

# Quadratus Lumborum Block

## Anatomical Concepts, Mechanisms, and Techniques

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Ultrasound-guided quadratus lumborum block is a recently described fascial plane block where local anesthetic is injected adjacent to the quadratus lumborum muscle with the goal of anesthetizing the thoracolumbar nerves. The objective of this article is to review the relevant anatomy, potential mechanisms, approaches, and techniques and summarize the clinical evidence for quadratus lumborum block.

### Anatomical Concepts

#### Muscles

Quadratus lumborum is a posterior abdominal wall muscle that originates from the posteromedial iliac crest and inserts into the medial border of the twelfth rib and the transverse processes of the first to fourth lumbar vertebrae. The lateral free border of quadratus lumborum is angled from craniomedial to caudolateral (fig. 1A). The quadratus lumborum and psoas major muscles traverse posterior to the lateral and medial arcuate ligaments of the diaphragm, respectively (fig. 1B). Posterior to the quadratus lumborum muscle lies the erector spinae muscle group, consisting of the multifidus, longissimus, and iliocostalis (figs. 2 and 3).

#### Fascia

The quadratus lumborum muscle is surrounded by a fibrous composite of aponeurotic and fascial tissue: the thoracolumbar fascia. The thoracolumbar fascia is part of a myofascial girdle that surrounds the lower torso and is important for posture, load transfer, and stabilization of the lumbar spine. The thoracolumbar fascia comprises multilayered fascia and aponeuroses, with two proposed models.

The two-layered model incorporates a posterior layer surrounding the erector spinae muscles and an anterior layer lying between the erector spinae and the quadratus

lumborum muscles.<sup>1</sup> In the two-layered model, the fascia on the anterior aspect of quadratus lumborum is the transversalis fascia, a fascial structure that is embryologically independent from the thoracolumbar fascia. The transversalis fascia lines the peritoneal surface of the transversus abdominis muscle and wraps the anterior aspect of the investing fascia (epimysium) of both quadratus lumborum and psoas muscles. The two-layered model follows the embryological development of the trunk muscles, where quadratus lumborum and psoas muscles belong to the hypaxial muscle compartment, anterior to the transverse processes, whereas the erector spinae muscles belong to the epaxial muscle compartment, posterior to the transverse processes.<sup>1</sup> We illustrate the two-layered model of the thoracolumbar fascia at L4 schematically in figure 2.

In the three-layered model, the posterior thoracolumbar fascia layer surrounds the erector spinae muscles, the middle layer passes between the erector spinae muscles and quadratus lumborum, and the anterior layer lies anterior to both quadratus lumborum and psoas muscles. We illustrate the three-layered model of the thoracolumbar fascia at the L4 level schematically in figure 2.

Cranially, the anterior layer of the thoracolumbar fascia (the transversalis fascia in the two-layer model) divides into two layers. One layer is continuous with the endothoracic fascia in the thorax, and the other layer blends with the diaphragm at the arcuate ligaments. Caudally, this fascial layer is continuous with the fascia iliaca.<sup>2-4</sup>

The three-layered model is the most commonly used. Regardless of which model is accepted, the fascial planes in the abdominal compartment follow the quadratus lumborum and psoas muscles through the medial and lateral arcuate ligaments and the aortic hiatus of the diaphragm, forming the endothoracic fascia. This provides a potential pathway for spread of injectate, such as local anesthetic, from the abdominal to the thoracic cavity and paravertebral space, thereby achieving clinical effect.<sup>2-4</sup>

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### Lateral Raphe and Lumbar Interfascial Triangle

The paraspinous retinacular sheath is the deep lamina of the posterior layer of the thoracolumbar fascia extending from the spinous to transverse processes.<sup>1</sup> The lateral raphe is a dense connective tissue complex formed where the abdominal myofascial structures (aponeurotic sheaths of the transversus abdominis and internal oblique muscles) join the paraspinous retinacular sheath at the lateral border of the paraspinous muscles. At this point, the myofascial structures separate into two laminae, which join the anterior and posterior paraspinous retinacular sheath layers. This creates the lumbar interfascial triangle, situated along the lateral border of the paraspinous muscles from the twelfth rib to the iliac crest (fig. 3).<sup>5</sup> The lumbar interfascial triangle provides a theoretical pathway for injectate spread deep to the thoracolumbar fascia.

### Vascular Structures

The abdominal branches of the lumbar arteries arise from the abdominal aorta and run laterally and posterior to the quadratus lumborum muscle. One exception is the fourth lumbar artery that may be located anterior to the quadratus lumborum.<sup>6</sup>

### Viscera

Intraabdominal viscera are located in close proximity to where quadratus lumborum block is performed. However, the transversalis fascia separates the muscle layers from the retroperitoneal abdominal contents. The kidney lies anterior to the quadratus lumborum muscle and is separated

from it by para- and perinephric fat, the posterior layer of renal fascia, and the transversalis fascia.

