

Nerves in quadratus lumborum planes: A cadaveric study

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ABSTRACT

Dermatomal analgesia achieved with quadratus lumborum blocks is site-dependent and inconsistent. Cadaveric and clinical studies reveal multiple mechanisms of action. We dissected six fresh human cadavers bilaterally and thoroughly studied their neurological linkages to the quadratus lumborum muscle (QLM) to identify neural structures and block targets. At the end of the investigation, only the subcostal nerve (anterolateral) and the ilioinguinal nerves were found near the QLM in all specimens. The iliohypogastric nerve was found in only two specimens. No further neural targets were found in the fascial planes before and posterior to the QLM.

Keywords: Cadaver, dissection, nerve block, quadratus lumborum

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INTRODUCTION

Three common approaches to quadratus lumborum block (QLB) have been described depending on the site of local anaesthetic (LA) deposition concerning the quadratus lumborum muscle (QLM). They are posterior QLB [between the erector spinae muscle (ESM) and QLM], lateral QLB (edge of the QLM), and anterior QLB [between QLM and psoas major muscle].^[1] Clinical studies have illustrated widespread dermatomal coverage and effective analgesic effect with the posterior QLB.^[2] Moreover, cadaver injection studies have demonstrated that the injected contrast dye can travel cranially to the thoracic paravertebral space and intercostal regions, soaking the somatic nerves and the thoracic sympathetic trunk up to the T4 level. These findings predict a possible visceral and a definitive somatic analgesic effect.^[3,4]

Anatomical dissection and study on six fresh frozen cadavers on each side (12 specimens) were performed after institutional approval for an observational study on six fresh frozen cadavers.

CASE PRESENTATION

The ages of the cadavers were 74, 65, 78, 66, 57, and 67 years, respectively. Each cadaver was dissected bilaterally, resulting in 12 specimens. The cadavers were devoid of any infectious medical pathologies, scoliotic deformations, or previous surgeries at the level of the cervical or thoracic spine that might have affected the dissection or distorted anatomical findings. Before dissection, the cadavers were stored at minus 20°C and thawed for 4 h at an ambient temperature of 22°C–23°C.

Dissection technique: Bilateral dissections were performed in the prone position, in layers superficial

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to deep, one side at a time, by a single anatomist with subsequent tracing of the neural structures found. A vertical midline incision extending from T6 to the iliac crest was made. Transverse incisions were then performed extending from the midline to the midaxillary line at T6 and iliac crest level. The skin and subcutaneous tissues were raised as a flap. The trapezius muscle above and the latissimus dorsi muscle below, along with the posterior thoracolumbar fascia, were dissected from the respective spinous process attachments and reflected laterally to the midaxillary line. Medial and lateral to the transverse process, the ESM that constitutes of spinal thoracis, longissimus coli (LC), and the tendons of iliocostalis (IC) muscle were revealed [Figure 1a]. Nerves emerging from the junction between the IC and the LC were identified as dorsal thoracic nerves [Figure 1b]. The ESM was dissected, and its ventral and dorsal surfaces were inspected for neural structures. It was then rolled up and reflected cephalad, displaying the middle thoracolumbar fascia along with the QLM beneath extending from the 12th rib cranially to the iliac crest caudally with its medial attachments to the spinous processes and a free lateral border [Figure 1c]. Efforts were then made to search, identify, and trace any nerves found about the QLM: a) at its dorsal surface, b) at its lateral border, and c) at its attachment on the 12th rib. Lastly, after detaching from its attachments, the QLM was reflected, and attempts were made to identify the nerves in relation to its ventral surface.

After reflecting the ESM, at the junction of the dorsal surface of the QLM and the 12th rib, the subcostal nerve was seen descending laterally and caudally. It was discerned at the apex of the lateral border of the QLM [Figure 2]. Further meticulous examination did not reveal any nerves traversing the dorsal surface or the lateral border of the QLM.

Upon reflecting on the QLM, the ilioinguinal nerve (IIN) was visualised on the ventral surface of the QLM and beneath the anterior thoracolumbar fascia (ATLF), which was covering the QLM anteriorly [Figure 3]. The iliohypogastric nerve was identified as a separate nerve in only two specimens. We presume the iliohypogastric nerve was either absent or conjoint with the IIN in the rest of the specimens. This finding has been observed in other studies as well.^[4] Only two nerves were traced in close association with the QLM in all the specimens: 1) subcostal nerve (anterolateral) and 2) IIN (anterior to QLM beneath the ATLF).

