

Ultrasound Guidance in Caudal Epidural Needle Placement

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Background: This study was conducted to investigate the feasibility of using ultrasound as an image tool to locate the sacral hiatus accurately for caudal epidural injections.

Methods: Between August 2002 and July 2003, 70 patients (39 male and 31 female patients) with low back pain and sciatica were studied. Soft tissue ultrasonography was performed to locate the sacral hiatus. A 21-gauge caudal epidural needle was inserted and guided by ultrasound to the sacral hiatus and into the caudal epidural space. Proper needle placement was confirmed by fluoroscopy.

Results: In all the recruited patients, the sacral hiatus was located accurately by ultrasound, and the caudal epidural needle was guided successfully to the sacral hiatus and into the caudal epidural space. There was 100% accuracy in caudal epidural needle placement into the caudal epidural space under ultrasound guidance as confirmed by contrast dye fluoroscopy.

Conclusions: Ultrasound is radiation free, is easy to use, and can provide real-time images in guiding the caudal epidural needle into the caudal epidural space. Ultrasound may therefore be used as an adjuvant tool in caudal needle placement.

CAUDAL epidural anesthesia is the injection of medications into the epidural space *via* the sacral hiatus. It is useful when anesthesia of the lumbar and sacral dermatomes is needed.¹ Successful caudal anesthesia relies on the proper placement of a needle in the epidural space. The most common method to identify the caudal epidural space is detecting the characteristic “give” or “pop” when the sacrococcygeal ligament is penetrated.^{1,2} Even with experienced physicians, the failure rate of the placement of needles into the caudal epidural space can be up to 25%.^{1,3}

In clinical practice, the “whoosh” test,³ nerve stimulation,¹ and fluoroscopy are the three methods that can be used to identify the caudal space before the injection of medications. The application of ultrasonography to locate the sacral hiatus for caudal epidural injections has not been described. The purpose of this study was to examine the practicality of using ultrasound guidance in the placement of a caudal needle into the caudal epidural space.

Materials and Methods

Seventy patients with low back pain and sciatica were studied. This study was approved by the local medical ethics and the human clinical trial committee (Chang Gung Memorial Hospital, Tao-Yuan County, Taiwan). All of the recruited subjects signed the informed consent and agreed to receive caudal injections.

The SONOS 4500 (Philips Medical Systems, Andover, MA) ultrasound machine was used in this study. The selected transducer was the S12 5-12 MHz real-time linear-array ultrasound transducer (Philips Medical Systems).

Design

Patients were placed in the prone position. The assistant's arms were placed horizontally, out of the physician's way, to hold the gluteal masses apart to achieve a flatter skin surface at the sacral hiatus area for the placement of ultrasound transducer. The examined area was prepared and draped in the usual sterile fashion. The transducer was covered with sterile plastic.

The transducer was first placed transversely at the midline to obtain the sonographic transverse view of the sacral hiatus. The following findings were observed (fig. 1):

1. The two hyperechoic reversed U-shaped structures were the two bony prominences of sacral cornua.
2. Between the two cornua, there were two hyperechoic band-like structures. The band-like structure on top was the sacrococcygeal ligament. The band-like structure at the bottom was the dorsal bony surface of the sacrum.
3. The sacral hiatus was the hypoechoic region observed between the two hyperechoic band-like structures.

The transducer was then rotated 90° to examine the sonographic longitudinal view of the sacral hiatus. Anatomically, the transducer then rested between the two cornua. A 21-gauge caudal epidural needle was inserted and advanced under the sonographic longitudinal view of the sacral hiatus. The caudal epidural needle appeared as a hyperechoic structure under sonography (fig. 2). The advancement of the caudal epidural needle between the two cornua to the sacral hiatus and into the caudal epidural space was observed as continuous and real-time sonographic images. As the caudal epidural needle pierced through the sacrococcygeal ligament, the portion of the needle inside the caudal epidural space was no longer observed under sonography (fig. 2).