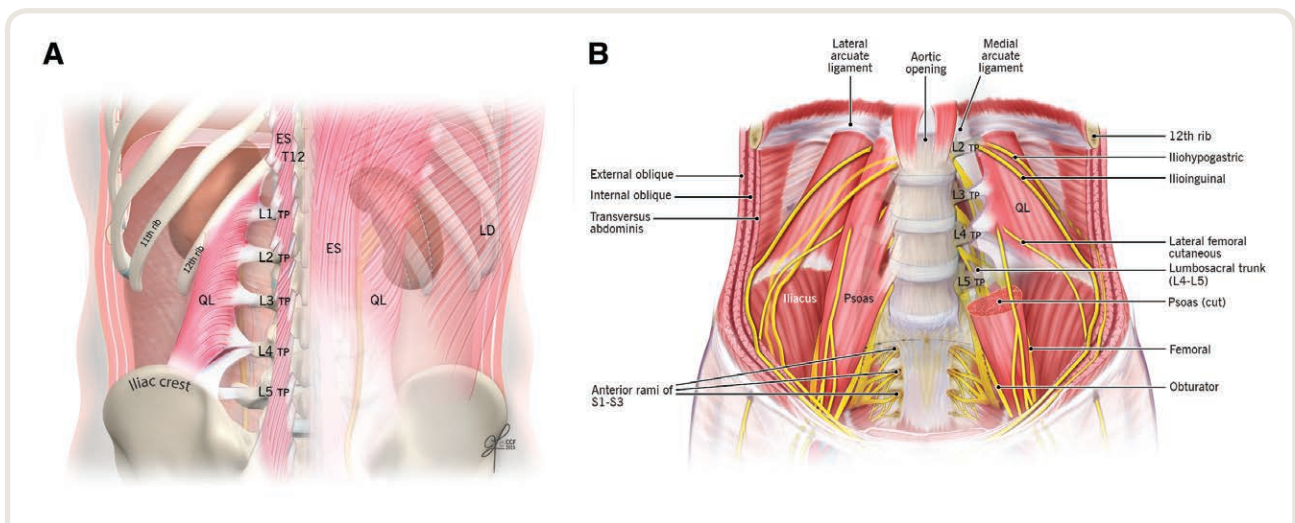
### Neural Structures

The iliohypogastric and ilioinguinal nerves (ventral ramus of L1 with occasional contributions from T12, L2, and L3) depart through the proximal and lateral aspect of the psoas major muscle and traverse the ventral surface of quadratus lumborum (fig. 1B).<sup>7,8</sup> In four cadaver studies, the iliohypogastric and ilioinguinal nerves were consistently involved in spread of injectate.<sup>4,9-11</sup> In published cases the reported dermatomal sensory blockade frequently includes the T12-L2, indicating consistent involvement of iliohypogastric and ilioinguinal nerves using different approaches.<sup>12-21</sup> The lateral femoral cutaneous, obturator, and femoral nerves exit the psoas major muscle at more caudal levels (fig. 1B).<sup>22-24</sup> The dorsal rami of the spinal nerves traverse the medial aspect of the middle thoracolumbar fascia posterior to the quadratus lumborum muscle and then enter the erector spinae muscles.

### Spread of Injectate and Mechanisms of Action

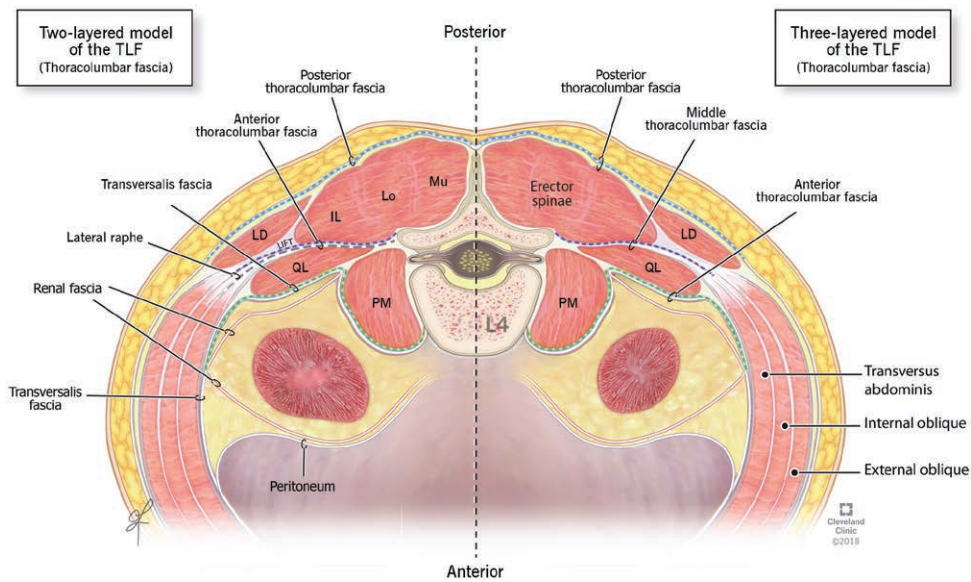
#### Endothoracic Fascia Pathway

It is plausible that local anesthetic injected anterior to the quadratus lumborum muscle and posterior to the transversalis fascia will spread to the thoracic paravertebral space, posterior to the medial and lateral arcuate ligaments of the diaphragm, along the endothoracic fascia to block

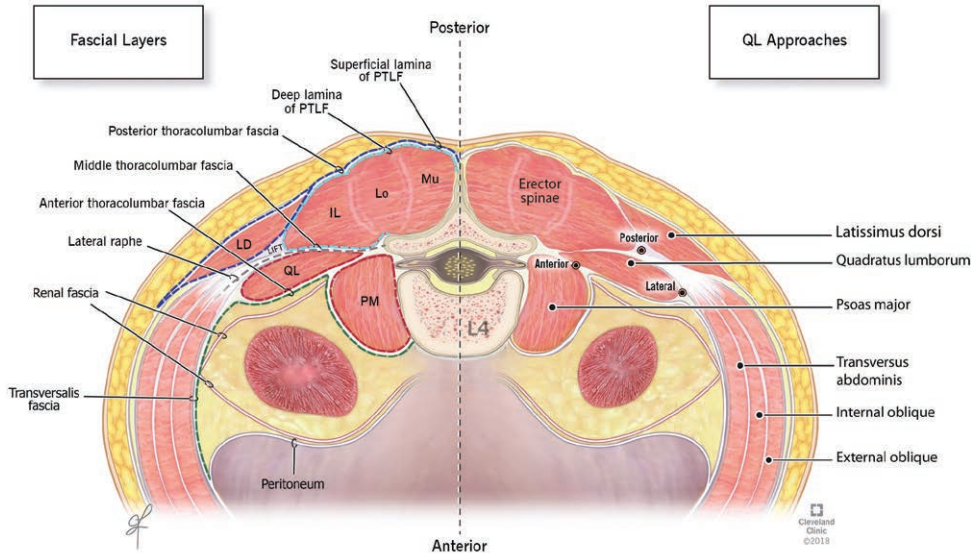


**Fig. 1.** (A) A posterior schematic illustration of the musculature of the posterior abdominal wall. The quadratus lumborum muscle originates from medial border of the twelfth rib and lumbar vertebrae transverse processes and inserts into the posteromedial iliac crest. (B) An anterior schematic illustration of the musculature of the posterior abdominal wall. On the left, the psoas muscle has been removed to reveal the ventral rami of the spinal nerve roots and branches passing anterior to the quadratus lumborum muscle. ES, erector spinae; LD; latissimus dorsi; QL, quadratus lumborum; TP, transverse process. Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2018. All Rights Reserved.

