Chapter

53 Truncal Blocks

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A three-year-old, former 33-week premature infant with a history of an omphalocele presents with a ventral hernia. She is now scheduled for repair. Her laboratory testing is unremarkable. The surgeon is requesting a regional block for this procedure and wants to discuss the options.

What Are the Boundaries of the Anterior Abdominal Wall?

The anterior abdominal wall extends from the costal margin of the seventh to tenth ribs and xiphoid process to the iliac crests, inguinal ligament, and pubic crest/symphysis. The lateral borders are demarcated by the bilateral mid-axillary lines.

What Muscles Make Up the Anterior Abdominal Wall?

The anterior abdominal wall is made up of three concentric muscle layers. From superficial to deep, they are the external oblique muscle, internal oblique muscle, and the transversus abdominis muscle.

The rectus abdominis muscle is a pair of vertical muscles that run down the midline of the anterior abdominal wall.

Some individuals may also have a second midline muscle known as the pyramidalis.

How Is the Anterior Abdominal Wall Innervated?

The anterior abdominal wall is innervated by the T_6–T_{12} thoracoabdominal nerves. These nerves originate from the T_6–T_{12} spinal nerves and traverse across the neurovascular transversus abdominis plane that lies between the internal oblique muscle and the transversus abdominis muscle (Figure 53.1).

The ilioinguinal and iliohypogastric nerves arise from the L1 spinal nerve. These nerves emerge from the lateral border of the psoas muscles and travel superior and parallel to the iliac crest. They both eventually pierce the transversus abdominis muscles, though there is variability in the location at which they enter the transversus abdominis plane.

How Is the Rectus Sheath Formed?

The rectus sheath encompasses the rectus abdominis muscle anteriorly and posteriorly. The anterior rectus sheath is formed from the aponeurosis of the external oblique and the internal oblique muscles. The posterior rectus sheath is formed from the aponeurosis of the internal oblique and transversus abdominis muscles.

What Changes Occur in the Rectus Sheath below the Arcuate Line?

The lower limit of the posterior rectus sheath is the arcuate line. Inferior to this point, the aponeurosis of the external oblique, internal oblique, and transversus abdominis muscles all pass anterior to the rectus abdominis muscles.

What Are the Major Muscles That Comprise the Posterior Abdominal Wall?

The muscles of the posterior abdominal wall include the latissimus dorsi muscle, erector spinae muscle, quadratus lumborum muscle, and the psoas major.

The erector spinae muscle is comprised of three paraspinal muscles: the iliocostalis muscle, the longissimus muscle, and the spinalis muscle.

What Is the Significance of the Thoracolumbar Fascia?

The thoracolumbar fascia encloses the deep muscles of the back. It is comprised of three layers: anterior,

