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ORIGINAL ARTICLE

Ultrasound to identify the lumbar space in women with impalpable bony landmarks presenting for elective caesarean delivery under spinal anaesthesia: a randomised trial

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ABSTRACT

Background: Ultrasound can facilitate neuraxial blockade in patients with poorly defined anatomical surface landmarks, but there are no studies comparing an ultrasound-guided technique with landmark palpation for spinal anaesthesia. The objective of this study was to compare pre-procedural lumbar ultrasonography with landmark palpation to locate the needle insertion point in women with impalpable lumbar spinous processes presenting for caesarean delivery.

Methods: After institutional ethics committee approval, 20 women with impalpable lumbar spinous processes presenting for elective caesarean delivery were recruited. Patients were randomised to palpation or ultrasound. The primary outcome of the study was the number of needle passes to achieve lumbar puncture. Secondary outcomes were the overall procedural time and patient satisfaction score.

Results: There was no difference in mean (±SD) body mass index of both groups (ultrasound 39.1 ± 5.02 kg/m^2 vs. palpation 38.3 ± 3.77 kg/m^2). There were significantly fewer needle passes in the ultrasound group (median 3 [IQR 1.8–3.2]) compared to the palpation group (median 5.5 [IQR 3.2–7.2] (P=0.03)). More time was required to locate the needle insertion point in the ultrasound group (ultrasound 91.8 ± 30.8 s vs. palpation 32.6 ± 11.4 s, P <0.001). There was no difference in the total procedural time between groups (ultrasound 191.8 ± 49.4 s vs. palpation 192 ± 110.9 s, P=0.99).

Conclusion: The use of ultrasonography to locate the needle insertion point reduced the number of needle passes in women with impalpable lumbar spinous processes undergoing elective caesarean delivery under spinal anaesthesia. Its use did not prolong overall procedural time.

Keywords: Spinal anaesthesia; Ultrasound; Caesarean delivery; Obstetric anaesthesia

Introduction

The use of ultrasound is evolving and it is becoming one of the more useful radiological tools whose benefits are not confined to the radiology department. Anaesthetists have become familiar with it as an aid for intravenous access, focused ultrasonography and regional anaesthesia. Dynamic imaging is possible and it is readily available in most departments.[1,2] One area of increasing popularity is ultrasound-guided neuraxial blockade.[3–5] There is accumulating evidence about its use for lumbar epidural and spinal anaesthesia,[3,5,6] particularly in patients with impalpable anatomical landmarks,[7] and in the obstetric setting.[8–10] Ultrasound in neuraxial obstetric anaesthesia may be most useful in parturients with impalpable lumbar spinous processes, irrespective of body mass index (BMI). The use of ultrasound for spinal anaesthesia for caesarean delivery, specifically in patients with impalpable spinous processes has not been studied. We hypothesised that pre-procedural ultrasound scanning could improve performance of spinal anaesthesia for elective caesarean delivery in patients with impalpable bony landmarks.

Methods

After institutional ethics board approval, 20 women were recruited over a 10-month period from February to December 2013. All patients were admitted for elective caesarean delivery on the morning of surgery and were first approached about participation during preoperative assessment. At this point the patient's back was examined by a trainee investigator to determine if the

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lumbar spinous processes were palpable. Impalpability was defined as an inability to identify the lumbar spinous process on palpation with the patient in a sitting position with the lumbar spine flexed. The patient was recruited after a consultant (TT) confirmed that the lumbar spinous processes were impalpable. All patients gave informed consent.

Patients were randomised into two groups of 10: an ultrasound (US) group and a palpation (PP) group using computer-generated numbers which were placed in sealed envelopes. After enrolment and arrival in the operating theatre, the envelope was opened by the investigator and the patient assigned accordingly. Inclusion criteria were American Society of Anesthesiologists class I and II patients undergoing elective caesarean delivery for singleton pregnancies whose lumbar spinous processes were impalpable.

