International Journal of Obstetric Anesthesia (2014) **23**, 206–212
0959-289X/$ - see front matter
http://dx.doi.org/10.1016/j.ijoa.2014.02.004

ORIGINAL ARTICLE

ELSEVIER
www.obstetanesthesia.com

Spinal anaesthesia for caesarean section: an ultrasound comparison of two different landmark techniques

K. Kallidaikurichi Srinivasan, M. Deighan, L. Crowley, K. McKeating
Department of Anaesthesia, National Maternity Hospital, Dublin, Ireland

ABSTRACT
Background: Spinal anaesthesia performed at levels higher than the L3–4 intervertebral space may result in spinal cord injury. Our aim was to establish a protocol to reduce the chance of spinal anaesthesia performed at or above L2–3.
Methods: One hundred and ten consenting patients at 32 weeks of gestation or greater scheduled for non-emergency caesarean section under spinal anaesthesia were randomly allocated to have needle insertion performed at an intervertebral space determined by one of two landmark techniques. In Group A, if the intercristal line intersected an intervertebral space, this space was selected or if the intercristal line intersected a spinous process the space immediately above was selected. In Group B, if the intercristal line intersected an intervertebral space or a spinous process, the intervertebral space immediately below was chosen. The actual intervertebral space chosen was identified using ultrasound by a blinded investigator.
Results: In Group A, an intervertebral space at or above L2–3 was marked in 25 (45.5%) patients compared with 4 (7.3%) in Group B (P <0.001). In 5/55 (9.1%) patients in Group A, the intervertebral space initially chosen was L1–2 whereas this occurred in no patient in Group B. There was no difference between groups in number of needle passes or attempts, onset of block at 5, 10 and 15 min or need for rescue analgesia.
Conclusion: Our data suggest that when performing spinal anaesthesia in pregnant patients, if the intercristal line intersects an intervertebral space then the space below should be chosen and if the intercristal line intersects a spinous process then the interspace below should be chosen. This will reduce the incidence of spinal anaesthesia performed at or above L2–3.

Keywords: Spinal anaesthesia; Intercristal line; Ultrasound

Introduction

Spinal anaesthesia is the commonest mode of anaesthesia for caesarean section.[1,2] Permanent neurological complications following spinal anaesthesia, although rare, can have devastating consequences.[3–8] Selecting an appropriate intervertebral space is important to avoid spinal cord damage during needle insertion.

The intercristal line is conventionally used to identify the vertebral interspace used for spinal anaesthesia. This may intersect the midline anywhere from L1–2 to L4–5.[9–15] There is considerable variation within anatomy and anaesthesia textbooks regarding the level at which the intercristal line crosses the midline.[16–20] Currently, there is no consensus for selecting an intervertebral space based on the intercristal line; selection of an interspace at, above or below the intercristal line is largely based on individual discretion. It has been shown previously that experienced anaesthetists were able to correctly identify the lumbar intervertebral space in only 29% of patients.[9] In the obstetric population, 32–48.5% of neuraxial blocks are performed at a more cephalad level (as high as L1–2) than originally intended.[21,22] The importance of avoiding spinal anaesthesia at or above L2–3 cannot be overstated as, based on previous studies on the level of termination of spinal cord and considering the angle of insertion of the needle, it is possible that a needle inserted at L2–3 might reach the conus medullaris in 4–20% of occasions.[7]

Our aim was to develop an objective guide for selecting the appropriate intervertebral space based on the palpated intercristal line. The hypothesis was that by selecting an intervertebral space below the intercristal line, the incidence of spinal anaesthesia performed at or above L2–3 would be decreased without increasing the number of attempts, number of passes or the failure rate.

Methods

Following approval by the Ethical Committee of National Maternity Hospital, Dublin, Ireland, 110 pregnant patients with gestational age of 32 weeks or greater

Accepted February 2014
Correspondence to: L. Crowley, Consultant Anaesthetist, National Maternity Hospital, Holles Street, Dublin 2, Ireland.
E-mail address: lcrowley@nmh.ie

undergoing non-emergency caesarean section under spinal anaesthesia who consented for the study were included. Patients with previous spinal surgery, known spinal deformity or in whom the anaesthetist could not palpate spinous processes or intervertebral spaces were excluded.