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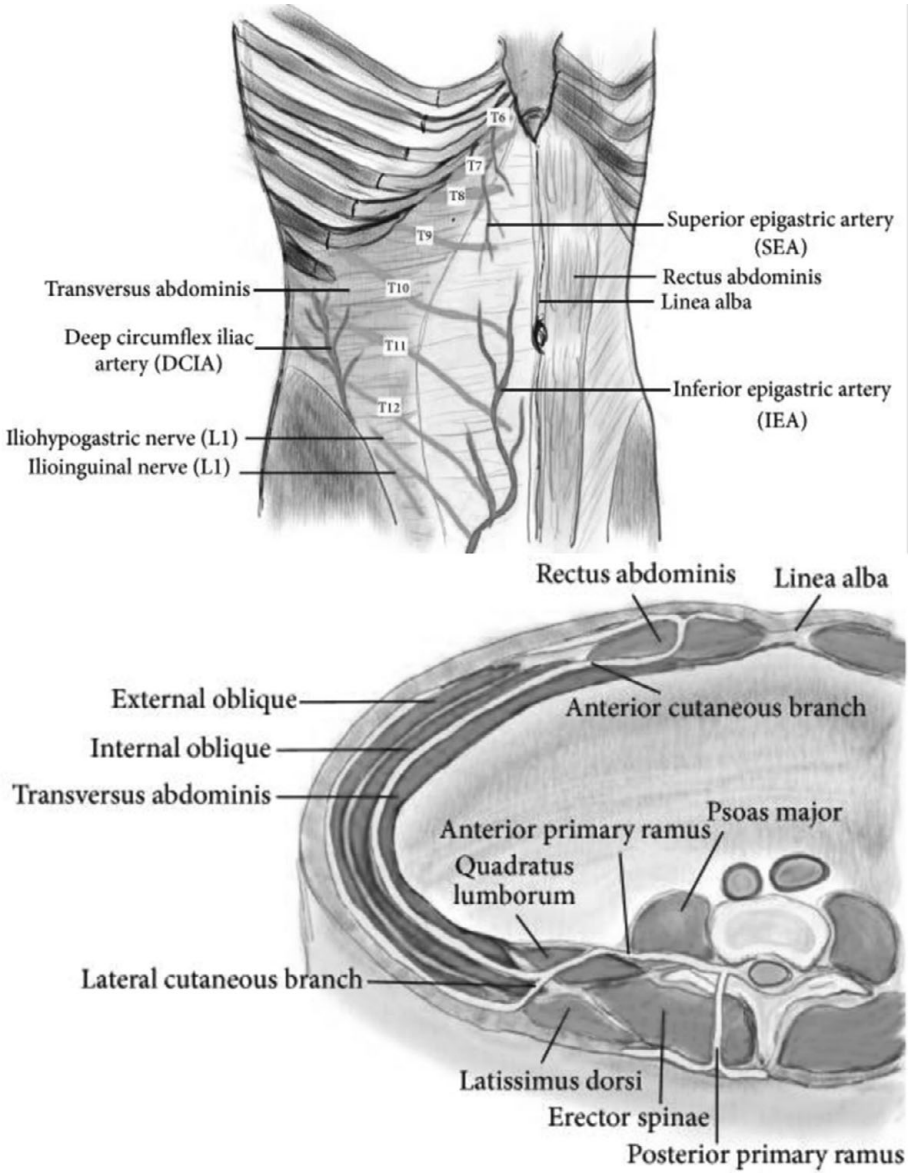

Figure 53.1 Anatomy of the anterior abdominal wall. Reproduced from Tsai H-C, Yoshida T, Chuang T-Y, et al. Transversus abdominis plane block: An updated review of anatomy and techniques. *BioMed Research International*, 2017, Article ID 8284363, under CC BY 4.0 license https://creativecommons.org/licenses/by/4.0/

middle, and posterior. The anterior layer is often referred to as the "transversalis fascia" and lies on the anterior surface of the quadratus lumborum muscle. It is thought that the thoracolumbar fascia may serve as a conduit for local anesthetic spread when performing the quadratus lumborum block.

What Are Commonly Performed Truncal Blocks?

- Transversus abdominis plane block
- Rectus sheath block
- Ilioinguinal-iliohypogastric block

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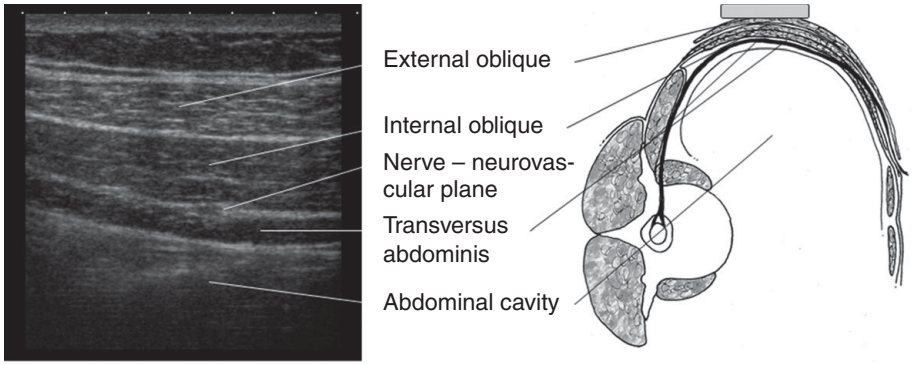

Figure 53.2 Abdominal wall anatomy. Reproduced with permission from Arthurs G, Nicholls B (eds.) 2016. *Ultrasound in Anesthesia, Critical Care, and Pain Management*. Cambridge, UK: Cambridge University Press

Figure 53.3 Ultrasound probe and needle position for transversus abdominis plane block. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

- Paravertebral block
- Quadratus lumborum block
- Erector spinae block

What Is a Transversus Abdominis Plane Block?

