

A cadaver study comparing spread of dye and nerve involvement after three different quadratus lumborum blocks

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Abstract

Background: Posterior variants of abdominal wall block include the quadratus lumborum type I, quadratus lumborum type II and quadratus lumborum transmuscular blocks. Our objectives were to compare the spread of injectate and nerve involvement, after conducting blocks using ultrasound guidance in soft embalmed cadavers.

Methods: After randomization, an experienced anaesthetist conducted three quadratus lumborum 1, three quadratus lumborum 2 and four transmuscular blocks on the left or right sides of five cadavers. All cadavers were placed in the lateral position and the quadratus lumborum muscle seen using a 3–9 MHz ultrasound probe placed in the flank. For each block, a 20 ml mixture of 17.75 ml water, 2 mls latex and 0.25 ml India ink was injected. The lumbar region and abdominal flank were dissected 72 h later.

Results: We conducted 10 blocks. Two quadratus lumborum 1 and two quadratus lumborum 2 blocks were associated with spread of dye within the TAP plane. One quadratus lumborum 1 block spread to the deep muscles of the back and one quadratus lumborum 2 block dispersed within the subcutaneous tissue surrounding the abdominal flank. All transmuscular quadratus lumborum blocks spread consistently to L1 and L3 nerve roots and within psoas major and quadratus lumborum muscles.

Conclusions: Consistent spread to lumbar nerve roots was achieved using the transmuscular approach through the quadratus lumborum.

Key words: anaesthesia; cadaver; regional; ultrasonography

Key points

- Understanding local anaesthetic spread may help to effectively refine posterior abdominal wall regional anaesthesia.
- Local anaesthetic spread in different quadratus lumborum blocks was studied in Thiel embalmed cadavers.
- Transmuscular approaches consistently spread to lumbar nerve roots, and within psoas major and quadratus lumborum.
- Choice of approach may affect success of quadratus lumborum block, despite accurate needle placement.

Transversus abdominis plane (TAP) block is commonly used to provide analgesia of the abdominal wall. Although initially described as a landmark technique,¹ it is generally conducted under ultrasound guidance.^{2–3} Best results have been gained using posterior approaches to abdominal wall blocks, because local anaesthetic preferentially spreads to lower thoracic and lumbar nerve roots^{4–5} rather than spreading anteriorly within the TAP plane.⁵ Posterior injection through the angle of Petit in cadavers⁴ was associated with spread of dye in the TAP plane from the costal margin to iliac crest, and in volunteers associated

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with paravertebral spread from T5 to L1 nerve roots using MRI imaging.⁵

Posterior modifications of ultrasound guided TAP blocks include: (1) the quadratus lumborum 1 (QL1) whereby local anaesthetic is deposited at the antero-lateral aspect of the QL muscle⁶; (2) the quadratus lumborum 2 (QL2) block,⁶ injecting local anaesthetic at the postero-lateral aspect of quadratus lumborum; and (3) the quadratus lumborum transmuscular (QL-TM) block⁷ inserting a needle through quadratus lumborum and injecting local anaesthetic between quadratus lumborum and the psoas muscle. Two randomized controlled studies (RCTs) have demonstrated better pain relief using quadratus lumborum block compared with femoral block for fractured neck of femur surgery⁸ and compared with placebo for Caesarean section.⁹ Several reports have shown benefit for paediatric renal surgery^{10 11} and adult laparoscopy¹²

However, for posterior abdominal wall blocks, the ideal regional anaesthesia technique is not known. Therefore, our primary objective was to compare the spread of a 20 ml solution of India ink and latex when conducting ultrasound guided QL1, QL2 and QL-TM blocks in soft embalmed cadavers. We chose this model because it provides realistic conditions for simulation of ultrasound guided regional anaesthesia (UGRA); tissue is soft, has life-like strain¹³ and stiffness¹⁴ characteristics, and is used for UGRA, difficult airway and surgical training.¹⁵ Our secondary objectives were to document the extent of nerve involvement.