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**Fig. 2.** A schematic illustration of cross-section at L4 level showing the quadratus lumborum muscle with the different layers of the thoracolumbar fascia. On the *left*, the two-layer model is depicted, where the *purple dashed line* represents the anterior layer of the thoracolumbar fascia, and the *green dashed line* represents the transversalis fascia. On the *right*, the three-layer model is depicted, where the *purple dashed line* represents the middle layer of the thoracolumbar fascia, and the *green dashed line* represents the anterior layer of the thoracolumbar fascia. The *blue dashed line* represents the posterior thoracolumbar fascia. IL, iliocostalis; LD, latissimus dorsi; Lo, longissimus; Mu, multifidus; PM, psoas major; QL, quadratus lumborum; TLF, thoracolumbar fascia. Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2018. All Rights Reserved.



**Fig. 3.** A schematic illustration of cross-section at L4 level showing the detailed descriptions of the three-layered model of the thoracolumbar fascia and its sublayers (*left*) and the anatomical relations of the three approaches to quadratus lumborum block (*right*) at L4 level. The *dark blue dashed line* represents the superficial lamina of the posterior layer of the thoracolumbar fascia encircling the latissimus dorsi and erector spinae muscles. The *light blue dashed line* represents the deep lamina of the posterior layer of the thoracolumbar fascia, also termed as paraspinal retinacular sheath, encircling the erector spinae muscles. The *red dashed lines* represent the epimysium-investing fascia of quadratus lumborum and psoas major muscles. The *white (gray dashed) layer* represents the aponeurosis of the internal oblique and transversus abdominis muscles. IL, iliocostalis; LD, latissimus dorsi; Lo, longissimus; Mu, multifidus; PM, psoas major; PTLF, posterior thoracolumbar fascia; QL, quadratus lumborum. Reprinted with permission, Cleveland Clinic Center for Medical Art & Photography © 2018. All Rights Reserved.

the somatic nerves and thoracic sympathetic trunk of the lower thoracic levels (fig. 1B). In addition to existing supporting anatomical<sup>2,25</sup> and clinical literature,<sup>3</sup> two recent cadaveric studies support this mechanism of action in anterior quadratus lumborum block.<sup>4,10</sup> Dam *et al.*<sup>4</sup> replicated an anterior quadratus lumborum block in a cadaveric model at the iliac crest (L4) and L2 and documented thoracic paravertebral spread involving somatic nerves and the thoracic sympathetic trunk to the T9–T10 level. Similarly, Elsharkawy *et al.*<sup>10</sup> replicated a subcostal anterior quadratus lumborum approach at L1–2 level using a parasagittal oblique approach and found cranial spread to involve T7–12. In contrast, Sondekoppam *et al.*<sup>11</sup> demonstrated, with an anterior approach at L3, dye spread in the lateral part of the thoracic paravertebral space (T11–12) with no clear craniocaudal spread. Adhikary *et al.*<sup>9</sup> performed anterior quadratus lumborum blocks at L3–L4 levels and also demonstrated no evidence of thoracic paravertebral spread. However, Elsharkawy *et al.*<sup>10</sup> investigated the posterior quadratus lumborum approach at the L3–4 level found staining up to T10 inside the lateral thoracic paravertebral space (table 1). Overall, local anesthetic injected between the transversalis fascia and the quadratus lumborum muscle may spread to the thoracic paravertebral space, and the vertebral level of injection will influence the extent of cranial spread.

### Involvement of the Lumbar Spinal Nerve Roots and Branches

Cadaveric data also support a possible mechanism of action *via* direct spread of dye to the roots and branches of the lumbar plexus.<sup>4,9–11</sup> L1–3 nerve roots were consistently involved in an anterior quadratus lumborum cadaveric injection study at the L3–4 level.<sup>26</sup> Three cadaveric studies<sup>9–11</sup> also demonstrated involvement of the upper lumbar plexus nerves and subcostal nerve after anterior quadratus lumborum block. Elsharkawy *et al.*<sup>10</sup> and Dam *et al.*<sup>4</sup> did not observe direct lumbar plexus involvement within the psoas major muscle in all approaches. It is notable that the spread of local anesthetic in living humans may be different from that of cadavers, and cadaveric evidence may not forecast clinical outcomes. Thus, careful analysis of translational data is needed.

### Peripheral Sympathetic Field Block

Recent evidence suggests that rather than being a “passive” scaffold, fascial tissue is more complex, with rich vascular and sensory innervation. The thoracolumbar fascia has extensive sensory innervation by both A- and C-fiber nociceptors and mechanoreceptors.<sup>27</sup> Sympathetic nerve fibers related to the abdominal branches of the lumbar arteries, located posterior to the quadratus lumborum muscle, innervate the thoracolumbar fascia.<sup>28</sup> Because these nerves have a strong vasomotor component, blocking these

sympathetic afferents could theoretically induce changes to both the local circulation and the general autonomic tone.<sup>28</sup> This might potentially contribute to the analgesic efficacy of posterior quadratus lumborum block.<sup>29</sup>

### Approaches, Sonography, and Technical Performance

We have proposed that quadratus lumborum block be named based on the anatomical location of needle tip placement in relation to the quadratus lumborum muscle (fig. 3).<sup>30</sup> Therefore we recommend the following terminology: lateral, posterior, and anterior quadratus lumborum block approaches. Figure 4 illustrates examples of in-plane approaches with anterior–posterior, posterior–anterior, and caudal–cranial trajectories.

### Needle Length and Gauge

Typical needle length would range from 80 to 150 mm depending on patient body habitus. The exact gauge would depend on single injection technique *versus* continuous technique.