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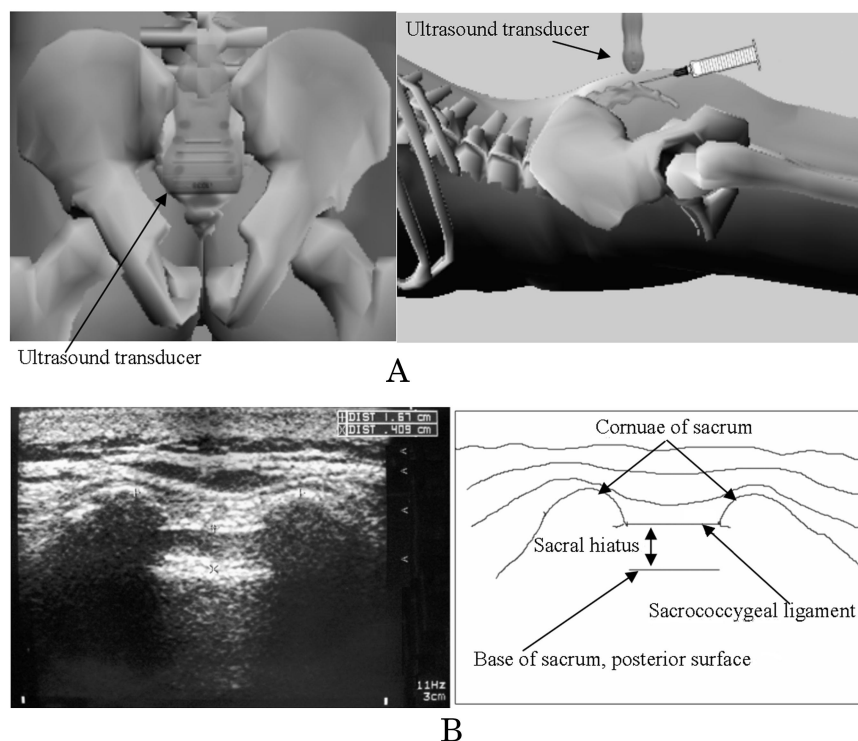


Fig. 1. (A) Transverse plane placement of the ultrasound transducer. (B) Sonographic transverse view of the sacral hiatus.

The ultrasound transducer was then adjusted in transverse and longitudinal views to make sure the spinal needle was inserted correctly into the caudal epidural space. Under the transverse view, the spinal needle appeared as a small circular hyperechoic structure, resting between the two hyperechoic cornua, and within the two hyperechoic band-like structures (fig. 3). Finally, contrast dye fluoroscopy was used to confirm the location of the caudal epidural needle (fig. 4). To prevent bias, the ultrasound-guided caudal needle insertions and the interpretation of fluoroscopy images were performed by different physicians.

Results

Seventy patients with low back pain and sciatica were recruited for this study. There were a total of 39 male and 31 female patients. The average age was 38 ± 5.6 yr. The average body height was 168 ± 8.9 cm for the male patients and 160 ± 4.3 cm for the female patients.

In all the recruited patients, the sacral hiatus was located correctly by ultrasonography in both the transverse and longitudinal views. The advancing motion of the hyperechoic caudal epidural needle to the sacral hiatus and into the caudal epidural space was observed as continuous and real-time images under the sonographic longitudinal view. The portion of the caudal epidural needle inside the caudal epidural space could not be observed under sonography (fig. 2). In all the cases, the characteristic “give” or “pop” was detected when the sacroccygeal ligament was penetrated.

The average time span from locating the sacral hiatus to the insertion of the caudal epidural needle into the caudal epidural space was less than 2 min. Under ultrasound guidance, only one attempt was needed in guiding the caudal epidural needle into the caudal epidural space.