A transversus abdominis plane (TAP) block provides somatic analgesia for the anterior abdominal wall by targeting the thoracoabdominal nerves (T_6–L_1). There are multiple approaches to performing the TAP block including the subcostal, oblique-subcostal, and lateral techniques. The lateral technique is used more commonly and is the easiest to perform. The patient is placed in the supine position for all approaches. The probe is held in the transverse position (i.e., parallel to the costal margin and iliac crest) and lies anywhere between the midaxillary to midclavicular line. The needle is inserted lateral to the probe, with the ultimate target for local anesthetic deposition being the transversus abdominis plane – which lies deep to internal oblique muscle and superficial to the transversus abdominis muscle (Figures 53.2–53.4).

What Are the Indications for a TAP Block?

The TAP block provides somatic analgesia for abdominal surgeries including laparoscopic surgeries, laparotomies, and caesarean sections.

What Is the Rectus Sheath Block?

The rectus sheath block provides somatic analgesia for midline incisions in the anterior abdominal wall by targeting the terminal branches of the thoracoabdominal nerves (T_{9-11}). These nerves lie in the plane deep to rectus abdominis muscles and superficial to the posterior rectus sheath. The probe is held in the transverse orientation – superior to the umbilicus and lateral to the linea alba (Figures 53.5–53.7).

In What Surgeries Would a Rectus Sheath Block Be Useful?

Rectus sheath blocks are commonly used for surgeries that involve midline incisions. These include umbilical hernia repairs, pyloromyotomies, and laparoscopic procedures with midline port insertions.

What Is the Ilioinguinal-Iliohypogastric Block?

The ilioinguinal and iliohypogastric nerves arise from L_1. They may occasionally also have contributions

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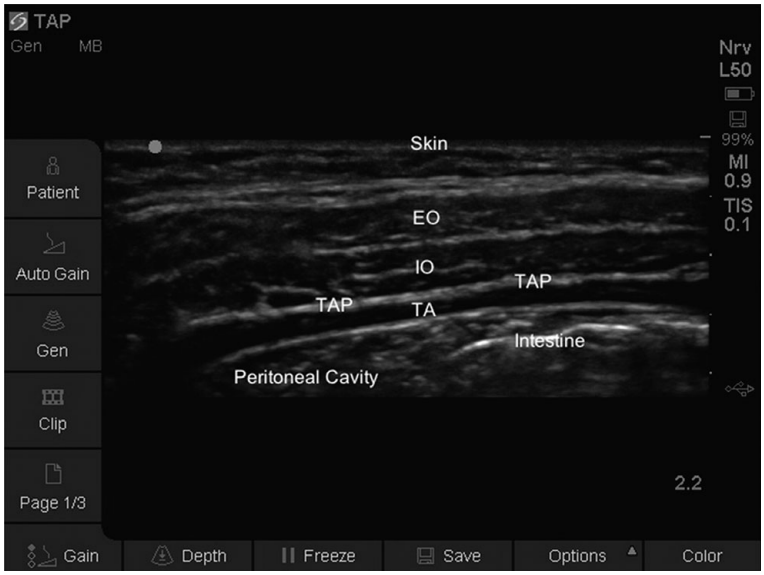

Figure 53.4 Ultrasound image of transversus abdominis plane block. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