### Injectate

Local anesthetic dosage in the range of 0.2 to 0.4 ml/kg of 0.2 to 0.5% ropivacaine<sup>31–33</sup> or 0.1 to 0.25% bupivacaine<sup>34–36</sup> per side is recommended. The operator will need to adjust dosage to ensure toxic thresholds are not exceeded, particularly when bilateral blocks are performed. There is no comparative data on the efficacy of adjuvants in quadratus lumborum blocks; however, the use of epinephrine may have benefits in reducing the rate of absorption and in detecting and limiting inadvertent intravascular injection. Standard safety precautions for performing regional anesthetic blocks should be followed.

### Positioning

The patient can be positioned supine with a lateral tilt, lateral, sitting or prone, largely depending on physician preference, patient mobility, and planned needle trajectory. For example, a posterior–anterior trajectory will require the patient to be lateral, prone, or in the sitting position.

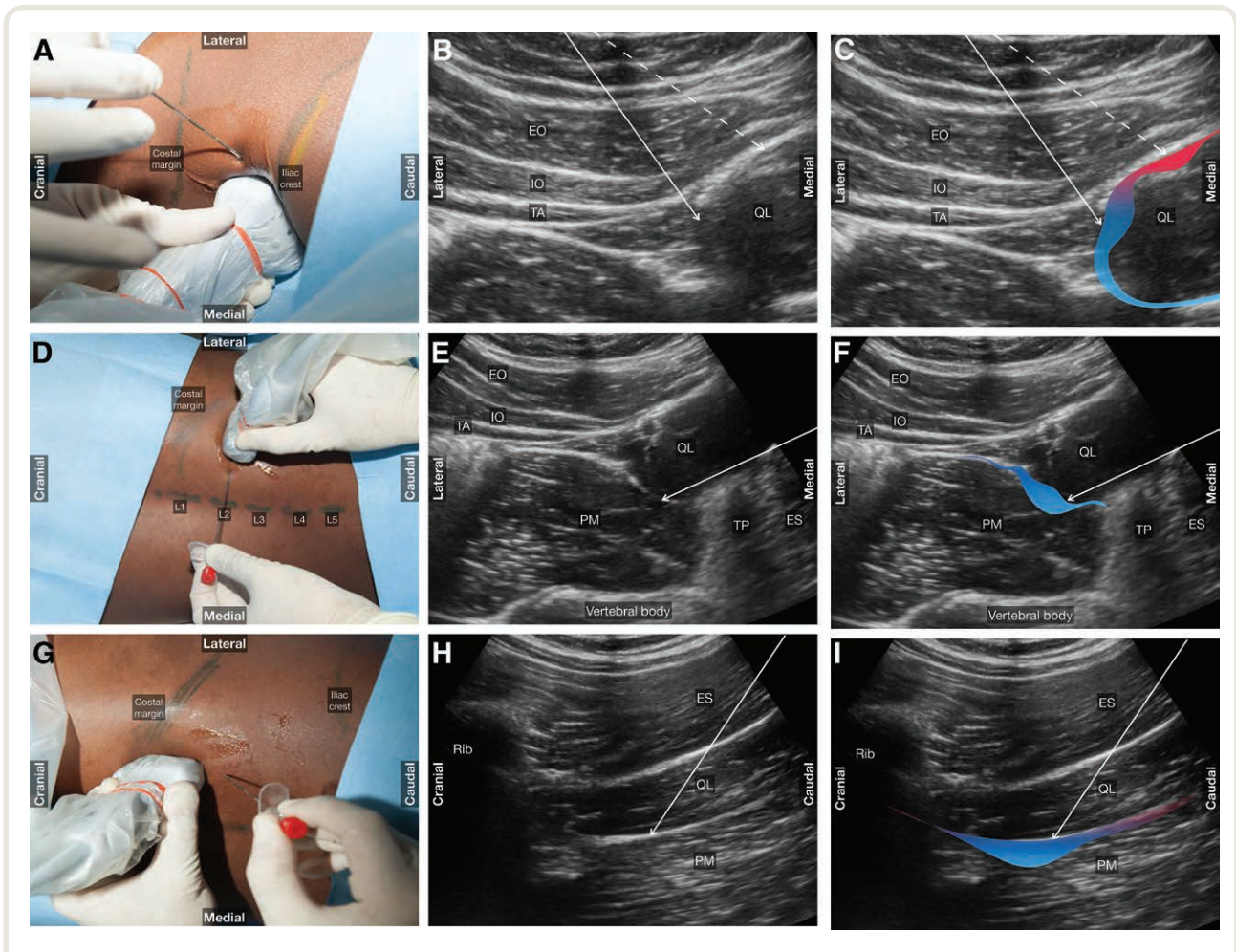
### Lateral Quadratus Lumborum Block

This can be performed using an in-plane approach, with a needle insertion lateral (anterior) to the ultrasound transducer with an anterior-to-posterior needle trajectory. Local anesthetic is deposited at the lateral border of quadratus lumborum muscle after the needle tip penetrates the transversus abdominis aponeurosis.<sup>37</sup> Lateral quadratus lumborum

