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## Could ultrasonography be used by an anaesthetist to identify a specified lumbar interspace before spinal anaesthesia?

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**Background.** Insertion of a needle into the lumbar subarachnoid space may cause damage to the spinal cord. Current techniques to identify a safe interspace have limitations. Ultrasound was investigated as a means to improve anatomical accuracy.

**Methods.** Seventeen patients attending for elective magnetic resonance imaging (MRI) of the spine were studied. Ultrasonic identification of the L3–4 interspace was attempted by an anaesthetist and a marker was placed. A radiologist identified the anatomical location of the marker on the MRI scan.

**Results.** Thirteen out of 17 markers were at the L3–4 interspace; four were at the L2–3 interspace.

**Conclusions.** These results suggest that ultrasonography may be a useful adjunct to safe subarachnoid anaesthesia.

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Cases of trauma to the conus medularis after spinal anaesthesia have been highlighted<sup>1</sup> and a report has described the inaccuracy of using Tuffier's line between the iliac crests to identify a safe lumbar interspace.<sup>2</sup> Therefore, an exploratory study was undertaken to determine the precision with which an anaesthetist could identify the L3–4 interspace using ultrasonography.

## Methods and results

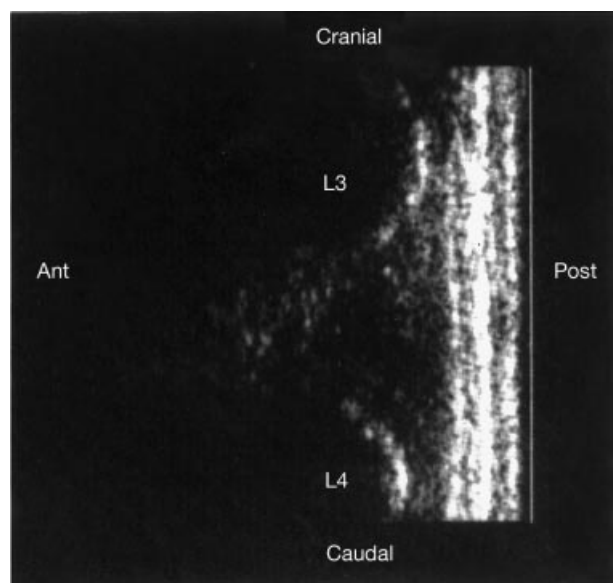
Ethical approval was obtained from the local research ethics committee and written consent was obtained from each patient. Patients with back pain or symptoms/signs of root compression, referred for magnetic resonance imaging (MRI) of the spine, were recruited to the study; all patients were older than 16 yr. Patients were excluded if discomfort

was anticipated or experienced during ultrasonography or if they admitted to previous lumbar spine surgery. The patient's sex, age, weight and height were recorded. An ATL HDL1000 portable ultrasound machine with a linear array 4–7 MHz probe was used to obtain images of the lumbar spine before MRI. Ultrasonography was performed with the patient sitting and the spine flexed. The continuous echogenic signal from the sacrum was identified and the probe moved cranially in the sagittal plane to identify individual lumbar spinous processes and interspaces (Fig. 1). The skin overlying the point thought to represent the L3–4 interspace was marked by the investigator's thumb while the patient sat upright and a cod liver oil capsule was taped to this point. The location of the nearest lumbar interspace on the MRI scan to the capsule was determined by the radiologist. The same anaesthetist (MJW) performed all ultrasound examinations in the study.

Twenty-three ultrasonographic examinations of the lumbar spine were performed and 17 were eligible for inclusion. Two patients refused the MRI scan after ultrasound examination, one patient exceeded the weight limit for the MRI scanner and three patients complained of pain at the start of ultrasonographic examination, so it was discontinued. Thus six patients did not complete the study. Ten male and seven female patients remained in the study. The patients' median [interquartile range (range)] age was 47 [32–68 (27–72)] yr and body mass index (BMI) 27 [24–29 (20–37)] kg m<sup>-2</sup>. In 13 of the 17 (76%) patients, the cod liver oil capsule was at the L3–4 interspace. In four patients, the capsule was at the L2–3 interspace. In five patients, apposition of spinous processes was noted on the MRI scan; in three of these patients, the capsule was at the L2–3 interspace.