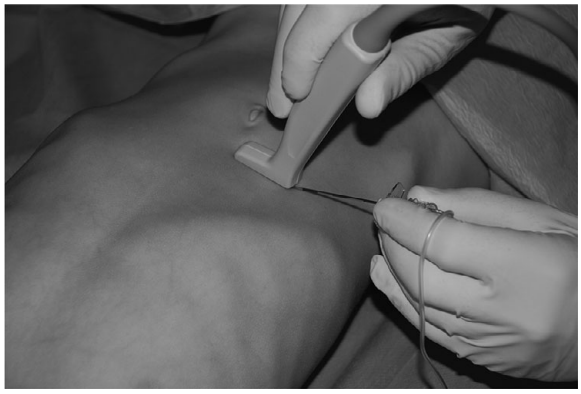

Figure 53.5 Ultrasound probe and needle position for rectus sheath block. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

from T_{12}, L_2, and L_3. The ultrasound-guided ilioinguinal-iliohypogastric block targets these nerves as they lie in transversus abdominis plane. The probe is placed posterior and superior to the ASIS, parallel to the line between the ASIS and umbilicus. Here the external oblique, internal oblique, and transversus abdominis muscles can be visualized. Additionally, the acoustic shadow of the ASIS can be seen as well. The nerves are not always consistently visualized in this window, but injection of local anesthetic into the TAP plane at this level will provide for somatic analgesia at the level of the inguinal fossa (Figures 53.8 and 53.9).

What Surgeries Would Use an Ilioinguinal-Iliohypogastric Block?

Ilioinguinal-iliohypogastric blocks are classically used in inguinal hernia repairs and urology surgeries (e.g., orchiopexy).

What Is the Paravertebral Vertebral Space?

The paravertebral space is a potential space that extends from the cervical spine down to the lumbosacral spine. At the thoracic level, this triangular-shaped space is demarcated anteriorly by the parietal pleural, posteriorly by the costotransverse ligament, and medially by the posterolateral border of the vertebral body and intervertebral discs. The paravertebral space contains thoracic spinal nerves, the sympathetic chain, intercostal vessels, and fatty tissue.

What Is the Paravertebral Nerve Block?

The paravertebral nerve block is frequently used for perioperative analgesia associated with chest wall surgeries, rib fractures, and renal surgeries. The key landmark in the paravertebral nerve block is the costotransverse ligament, which forms the posterior border of the paravertebral space (Figures 53.11–53.12). Using a linear probe, the costotransverse ligament can be found using in-plane or out-of-plane approaches, though the out-of-plane

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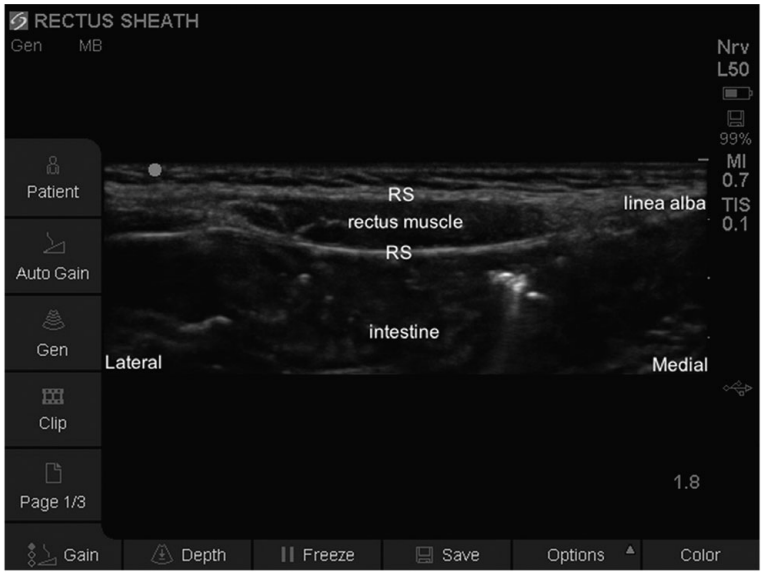

Figure 53.6 Ultrasound image of rectus sheath anatomy. RA, rectus sheath. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