**Table 1.** Cadaveric Studies Conducted Investigating Quadratus Lumborum Block

Article	N	Quadratus Lumborum Block Approach	Objectives	Injectate	Main Finding	Other Findings or Comments
Carline <i>et al.</i> <sup>26</sup>	5 (10 sides)*	Anterior quadratus lumborum block Lateral quadratus lumborum block Posterior quadratus lumborum block	Document injectate spread	20 ml of India ink and latex	Lateral quadratus lumborum block (n = 3): transversus abdominis plane, subcutaneous tissue or muscular spread Posterior quadratus lumborum block (n = 3): transversus abdominis plane, subcutaneous tissue or muscular spread Anterior quadratus lumborum block (n = 4) L1 and L3 nerve root spread; within psoas major and quadratus lumborum muscles	Difficult to interpret intramuscular spread, perhaps technique- or tissue-related
Dam <i>et al.</i> <sup>4</sup>	8 (16 sides)†	Anterior quadratus lumborum block	Document injectate spread and involvement of ventral rami, sympathetic trunk, and peripheral nerves	30 ml of dye mixture (polymers, latex, acrylates, acrylic esters, alcohols all mixed to control viscosity)	Above diaphragm: dye spread into the thoracic paravertebral space involving somatic and sympathetic nerves (upper limit T9–T10) Below diaphragm: dye staining of subcostal, iliohypogastric, and ilioinguinal nerves	Dye did not involve lumbar plexus or sympathetic trunk, femoral nerve, with limited involvement of genitofemoral and lateral femoral cutaneous nerves
Adhikary <i>et al.</i> <sup>9</sup>	5 (10 sides)	Anterior quadratus lumborum block	Document injectate spread and peripheral nerve involvement using dissection and computerized tomography imaging	20 ml of methylene blue with iodinated contrast mixture	Cranial extent of radiographic spread reached the L1 transverse process in all specimens, to the T12 transverse process in two (25%); no visible injectate spread into the thoracic cavity	Injectate spread to the psoas major muscle and included the upper branches of the lumbar plexus: ilioinguinal (100%), iliohypogastric (80%), subcostal (50%)
Eisharkawy <i>et al.</i> <sup>10</sup>	6 (12 sides)	Posterior quadratus lumborum block Anterior subcostal quadratus lumborum block	Document injectate spread	30 ml of 0.5% methylcellulose with India ink	Spread of dye with posterior injection (T10–L1) was different from anterior subcostal (T6–L3)	For both techniques, ilioinguinal, iliohypogastric, subcostal, T11–L1 nerve roots were deeply stained in all specimens; there were two levels of difference between two approaches (anterior subcostal at L1–L2, posterior quadratus lumborum at L3–L4)
Sondekoppam <i>et al.</i> <sup>11</sup>	5 (10 sides)	Anterior quadratus lumborum block	Document injectate spread to subcostal, iliohypogastric, ilioinguinal, and lateral femoral cutaneous nerves	20 ml of 0.5% methylcellulose with India ink	Consistent involvement of ilioinguinal, iliohypogastric, and subcostal nerves Inconsistent spread to the lateral femoral cutaneous nerve	Clinical correlations in case series showed reliable coverage of T9–L2 dermatomes

\*Thiel embalmed cadavers. †Preserved cadavers so that ultrasound images can be acquired. QL, quadratus lumborum; TAP, transversus abdominis plane.



**Fig. 4.** Photographs and ultrasound images for different quadratus lumborum blocks. (A–C) Lateral or posterior quadratus lumborum blocks. Transverse transducer and anteroposterior needle trajectory are shown. The external image and ultrasound images show the ultrasound probe position with a *solid arrow* indicating the needle trajectory for a lateral quadratus lumborum block and the *dashed line* indicating the needle trajectory for a posterior quadratus lumborum block approach. The *red-/blue-shaded area* represents the spread of the local anesthetic. (D–F) Anterior quadratus lumborum block: transverse oblique paramedian approach. Transverse transducer and posteroanterior needle trajectory are shown. The external image and ultrasound images show the ultrasound probe position with an *arrow* indicating the needle trajectory. The *blue-shaded area* represents the spread of the local anesthetic. (G–I) Anterior quadratus lumborum block: subcostal approach. Parasagittal oblique transducer and caudal-to-cranial needle trajectory are shown. The external image and ultrasound images show the ultrasound probe position with an *arrow* indicating the needle trajectory. The *blue-shaded area* represents the spread of the local anesthetic. EO, external oblique; ES, erector spinae; IO, internal oblique; PM, psoas major; QL, quadratus lumborum; TA, transversus abdominus; TP, transverse process.

block has been shown to be opioid-sparing compared with placebo for post-cesarean section analgesia.<sup>31,32</sup>

### Posterior Quadratus Lumborum Block

This can be performed using an in-plane approach using an anterior-to-posterior or posterior-to-anterior trajectory. Local anesthetic is injected on the posterior surface of quadratus lumborum muscle, between the quadratus lumborum and erector spinae muscles. This approach was used in two randomized controlled trials that documented an

opioid-sparing effect of quadratus lumborum block compared with placebo<sup>34</sup> or transversus abdominis plane block<sup>35</sup> after caesarean section.

### Anterior Quadratus Lumborum Block

This can be performed using an in-plane approach, with a needle insertion medial to the ultrasound transducer, using a posterior-to-anterior trajectory.<sup>38</sup> Alternatively an in-plane approach, with an anterior-to-posterior trajectory can be used. A further option is with the subcostal

oblique anterior approach; the needle insertion is caudal to the transducer, and the trajectory is in-plane, caudal–lateral to cranial–medial. The point of injection of local anesthetic lies in the tissue plane between the quadratus lumborum and psoas muscles.<sup>38–40</sup> These variants differ in the needle trajectory used (anterior-to-posterior; posterior-to-anterior; caudal-to-cranial) but have the same plane of injection.

According to cadaveric and clinical reports, it is reasonable to conclude that different quadratus lumborum blocks have different mechanisms of action. Anterior quadratus lumborum block injectate may spread to the lumbar nerve roots and branches in addition to the thoracic paravertebral space.<sup>4,9–11</sup> Posterior quadratus lumborum blocks appear to demonstrate their clinical effect by injectate spread along the middle thoracolumbar fascia intertransverse area.<sup>10,26</sup> Lateral quadratus lumborum blocks are associated with injectate spread to the transversus abdominis muscle plane and to subcutaneous tissue,<sup>26</sup> although clinical reports refer to a more extensive distribution.<sup>31,32,35,41</sup> At present, there is insufficient evidence to recommend one approach and transducer positioning over another for individual patient populations and specific surgical types.

## Sonography

Because identifying the quadratus lumborum muscle is critical to performing quadratus lumborum block, it is important to note the following landmarks and relationships: the aponeuroses of the abdominal wall muscles (external oblique, internal oblique, transversus abdominis) are located posterolateral to the quadratus lumborum muscle (fig. 2); the quadratus lumborum muscle is often hypoechoic relative to psoas major muscle, which is found anteromedially; and the lumbar transverse processes are apparent with their hyperechoic curved appearance (fig. 4E).