## Comment

For the identification of a safe lumbar interspace, clinicians often rely on three beliefs. Firstly, an imaginary line



**Fig 1** Sagittal ultrasonic image of a lumbar interspace. A typical view of an interspace with bright, echogenic, crescent-shaped spinous processes visible above and below.

(described by Tuffier) joining the iliac crests is assumed to be close to the fourth lumbar spine, but it may cross higher or lower.<sup>3</sup> Secondly, classical teaching is that the spinal cord ends at L1–2, but it has been known for over half a century<sup>4</sup> that this is the mean position of a normal distribution. Several series describe the spinal cord extending to the body of L3 in 1–3% of cases, and to L2 or lower in almost 50% of cases, with increased variability in women.<sup>4</sup> Thirdly, reliance may be placed on a lack of paraesthesia, but this confidence may be misplaced if the latter does not occur during cordotomy with a 22 G needle until electrical stimulation is applied.<sup>5</sup> A technique to improve the localization of a lumbar interspace would be an advantage.

As in a previous study,<sup>2</sup> in order to assess the value of ultrasonography as an adjunct, patients requiring MRI were used, and the interspace was identified with the patient's spine flexed. The majority of the patients in our study had lumbar spine symptoms, so discomfort or difficulty with flexion might be expected. Our investigator had a low threshold for patient discomfort, resulting in discontinuation of three cases. In the clinical situation, many patients receiving spinal anaesthesia are either pregnant or elderly, so flexion may be difficult, as with our study population. The L3–4 interspace was selected for study as the highest that might be considered safe for spinal anaesthesia.<sup>1</sup>

The MRI results revealed four instances of inaccuracy. Narrowed interspaces at or below L3–4 were noted by the radiologist on MRI scans in five cases; in three of these five patients, the oil capsule had been placed one interspace too high. A high incidence of degenerative disc disease was reported on MRI. Apposition of adjacent lumbar spinous processes as a result of disc disease could partly explain our inaccuracy. In a younger, child-bearing population, disc degeneration may be less of a problem; in older age groups, progression of disc disease is reduced.<sup>6</sup>

As suspected by many clinicians, precise lumbar interspace identification by palpation is prone to error. Broadbent and colleagues<sup>2</sup> confirmed this, showing that anaesthetists were 29% accurate, as determined by MRI. Ultrasonography was not investigated in this study. The inaccuracy was corroborated by Furness and colleagues,<sup>7</sup> who showed that clinical identification by anaesthetists using palpation was 30% accurate, determined by lumbar

spine x ray. In contrast, in the latter study, correct placement of markers using ultrasonography at the L3–4 interspace was 71%, which is comparable with 76% in our study. The important difference in the study by Furness and colleagues is that ultrasonography was performed by a consultant radiologist. Both previous studies also showed that clinical identification by anaesthetists was often inaccurate by two, three or four interspaces. Using ultrasound, markers were always within one interspace of the intended position.

The ultrasonic investigations in our study were performed by a trainee anaesthetist who had initially looked at ultrasonic images on a human volunteer; the feasibility of further study was then discussed with a radiologist. Before commencement of the study, 5 min of instruction on ultrasonic interpretation of lumbar spines and interspaces had been given by a radiologist. The technique was successfully cascaded to another trainee anaesthetist after two 'practice ultrasounds' of less than 5 min duration. In comparison with many skills in anaesthesia, the interpretation of these ultrasonic images for anatomical purposes is relatively simple (Fig. 1), but our study was not designed to examine the learning curve. As anaesthetists are being taught by other anaesthetists to use ultrasound for the location of central veins, we see no reason why the same might not apply also to this ultrasonic technique.

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