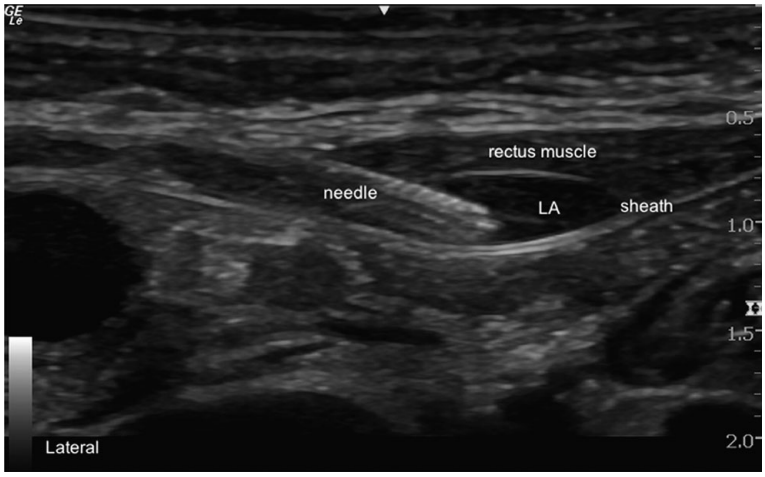

Figure 53.7 Ultrasound image of rectus sheath block. LA, local anesthetic. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

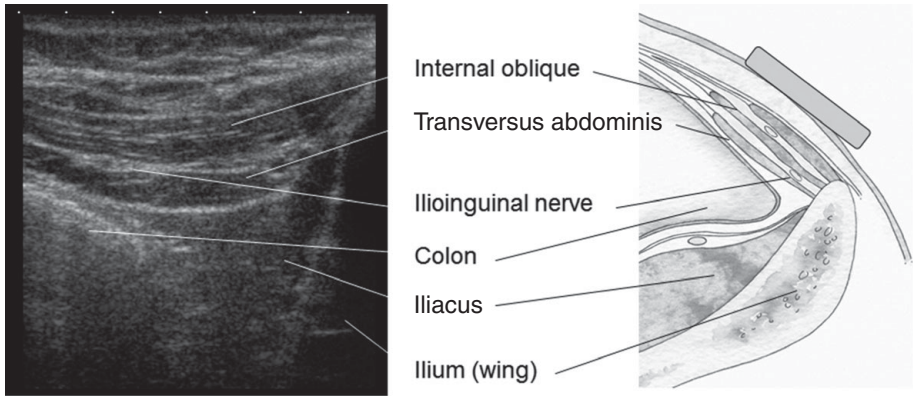

Figure 53.8 Ilioinguinal nerve anatomy. Reproduced with permission from Arthurs G, Nicholls B (eds.) 2016. *Ultrasound in Anesthesia, Critical Care, and Pain Management*. Cambridge, UK: Cambridge University Press

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approach is favored. The ultrasound probe is positioned along the mid-scapular line at the desired level. The layers of intercostal muscles are identified, and in between the transverse process is the hyperechoic costotransverse ligament. Local anesthetic is injected between the costotransverse ligament with subsequent downward displacement of the pleura.

What Is a Quadratus Lumborum Block?

The ultrasound-guided quadratus lumborum (QL) block deposits local anesthetic in or around the quadratus lumborum muscle (Figure 53.13). The block was first described as a "posterior TAP block," however, emphasis has since been placed on the QL muscle as the sonographic landmark and the role of the thoracolumbar fascia in the spread of local anesthetic.

There are four main approaches to the QL block, with names based on the location of the needle relative to the QL muscle.

- Lateral QL block
- Posterior QL block
- Anterior QL block
- Intramuscular QL block