A curvilinear low-frequency transducer is often required, facilitating tissue penetration of ultrasound and a wide field of view. The transducer is placed in transverse orientation at the posterior or midaxillary line at the L2–L4 level with the objective of imaging the quadratus lumborum and erector spinae muscles, together with a transverse process forming the “shamrock sign” (fig. 4E).<sup>42</sup> A variation is maintaining the transducer in transverse orientation but placing it more medially, approximately 3 cm lateral to the L2 spinous process (fig. 4D). This has been referred to as the transverse oblique paramedian placement, and the image is enhanced with medial rocking of the transducer and slight caudal rotation of the lateral aspect of the transducer.<sup>38</sup> A further option is to place the transducer in a parasagittal oblique plane tilted medially (subcostal oblique anterior approach) at the level of the twelfth rib approximately 6 to 8 cm from the spinous process (fig. 4G). This view corresponds to the transverse oblique paramedian view but with the transducer rotated to a parasagittal oblique plane. With the subcostal oblique anterior approach, the quadratus lumborum muscle

can be imaged at its point of insertion on the lower border of the twelfth rib, and the erector spinae muscle is seen posterior (superficial) to the quadratus lumborum muscle. The psoas major muscle, diaphragmatic zone of apposition, the kidney and perinephric fat and renal fascia are anterior (deep) to the quadratus lumborum muscle. The needle trajectory for the anterior approach to quadratus lumborum block is deep and close to the abdominal and retroperitoneal viscera; therefore a high level of vigilance and technical competency is required.

## Indications and Clinical Relevance

To date, two randomized controlled trials demonstrated that quadratus lumborum block reduces cumulative opioid consumption for 48 h after caesarean section.<sup>31,32</sup> Two further randomized controlled trials have demonstrated that posterior quadratus lumborum block has an opioid-sparing effect after caesarean section (table 2).<sup>34,35</sup> Posterior quadratus lumborum block is associated with reduced postoperative pain scores after laparoscopic gynecological surgery<sup>33</sup> and reduced rescue analgesia requirements after lower abdominal surgery.<sup>36</sup> Successful use of quadratus lumborum block with all approaches has been published in case reports for the following surgical procedures: proctosigmoidectomy,<sup>18</sup> hip surgery,<sup>12</sup> above-knee amputation,<sup>43</sup> abdominal hernia repair,<sup>44</sup> breast reconstruction,<sup>13</sup> colostomy closure,<sup>14</sup> radical nephrectomy,<sup>15</sup> lower extremity vascular surgery,<sup>45</sup> total hip arthroplasty,<sup>16,17,20</sup> laparotomy,<sup>19</sup> and colectomy.<sup>46</sup> Several other case reports with a variety of indications for quadratus lumborum block document sensory blockade to include the T7–L2 dermatomes (table 3).<sup>9,19,20,24,44,47–66</sup>

## Contraindications

Because of the ongoing investigative nature of this technique, empirical contraindications apply. Absolute contraindications include local infection, allergy to local anesthetics, and a known bleeding diathesis because it is a deep block. Relative contraindications include anatomical abnormalities, hemodynamic instability, and known neurologic disorders.

## Complications

### Local Anesthetic-related Complications

Quadratus lumborum block may result in local anesthetic distribution to the lumbar plexus and prolonged motor block, delaying mobilization and hospital discharge. Lower-limb weakness has been reported after use of all quadratus lumborum block approaches.<sup>67,68</sup> Hypotension has been

**Table 2.** Randomized Controlled Trials with Quadratus Lumborum Block Interventions

Article	N	Surgery	Quadratus Lumborum Block	Comparator	Injectate	Primary Outcome	Results
Blanco <i>et al.</i> <sup>34</sup>	50	Caesarean section	Posterior quadratus lumborum block (bupivacaine)	Posterior quadratus lumborum block (saline)	0.2 ml/kg 0.125% bupivacaine or saline	48-h morphine consumption	Morphine requirements (mg) reduced at 6 and 12 h (2, 8 vs. 7, 14, respectively) in quadratus lumborum block group
Blanco <i>et al.</i> <sup>35</sup>	76	Caesarean section	Posterior quadratus lumborum block	Lateral transversus abdominis plane	0.2 ml/kg 0.125% bupivacaine (bilateral)	48-h morphine consumption	Morphine requirements (mg) reduced at 12, 24, and 48 h (5, 6, 9 vs. 8, 13.5, 17.5, respectively) in quadratus lumborum block group
Kroong <sup>31</sup>	40	Caesarean section	Lateral quadratus lumborum block (ropivacaine)	Lateral quadratus lumborum block (saline)	0.4 ml/kg 0.2% ropivacaine or saline, bilaterally	24-h analgesia requirement	Number of patients requiring postoperative analgesia lower (3 vs. 7) in quadratus lumborum block group
Mieszkowski <i>et al.</i> <sup>32</sup>	58	Caesarean section	Lateral quadratus lumborum block	No block	24 ml of 0.375% ropivacaine, bilaterally	48-h morphine consumption	Morphine requirements (mg) reduced at 48 h (15.0 vs. 30.0) in quadratus lumborum block group
Parras and Blanc <sup>41</sup>	97	Hip hemiarthroplasty for femoral neck fracture	Lateral quadratus lumborum block	Femoral nerve block	30 ml of 0.125% levobupivacaine	24-h visual analog scale pain score; postanesthesia care unit opioids; 24-h opioid consumption	Visual analog scale reduced at 6, 12, 18, and 24 h (3.7, 1.4, 0.8, 0.7 vs. 5.2, 4.6, 3.4, 2.6, respectively) in the quadratus lumborum block group; 24-h opioid consumption (mg) lower (9.7 vs. 16.9) in the quadratus lumborum block group
Ishio <i>et al.</i> <sup>33</sup>	70	Laparoscopic gynecological surgery	Posterior quadratus lumborum block	No block	20 ml of 0.375% ropivacaine	Numeric rating scale pain scores	Numeric rating scale pain scores reduced at 1, 3, and 24 h (1.4, 1.8, 1.5 vs. 3.1, 4.0, 4.4, respectively) in quadratus lumborum block group
Oksüz <i>et al.</i> <sup>36</sup>	53	Pediatric: inguinal hernia repair or orchidopexy	Posterior quadratus lumborum block	Lateral transversus abdominis plane	0.5 ml/kg 0.2% bupivacaine	Analgesic requirements	Reduced need for rescue analgesia in quadratus lumborum group