Methods

After approval by the University of Dundee Thiel Advisory Group, ten quadratus lumborum blocks were conducted on soft embalmed cadavers independently chosen by the scientific officer of at the Centre for Anatomy and Human Identification (CAHiD), University of Dundee. Cadavers were randomized by computer to QL1, QL2 and QL-TM blocks. All cadavers were placed in the lateral position and blocks performed by a single experienced anaesthetist using an 18 gauge, 100 mm PlexoLong Sono Tuohy needle (Pajunk, Geisingen, Germany) and linear 3–9 MHz ultrasound probe and a Zonare Ultra ultrasound machine (Zonare, PaloAlto, CA). The block needle was connected to a syringe containing a 20 ml mixture of 17.75 ml water, 2 mls latex and 0.25 ml India ink. The injectate was chosen from results of a cadaver pilot project conducted by the principal author. The Tuohy needle was chosen for ease of injection of the solution. For all blocks, the ultrasound probe was placed transversely in the abdominal flank above the iliac crest. In this position, the external oblique, internal oblique, transversus abdominis muscles and aponeurosis were identified. The probe was then moved posteriorly in order to visualize the quadratus lumborum antero-lateral to the apex of the L3 and L4 transverse processes and superficial to the psoas muscle.

Block procedure

Each block is illustrated in Fig 1. The QL1 block was performed by inserting the needle in-plane from the anterior edge of the probe, depositing 20 ml of the latex and ink mixture onto the anterolateral surface of quadratus lumborum. The QL2 block was conducted in a similar fashion to the QL1 block but dye was injected more superficially onto the posterolateral surface of quadratus lumborum. QL-TM blocks were performed according to the technique described by Borglum and colleagues.⁷ The needle was inserted in-plane from the posterior edge of the probe through quadratus lumborum in an anteromedial direction.

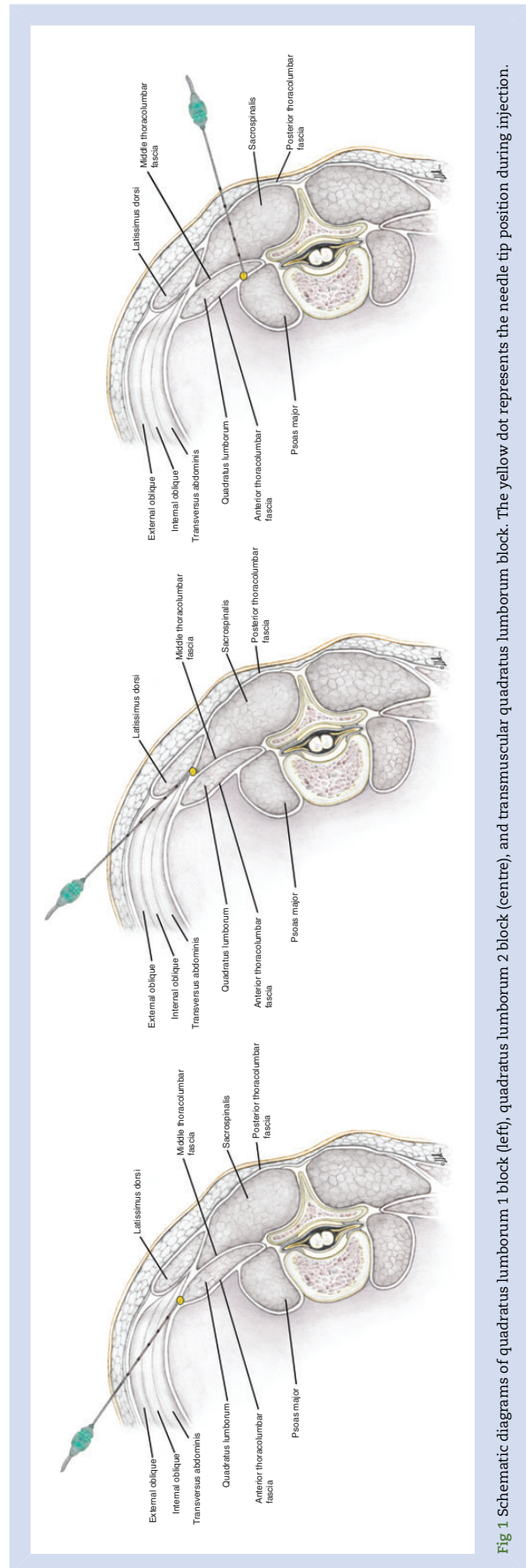


Fig 1 Schematic diagrams of quadratus lumborum 1 block (left), quadratus lumborum 2 block (centre), and transmuscular quadratus lumborum block. The yellow dot represents the needle tip position during injection.

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