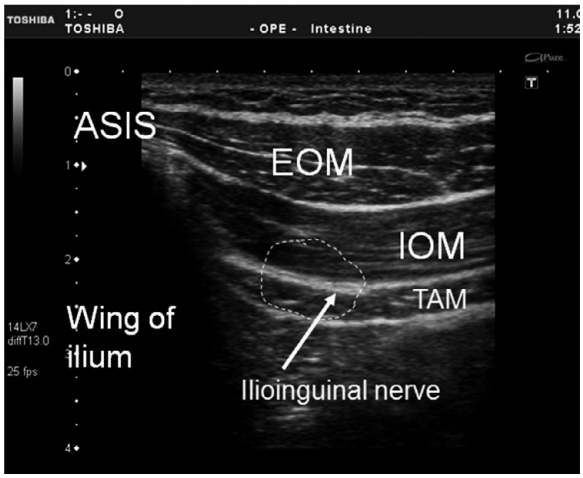

Figure 53.9 Ultrasound Ilioinguinal nerve block. ASIS, anterior superior iliac spine; EOM, external oblique muscle; IOM, internal oblique muscle; TAM, transversus abdominal muscle. Reproduced with permission from Arthurs G, Nicholls B (eds.) 2016. *Ultrasound in Anesthesia, Critical Care, and Pain Management*. Cambridge, UK: Cambridge University Press

Figure 53.11 Ultrasound probe and needle position for lateral paravertebral nerve block. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

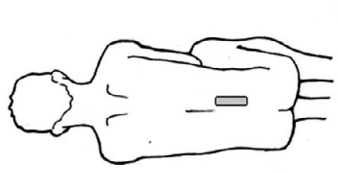

Figure 53.10 Ultrasound Ilioinguinal nerve block. ASIS, anterior superior iliac spine; EOM, external oblique muscle; IOM, internal oblique muscle; TAM, transversus abdominal muscle. Reproduced with permission from Arthurs G, Nicholls B (eds.) 2016. *Ultrasound in Anesthesia, Critical Care, and Pain Management*. Cambridge, UK: Cambridge University Press

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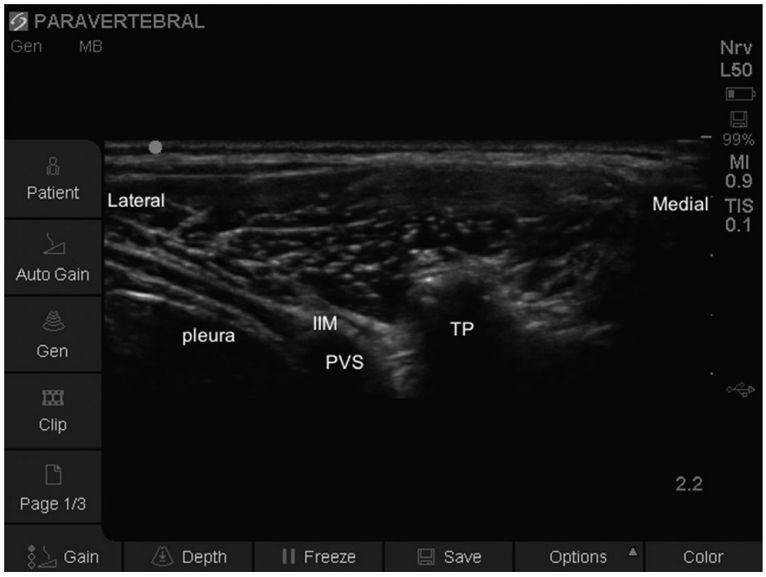

Figure 53.12 Ultrasound-guided lateral paravertebral nerve block. PVS, paravertebral space; IIM, internal intercostal membrane; TP, transverse process. Reproduced with permission from Mannion S, Iohom G, Dadure C, Reisbig MD, Ganesh A (eds.) 2015. *Ultrasound-Guided Regional Anesthesia in Children*. Cambridge, UK: Cambridge University Press