**Table 3.** Case Reports of Quadratus Lumborum Block

Case Types	N	Surgery	Timing/ Indication	Site of Injection	Injectate	Results
Abdominal surgery Kadam <sup>19</sup>	1	Laparotomy (duodenal tumor)	Perioperative analgesia	Posterior quadratus lumborum block	25 ml of 0.5% ropivacaine	Initial sensory block T8–L1; first analgesic request at 3 h, patient-controlled analgesia fentanyl 720 µg on postoperative day 1, 1,000 µg on postoperative day 2
Kadam <sup>61</sup>	1	Hemicolectomy	Perioperative analgesia	Posterior quadratus lumborum block	5 ml/h 0.2% ropivacaine	Perioperative opioids: 500 µg of fentanyl (intraoperative, postanesthesia care unit combined); 10 mg of oxycodone as rescue in first 48 h Numeric rating scale improved from 10/10 to 2–3/10
Shaaban <i>et al.</i> <sup>18</sup>	1	Proctosigmoidectomy, colorectal anastomosis	Postoperative day 1, after opioid-induced hypoventilation and respiratory failure, surgical team refusal of thoracic epidural analgesia	Posterior quadratus lumborum block	Bilateral bolus: 15 ml of 0.5% bupivacaine; bilateral infusion, 8 ml/h 0.1% bupivacaine	
Eisharkawy <i>et al.</i> <sup>46</sup>	1	Colectomy	Perioperative analgesia	Anterior quadratus lumborum block compared with transversus abdominis plane on same patient	Bilateral: 25 ml of 1.3% liposomal bupivacaine	Anterior quadratus lumborum block: T7–L1; sensory blockade, 48 h transversus abdominis plane: T10–L1; sensory blockade, 24 h; 190 mg of IV morphine equivalent in first 72 h
Spence <i>et al.</i> <sup>13</sup>	1	Breast reconstruction using transverse rectus abdominis myocutaneous flaps	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral bolus through catheter, 20 ml of 1.5% mepivacaine; bilateral infusion, 10 ml/h 0.2% ropivacaine	Sensory block T7–L1, postoperatively numeric rating scale 0–3; minimal postoperative opioid use: 15 mg of oxycodone (to postoperative day 3); patient-controlled analgesia hydromorphone use to postoperative day 2 was 1.4 mg
Carvalho <i>et al.</i> <sup>44</sup>	1	Multiple abdominal wall surgeries	Chronic neuropathic pain	Posterior quadratus lumborum block	25 ml of 0.2% ropivacaine + 20 mg of methylprednisolone	Immediate pain relief lasting up to 6 months
Corso <i>et al.</i> <sup>47</sup>	1	Open nephrectomy	Perioperative analgesia	Anterior quadratus lumborum block	30 ml of 0.375% ropivacaine	Good analgesia
Garg <i>et al.</i> <sup>48</sup>	1	High inguinal orchiectomy	Perioperative analgesia	Posterior quadratus lumborum block	20 ml of 0.2% ropivacaine	Sensory level T8–L1
Suri <i>et al.</i> <sup>49</sup>	6	Open radical nephrectomy	Perioperative analgesia	Lateral quadratus lumborum block (surgeon-assisted injection)	20 ml of 0.2% ropivacaine	Sensory level T5–L1
Ueshima and Hiroshi <sup>50</sup>	2	Lower abdominal surgery	Perioperative analgesia	Anterior subcostal quadratus lumborum block	Bolus through catheter: 20 ml of 0.375% levobupivacaine	Good analgesia
Ueshima and Otake <sup>51</sup>	2	Open nephrectomy	Perioperative analgesia	Anterior subcostal quadratus lumborum block	Bolus through catheter: 20 ml of 0.5% levobupivacaine	Sensory block T8–12
Sindwani <i>et al.</i> <sup>52</sup>	1	Laparoscopic nephrectomy	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral bolus through catheter: 15 ml of 0.2% ropivacaine	Excellent analgesia without opioid
Sá <i>et al.</i> <sup>53</sup>	2	Gastrectomy and colectomy	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral 20 ml of 0.25% levobupivacaine	Good analgesia, postblock hypotension

(Continued)

Table 3. (Continued)