DISCUSSION

The profound and multi-dermatomal analgesia achieved from QLB cannot be explained to be due to the blockade of a single nerve, that is, the IIN.^[5] If blocking a single nerve, which is IIN, is the target of the anterior QLB, then risking a deep trans-muscular needle penetration that this block requires is not justified when other superficial approaches are available and

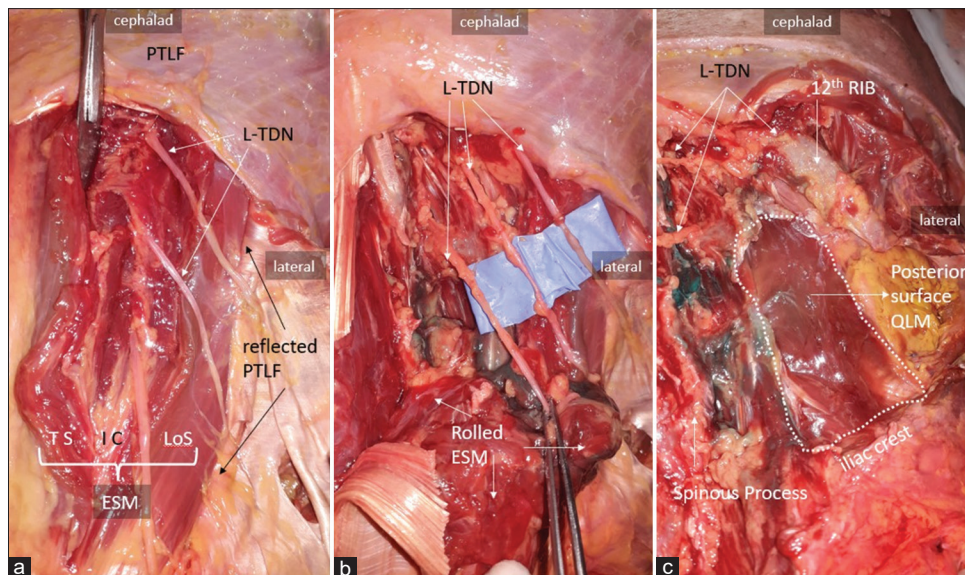


Figure 1: (a) Posterior thoracolumbar fascia (PTLF) is reflected to visualise the erector spinae muscle (ESM). Between the longissimus and the iliocostalis emerge the lower thoracodorsal nerves and pierce the posterior thoracolumbar fascia. (b) Three lower thoracodorsal nerve (L-TDN) are illustrated as they course from medial to lateral and beyond the iliac crest. (c) The three L-TDN are retracted medially, and the ESM is rolled up to envisage the posterior surface of the quadratus lumborum muscle (white arrows). No nerves are detected. PTLF: posterior thoracolumbar fascia, L-TDN: lower thoracodorsal nerve, QLM- quadratus lumborum muscle

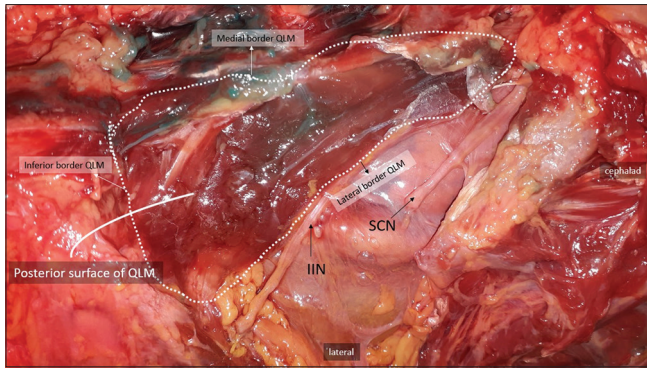


Figure 2: The subcostal nerve (SCN) is at the apex of the quadratus lumborum muscle (QLM) on its lateral aspect. The ilioinguinal nerve (IIN) leaves the lateral border of the QLM. The entire posterior surface of the QLM devoid of nerve course is represented by one of the cadavers. QLM: quadratus lumborum muscle, SCN: subcostal nerve, IIN: ilioinguinal nerve

