spinal anesthesia to minimize the chances of peridural bleeding.

In summary, we observed the exact puncture point and distance from the skin to the spinal cord with an ultrasound technique before performing spinal block in a post-laminectomy patient. This technique is useful for patients with anatomical changes around the spine, and should be known to anesthetists for such situations.

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