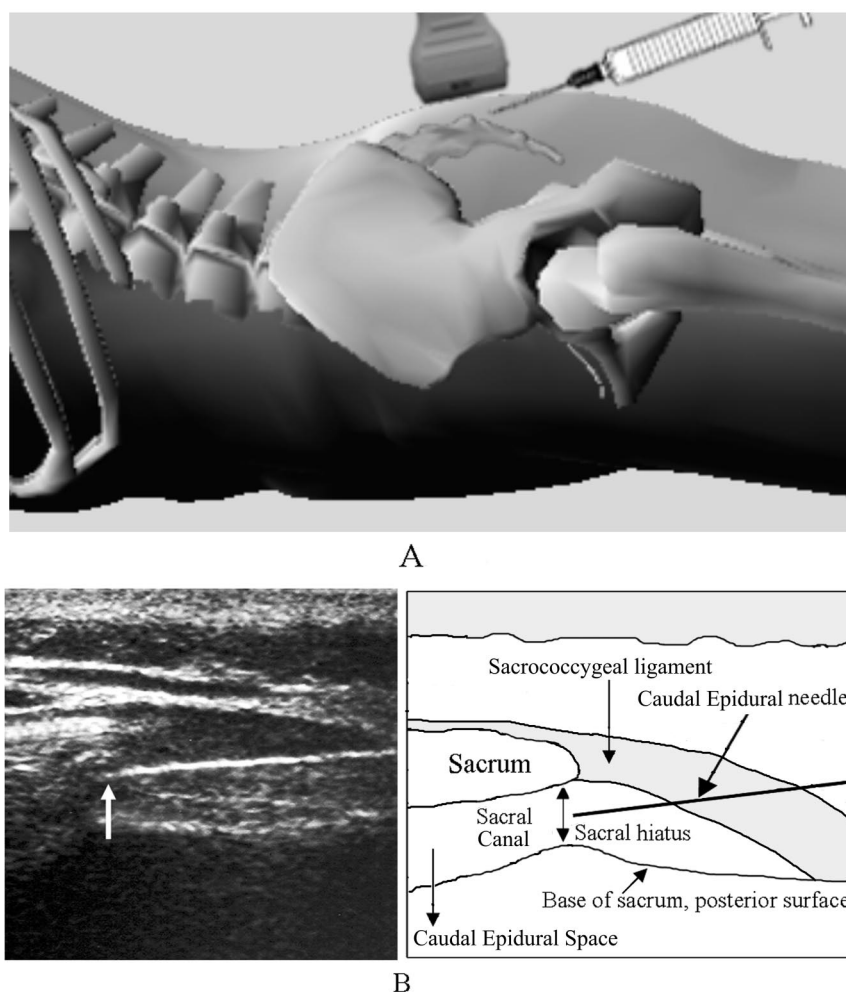
Fluoroscopy was then used to confirm the location of the caudal epidural needle. The caudal epidural needle was correctly placed into the caudal epidural space in all of the recruited patients as confirmed by contrast dye fluoroscopy. Christmas tree-like appearance resembling contrast dye distribution was observed in all of the patients (fig. 4).

Therefore, after fluoroscopic confirmation, the accuracy of ultrasound guidance in locating the sacral hiatus for proper placement of the caudal epidural needle into the caudal epidural space was 100%.

Discussion

Epidural injections of local anesthetic agents and corticosteroids are widely used to provide symptomatic relief in patients with low back disorders.³ Epidural steroid injections have been used since 1952.⁴ These injections can be approached by translaminar,⁵ transforaminal,⁴ and caudal routes.⁵ The caudal entry into the epidural space is preferred by many practitioners because accidental puncture of the dural sac and subsequent risk of intrathecal injection of medication is rare.^{1,3} However, even with experienced physicians, up to 25% of the injections using the caudal route do not

Fig. 2. (A) Longitudinal plane placement of the ultrasound transducer. (B) Caudal epidural needle is observed as a hyper-echoic structure under sonography. The portion of the needle inside the caudal epidural space cannot be observed under ultrasonography.



enter the epidural space.^{1,3} As a result, the development of an easy and reliable objective method that enables rapid confirmation of proper caudal needle placement is desirable.¹

There are several ways to identify the caudal epidural

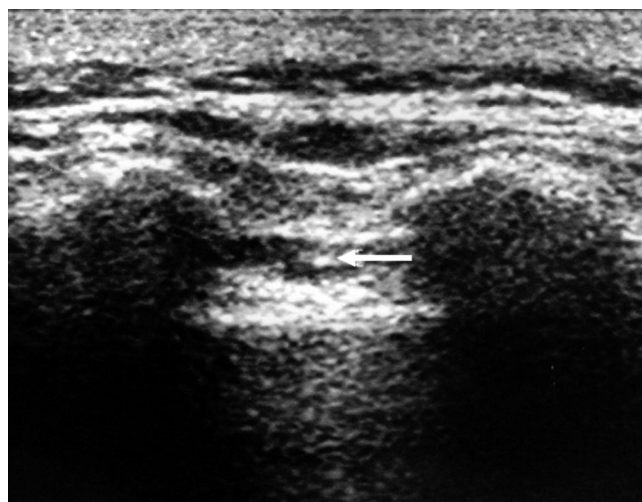


Fig. 3. The ultrasound transverse view. Arrow indicates caudal epidural needle.

space. The most common one is the detection of the characteristic “give” or “pop” on penetration of the sacroccygeal ligament.¹ However, final confirmation of the proper needle placement can be made only after observing the clinical effect of the injected medication.¹ The lack of subcutaneous bulging or resistance on injection of local anesthetic are also important signs of proper needle placement.¹ The “whoosh” test was claimed to be more reliable than the “give” or “pop” of the sacroccygeal ligament.⁶ However, eliciting the “whoosh” may cause venous air embolism after injection of 2.5 ml air.^{1,2} The nerve stimulation test is the other method to confirm caudal needle placement.^{1,7} The needle is classified as correctly or incorrectly placed depending on the presence or absence of anal sphincter contraction to electrical stimulation.¹