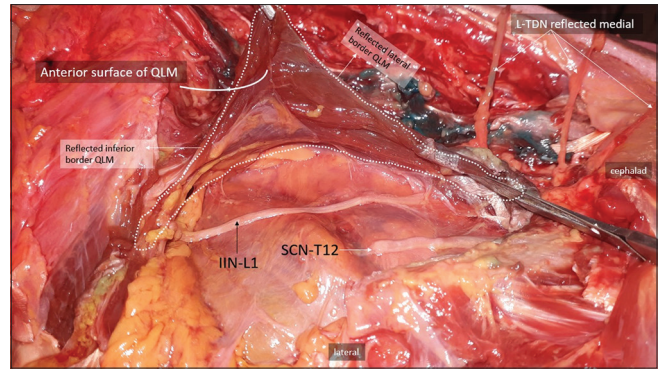


Figure 3: Reflecting the quadratus lumborum muscle (QLM) medially, the entire course of the ilioinguinal nerve could be portrayed. No other nerves were divulged. QLM: quadratus lumborum muscle, IIN: ilioinguinal nerve, SCN: subcostal nerve, L-TDN: lower thoracodorsal nerve

practised. The answer to this dilemma requires a much deeper understanding of the microscopic and macroscopic anatomy and, thus, the mechanisms of action.

Literature mentions the presence of high-threshold and low-threshold mechanoreceptors and pain receptors in the middle and ATLF engulfing the QLM. These receptors surround mainly the blood vessels and are assumed to lower the sympathetic nervous system activity. Blockades of these receptors should thus provide only sympathetic blocks and do not explain the sensory blockades from the posterior and the lateral QLB. The TLF is also known to be well-innervated with a high-density network of sympathetic fibres, and there is a suggestion of the involvement of sympathetic fibres in acute pain management that needs to be investigated.

Cadaveric injection studies illustrate a cranial spread to the thoracic paravertebral and intercostal space up to the fourth thoracic level.^[6] The lower thoracic paravertebral extension of the LA is a plausible mechanism of action after an anterior QLB. Its incidence of spread, however, remains unclear in cadaveric and clinical studies.^[5] Nevertheless, in a small cadaveric study, all five trans-muscular QLBs (anterior QLB) spread consistently to L1 and L3 nerve roots and within psoas major and QLMs.^[7,8] Amongst six cadavers, only one cadaver demonstrated a thoracic paravertebral spread with a posterior QLB. However, the subcostal anterior QLB appeared to be a potential approach to the thoracic paravertebral space, with the subendotheracic fascia being the link. The iliohypogastric, ilioinguinal, and subcostal nerves are consistently drenched with the injected dye. The

genitofemoral and lateral femoral cutaneous nerves may occasionally get blocked. Though the contrast can reach lumbar nerve roots inconsistently, this spread predicts a possible visceral and a definitive somatic analgesic effect.^[3,9]

Another mechanism of the spread of LA from QLB is the lumbar interfascial triangle (LIFT) found at the lateral border of paraspinal muscles. It extends from the 12th rib to the iliac crest and is a potential pathway for spreading the injectate deep into the transversus abdominis planes. The unpredictability of the anterior QLB is further exaggerated by the position of the needle, either high (upper pole of the kidney) or low (lower pole of the kidney), and the spread of LA takes the path of least resistance. This was demonstrated in a study wherein contrast injected via trans-muscular catheters (anterior QLB) demonstrated a variable spread on computed tomography contrast images.^[10] An inconsistent paravertebral spread blockade of the sympathetic fibres in the thoracolumbar fascia has been proposed to explain the visceral analgesic effect of posterior QLB.

Our cadaveric dissections reveal only three nerves around the quadratus lumborum beneath its fascia. The ilioinguinal and subcostal nerves are reliably situated between the ventral surface of the quadratus lumborum and the anterior thoracolumbar fascia. The subcostal nerve is situated at the lateral border of the QLM. The iliohypogastric nerve is inconsistent in its appearance. Moreover, there are no nerves posterior to the quadratus lumborum. Thus, it seems that targeting a single nerve through an anterior QLM would be unreasonable. Furthermore, with no nerves posterior to the QLM, the block through the posterior approach seems unjustified. Though sympathetic nerve endings

in the posterior thoracolumbar fascia seem to be a relevant target, more definitive studies would be required to establish its role. We postulate that the posterior QLB acts mainly through a lateral extensive spread in the transversus abdominis plane (TAP).

Ethical approval

Institutional approval for an observational study on six fresh frozen cadavers was given by the University of Barcelona's ethical and scientific committee.

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Conflicts of interest

There are no conflicts of interest.

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