This was a prospective, randomized, double-blind study with patients randomised using computer-generated random numbers to one of two groups. Group codes were enclosed in sealed envelopes and were seen only by the anaesthetist performing the block. The patient and the anaesthetist performing ultrasound were blinded to the study group. The anaesthetist who was normally assigned to the theatre performed the spinal anaesthetic. The experience of the staff varied from trainee anaesthetists with >1 year of experience to consultant anaesthetists.

In Group A, if the intercristal line intersected an intervertebral space, this space was selected or if the intercristal line intersected a spinous process the space immediately above was selected. In Group B, if the intercristal line intersected an intervertebral space or a spinous process, the intervertebral space immediately below was chosen.

In the operating room, all patients were positioned sitting for spinal anaesthesia after applying routine monitors and securing intravenous access. Patients were seated on the edge of a level operating table with their feet supported by a footrest. They were requested to hug a pillow and flex their neck, back and hips. An assistant supported the patient during performance of the block. The anaesthetist marked the level on the back as per the study group. To identify the intercristal line, a standard protocol using both hands simultaneously to palpate the iliac crests and using the thumb to identify the midline at the same level was employed. Anaesthetists were instructed to open the sealed envelope and mark only the selected intervertebral space on the back with a skin marker before scrubbing. No other mark was allowed to ensure blinding of the investigator performing ultrasound.

One of the four authors, each of whom had prior experience with neuraxial ultrasound (>75 neuraxial ultrasound examinations before the study) and were blinded to the study group, performed ultrasound evaluation of the marked intervertebral space. Portable ultrasound equipment with a curved 2–5 MHz probe was used (Venue 40, 4C-SC curvilinear probe, GE Healthcare, Wauwatosa, WI, USA). Initially, a paramedian sagittal oblique view was used and the sacrum identified after which the interlaminar space between L5 and S1 was noted. Subsequent intervertebral spaces were identified by counting the interlaminar spaces up from L5–S1. At each interspace the interlaminar space was centred on the ultrasound screen and the corresponding point on the skin at the middle of the long axis of the probe was noted. The interspace corresponding to the skin marking was thus identified and documented. If on scanning the interspace was found to be L1–2 or higher, the anaesthetist performing the block was advised to perform needle insertion two interspaces lower; these patients' data were included for analysis of the primary outcome. The intervertebral level identified by the ultrasound was not conveyed to the anaesthetist performing the block.

Full aseptic precautions were used for performing the spinal anaesthesia (anaesthetist scrubbed with cap, mask, sterile gown and gloves). Lidocaine was used for skin infiltration. A 25-gauge Whitacre spinal needle was used with an introducer. Hyperbaric bupivacaine 10–12 mg with or without fentanyl 15 μg and morphine 100 μg was used for all patients. If more than one attempt was needed for performing spinal anaesthesia, the anaesthetist could choose the same interspace or a different interspace for subsequent attempts which was left to their discretion. Attempts at or above L1–2 were not allowed at any stage. In addition to the initial level marked, the final level at which the spinal anaesthesia was performed was noted.

The primary endpoint was the difference between groups in the proportion of interspaces marked at or above L2–3. In addition, demographic variables, gestational age, the experience of the anaesthetist, the number of needle passes (number of times the spinal needle was withdrawn and redirected in the same interspace without exiting the skin) and the number of attempts (number of times the spinal needle was withdrawn from the skin) were noted. Additionally, the presence or absence of paraesthesia or radicular pain during needle placement and injection, dose of bupivacaine and opioid, level of block (loss-of-cold sensation) at 5, 10 and 15 min and need for rescue analgesia and conversion to general anaesthesia were noted. All patients who had paraesthesia or radicular pain were followed up between 12 to 24 h post-procedure. In cases of persistent radicular symptoms, the patients were further evaluated and followed-up as per department guidelines.

Statistical analysis

Based on a previous study by Locks et al.[15] we estimated that if spinal anaesthesia were performed at or above the level of the palpated intercristal line, the incidence of needle insertion at or above L2–3 would be approximately 44%. We hypothesized that, by consistently selecting an interspace below the palpated intercristal line, we could decrease the incidence to <10%. A study with 55 patients in each arm would have at least 80% power to detect a difference between these proportions with a level of significance of 0.05.

Continuous variables were inspected for approximate normal distribution by visualising histograms. The primary analysis set consisted of the intention-to-treat (ITT) population. Age and gestational age were