Fluoroscopy is most commonly used in interventional spine procedures⁴ and is frequently used in confirming the location of caudal epidural needle. It has been advocated that caudal epidural needle placement should be confirmed by fluoroscopy alone or by epidurography.³ Radiation exposure is the major concern when obtaining fluoroscopic images. Botwin *et al.*⁴ stated that spinal

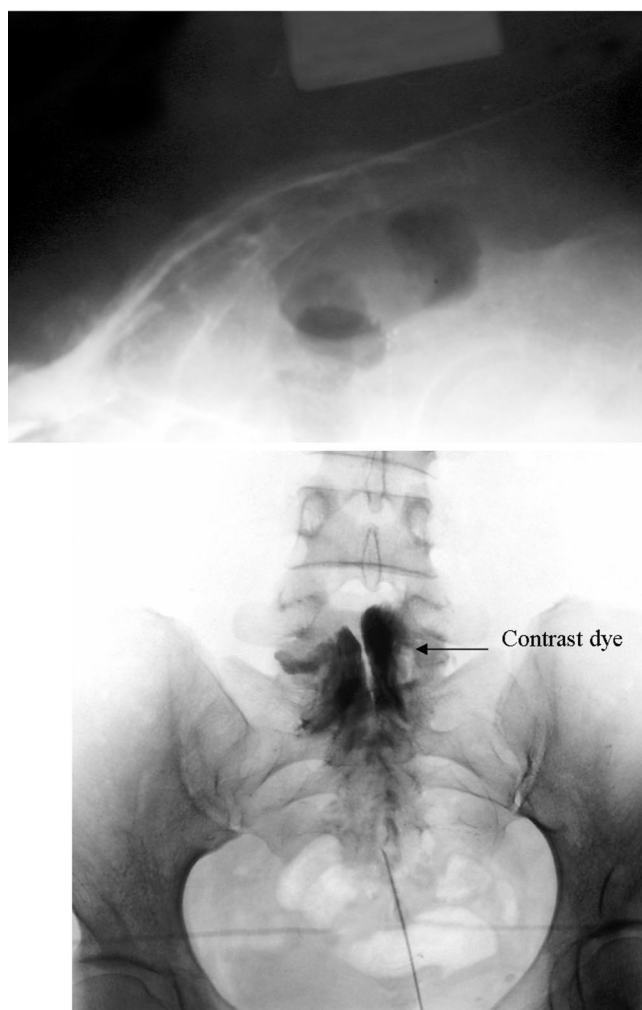


Fig. 4. Fluoroscopy confirmation with contrast dye. Christmas tree-like appearance can be observed as the contrast dye bathes the external aspect of the dura mater and nerve roots.

interventionalists should adhere to simple rules of radiation safety to minimize the cumulative radiation exposures. These rules included increasing the distance between the interventionalist and the radiation source; decreasing the overall time of exposure; shielding susceptible areas with leaded aprons, thyroid shields, leaded glasses, and leaded gloves; and being proficient in

guiding needles under the fluoroscope.⁴ Fluoroscopy can also provide real-time and continuous images, but this increases the overall time of exposure. Currently, pulsed imaging is preferred during fluoroscopy because it can reduce overall exposure by 20–75%.⁴

In this study, ultrasonography proved to be an effective tool, with 100% accuracy in locating the sacral hiatus and in guiding the caudal epidural needle into the caudal epidural space. The advantages of ultrasound are that it is easy to use, it is radiation-free, and can be used in virtually any clinical setting.⁸ Most significantly, ultrasonography can provide real-time and continuous needle-guiding images without radiation exposure. It takes approximately 2 h of training for an inexperienced physician to learn the ultrasound-guided caudal epidural injection technique. Physicians must be acquainted with skills in manipulating the ultrasound probe and interpreting the sonograms.

Perhaps the only disadvantage with ultrasound is the fact that it cannot provide us with the image information as to the depth of the inserted needle. Ultrasound waves cannot penetrate the sacral bone to observe the hyperechoic caudal epidural needle inside the caudal epidural space. Therefore, checking for the escape of cerebrospinal fluid for possible dura tear is critical before steroid injection can be pursued.

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