Case Types	N	Surgery	Timing/ Indication	Site of Injection	Injectate	Results
Obstetric and gynaecological surgery Jadon <sup>54</sup>	1	Hysterectomy	Perioperative analgesia	Anterior quadratus lumborum block	Bilateral bolus through catheter: 25 ml of 0.3% ropivacaine	Good analgesia
Sebbag <i>et al.</i> <sup>55</sup>	3	Cesarean delivery	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral 30 ml of 0.25% ropivacaine	Good analgesia
Wikner <sup>68</sup>	1	Gynecological laparoscopy	Perioperative analgesia	Lateral quadratus lumborum block	40 ml of 0.25% levobupivacaine	Motor block on left side involving hip and knee for 18 h, delaying discharge; sensory block right: T7–L1; left: T7–L2 Excellent analgesia
Ben-David <i>et al.</i> <sup>56</sup>	1	Uterine artery embolization	Perioperative analgesia	Lateral quadratus lumborum block	Bilateral 20 ml of 0.375% ropivacaine	T10–L2, oxycodone 50 mg until postoperative day 2
Lower limb surgery Hockett <i>et al.</i> <sup>16</sup>	1	Total hip arthroplasty	Perioperative analgesia	Posterior quadratus lumborum block	Bolus through catheter: 15 ml of 0.5% lidocaine; infusion: 7 ml/h 0.2% ropivacaine	T12–L2 sensory block, oxycodone 80 mg in first 48 h
Johnston and Sondokoppam <sup>20</sup>	1	Revision hip arthroplasty	Perioperative analgesia	Anterior quadratus lumborum block	Bolus: 30 ml of 0.5% ropivacaine; infusion: 10 ml/h 0.2% ropivacaine	General anesthesia abandoned because of hemodynamic instability; remainder of case performed under regional anesthesia
Watanabe <i>et al.</i> <sup>45</sup>	1	Femoral–femoral bypass and bilateral foot amputation	Analgia/anesthesia	Posterior quadratus lumborum block (combined with lumbar plexus branch and parasacral sciatic blocks)	15 ml of 0.125% levobupivacaine	Initial numeric rating scale 0/10, mean 4–5/10 on postoperative day 1; sensory block T6–L2 to 24 h postoperatively
La Colla <i>et al.</i> <sup>12</sup>	2	Hip surgery (open reduction and internal fixation, femoral neck fracture); total hip arthroplasty	Perioperative analgesia	Lateral quadratus lumborum block	0.5% ropivacaine + 20 µg dexmedetomidine + 4 mg dexamethasone: 20 or 30 ml	Sensory block T9–L2 dermatomes
Ohgoshi <i>et al.</i> <sup>57</sup>	2	Hip arthroplasty	Perioperative analgesia	Anterior subcostal quadratus lumborum block	Bolus through catheter: 20 ml of 0.375% ropivacaine	T11–L4; T12–L2
Ueshima <i>et al.</i> <sup>17</sup>	2	Total hip arthroplasty	Perioperative analgesia	Anterior quadratus lumborum block	Bolus: 25 ml of 0.3% levobupivacaine infusion: 6 ml/h 0.125% levobupivacaine + 3 ml of bolus	No supplemental sedation or analgesics required
Ueshima and Otake <sup>43</sup>	2	Above knee amputation	Surgical anesthesia	Anterior quadratus lumborum block (combined with sciatic nerve block)	20 ml of 0.375% levobupivacaine	Excellent analgesia without additional opioid requirements Excellent analgesia without opioid
Segura-Grau <i>et al.</i> <sup>58</sup>	1	Iliac and acetabulum fracture	Perioperative analgesia	Posterior quadratus lumborum block	Bolus through catheter: 20 ml of 0.25% levobupivacaine	Excellent analgesia without opioid
Spinal surgery Iwamitsu <i>et al.</i> <sup>66</sup>	3	Spinal fusion	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral bolus through catheter: 20 ml of 0.375% levobupivacaine	Excellent analgesia without opioid
Ueshima <i>et al.</i> <sup>66</sup>	2	Lumbar laminectomy	Perioperative analgesia	Posterior quadratus lumborum block	Bilateral 20 ml of 0.375% levobupivacaine	Excellent analgesia without opioid

(Continued)

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Table 3. (Continued)

Case Types	N	Surgery	Timing/ Indication	Site of Injection	Injectate	Results
Pediatric surgery Visoli and Yakovleva <sup>4</sup>	1	Colostomy closure, pediatric	Perioperative analgesia	Anterior quadratus lumborum block	Bolus through catheter: 10 ml of 0.5% ropivacaine	Sensory level to T10 maintained postoperatively; low pain scores, morphine 0.096 mg/kg required on Postoperative day 1 Good Analgesia
Aksu and Gürkan <sup>65</sup>	10	Inguinal hernia repair, pediatric	Perioperative analgesia	Anterior quadratus lumborum block	20 ml of 0.25% bupivacaine	Good analgesia
Yayik <i>et al.</i> <sup>60</sup>	1	Extracorporeal shock wave lithotripsy, pediatric	Perioperative analgesia	Anterior quadratus lumborum block	3 ml of 0.5% bupivacaine + 3 ml of 2% lidocaine	Good analgesia
Baldya <i>et al.</i> <sup>63</sup>	5	Pyeloplasty, pediatric	Perioperative analgesia	Anterior quadratus lumborum block	0.5 ml/kg 0.2% ropivacaine	Good analgesia
Chakraborty <i>et al.</i> <sup>15</sup>	1	Radical nephrec- tomy, pediatric	Perioperative analgesia	Anterior quadratus lumborum block	Bolus through catheter: 5 ml of 0.375% levobupivacaine Infusion: 5 ml/h 0.1% levobupivacaine	Sensory block T7–L2 maintained postoperatively, pain numeric rating scale 2/10, no systemic analgesics required (except for paracetamol)

NRS, numeric rating scale; ORIF, open reduction and internal fixation; PCA, patient controlled analgesia; POD, postoperative day; QL, quadratus lumborum; TAP, transversus abdominis plane; TEA, thoracic epidural analgesia.

reported, which may be related to local anesthetics spread to the paravertebral space.<sup>53</sup> Because of the doses used and the vascularity of the area, local anesthetic systemic toxicity is a potential risk,<sup>69,70</sup> although peak concentrations of local anesthetic are lower after quadratus lumborum blocks than transversus abdominis plane blocks.<sup>71</sup>

### Needle Trauma

The proximity of quadratus lumborum block to the pleura and kidney in the subcostal anterior approach presents a risk because of direct needle trauma.<sup>10</sup> The risks of bleeding complications are not yet known. There is no evidence for the stratification of the risk of bleeding based on quadratus lumborum approaches. The posterior and lateral quadratus lumborum block approaches use a fascial plane through which the abdominal branches of the lumbar arteries course. The anterior quadratus lumborum block is a deep block, close to the lumbar plexus and risks retroperitoneal spread of hematoma. Therefore, the authors recommend that, for all approaches, the American Society of Regional Anesthesia and Pain Medicine guidelines for deep peripheral blocks be followed.

### Conclusions

An understanding of the relevant anatomy and technical aspects of quadratus lumborum block are essential for its effective and safe use. Cadaveric studies demonstrate that the iliohypogastric and ilioinguinal nerves are consistently involved. Quadratus lumborum block approaches are named in reference to injection location in relation to the quadratus lumborum muscle. Current indications are based on few existing randomized controlled clinical trials and case reports (tables 2 and 3). Although the evidence base is weak and still growing, the data thus far suggest that quadratus lumborum block potentially results in extensive sensory blockade (T7–L2). Quadratus lumborum block may lead to dermatomal coverage required for abdominal surgery and hip surgery, representing an avenue for future research.

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