Three trainee anaesthetists performed the spinal injections. All were in their first two years of anaesthesia practice and in their first six months of obstetric anaesthesia training. They had all received a didactic lecture on ultrasonography of the neuraxis and had completed 10 lumbar punctures with ultrasound guidance supervised by a consultant experienced in the use of ultrasound of the spine.

Patients in the US group sat on the operating table with the lumbar spine flexed. A curvilinear low frequency probe (Sonosite NanoMaxx C60, 2–5 MHz) was used to identify the L3–4 interspace before sterilization of the site. Imaging was performed in the parasagittal and horizontal planes. The cross-point of these planes was then marked as the insertion site. Two time periods were recorded. Insertion site identification time was the interval in seconds between the US probe touching the skin and the investigator marking the intended insertion point; needle insertion time was that from the local anaesthetic needle touching the skin to visualisation of cerebrospinal fluid (CSF) in the spinal needle. Together these were referred to as overall procedural time. Timing was stopped between these intervals to allow the operator to scrub-up.

Patients in the PP group were treated similarly. The trainee operator palpated the iliac crests and identified the intercristal line, the midpoint of this line, and chose the point they wished to use for needle insertion. This was assumed to be the L3–4 interspace. Insertion site identification time was commenced the moment the investigator began examining the patient's back and stopped when they marked the intended insertion point. Needle insertion time was as defined for the US group.

Spinal anaesthesia was performed at the marked interspace using a 25-gauge pencil point (Whitacre) needle with 0.5% hyperbaric bupivacaine 10 mg, fentanyl 25 μg and preservative-free morphine 150 μg. The patient was positioned supine with left uterine displacement using a wedge under the right hip. Surgery was allowed to proceed once bilateral sensory block to cold spray to T4 was achieved. The day after delivery, patients had their BMI and percentage body fat measured in our institutional obstetric research laboratory.

The primary outcome of our study was the number of needle redirections, defined as any ventral advancement of the needle and/or introducer, as well as any new intervertebral space attempted. Secondary outcomes were the defined time periods in both groups (insertion site identification time, needle insertion time and overall procedural time) and patient satisfaction score measured on a five-point Likert scale.

Statistical analysis

The sample size was based on the mean number of needle passes from a published observational study on neuraxial techniques on obese parturients,[11] and on our own unpublished pilot study. Ellinas' data showed that the mean number of passes for "difficult backs" was 3.9 (95% confidence intervals 3.1 to 4.6)[11] which corresponded to our own unpublished data of number of passes of 4 (standard deviation (SD) ± 2). It was calculated that 20 patients would be required to have an 80% power of detecting a difference of two ventral redirections at lumbar puncture at a significance level of 0.05 (α=0.05 and β=0.2). Statistical analysis was performed with Prism 5 for Mac v 5.0a (GraphPad Software Inc., La Jolla, CA, USA). Patient demographic data and parametric data were analysed using Student's t-test. Non-parametric data in-between group comparisons were analysed using Wilcoxon's ranked sum test. Parametric data were presented as mean ± SD and non-parametric data presented as median and interquartile range (IQR). A P value <0.05 was considered significant.

Results

All participants completed the study and were included in data analysis (Fig. 1). Patient characteristics were similar in both groups (Table 1). The median number of attempts, which included all ventral advancements of the needle in all spaces attempted, was significantly fewer in the US group (P=0.03, Table 2). One patient in the PP group required a second space to be attempted. Mean total procedural time was similar in both groups (Table 2). However, there were differences in time to identification of insertion point and time to confirmation of CSF. Time for marking was significantly longer in the US group (P <0.001); time to identification of CSF was shorter in this group, although this was not statistically significant. Block heights were not collected for the purpose of this study although all patients developed a sensory block to cold spray to at least T4 or higher before surgery was allowed to commence. There were no failures of spinal anaesthesia

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