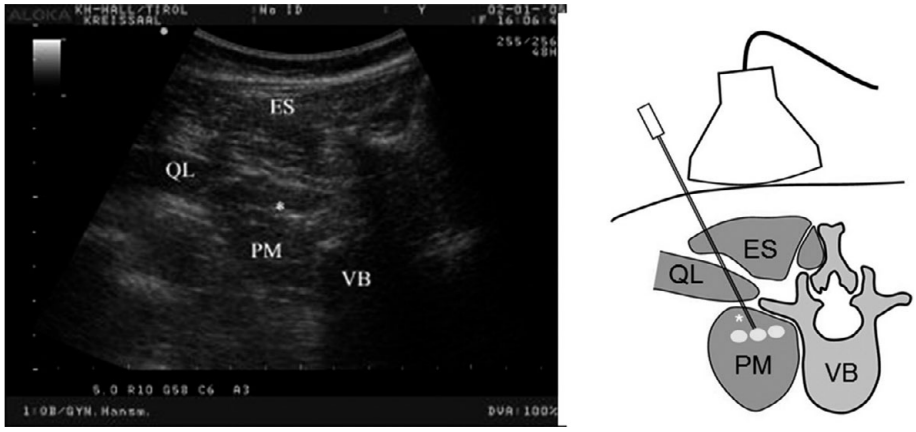

Figure 53.13 Cross-sectional view of lumbar plexus with "shamrock" sign. ES, erector spinae; PM, psoas major; QL, quadratus lumborum; VB, vertebral body. Reproduced with permission from Arthurs G, Nicholls B (eds.) 2016. *Ultrasound in Anesthesia, Critical Care, and Pain Management*. Cambridge, UK: Cambridge University Press

The lateral QL block is also known as the QL 1 block. The posterior QL block is also known as the QL 2 block. The anterior QL block is also known as the transmuscular or QL 3 block.

How Does the QL Block Work?

There is currently no consensus on the mechanism of local anesthetic spread for QL blocks. A common theory is that the thoracolumbar fascia likely acts as a conduit for spread of local anesthetic into the paravertebral space – which encompasses the sympathetic trunk and the ventral and dorsal rami of the spinal nerves.

Are there Advantages to the Quadratus Lumborum Block over the TAP Block?

With potential spread into the paravertebral space, the QL block may provide both somatic and visceral analgesia. In contrast, the TAP block provides only somatic analgesia.

What Are the Indications for a Quadratus Lumborum Block?

The QL block has been used for exploratory laparotomy, bowel resections, laparoscopic/open

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Figure 53.14 Probe positioning for erector spinae plane block (left). Ultrasound image of erector spinae plane block (right)

appendectomies, laparoscopic/open cholecystectomies, hysterectomies, cesarean sections, nephrectomies, and renal transplant surgeries.

The block has also been used in urologic surgeries, inguinal hernia repairs, iliac crest bone grafts, and hip surgeries.

What Is an Erector Spinae Muscle Block?

First described in 2016, the erector spinae block is an interfascial plane block that has been utilized in thoracic surgery, breast surgery, abdominal surgery, and hip surgery. The ultrasound probe is placed in the longitudinal position in the sitting or lateral position. The transverse process at the target level is identified and the needle is advanced in the cephalad to caudad through the trapezius, rhomboid major, and erector spinae muscles. The needle subsequently contacts the transverse process and local anesthetic is subsequently injected deep to the erector spinae muscle (Figure 53.14).

How Does the Erector Spinae Block Work?

Unlike the paravertebral block, the erector spinae plane block does directly penetrate the costotransverse ligament. The mechanism of action is thought to be diffusion of local anesthetic into the paravertebral space.

What Complications May Be Associated with Truncal Blocks?

- Intraperitoneal injection.
- Vascular trauma and/or injection.
- Pneumothorax.
- Pleural puncture.
- Epidural spread of local anesthetic.

What Is the ASRA/ESRA Recommended Dose of Truncal Blocks?

In 2018, ASRA/ESRA published recommendations for dosing ultrasound-guided blocks in pediatric patients. For fascial plane blocks, they recommend using 0.25–0.75 mg/kg of bupivacaine or ropivacaine.

What Are the Approaches to the Pectoralis Block?

From superficial to deep, the anterior chest wall comprises of the pectoralis major, pectoralis minor, and the serratus anterior muscle. The lateral pectoral nerve originates from the lateral cord of the brachial plexus and provides sensory innervation to the head of the pectoralis major. The medial pectoral nerve originates from the medial cord of the brachial plexus and innervates the pectoralis major and pectoralis minor.

The Pecs blocks are frequently used in breast surgery and have been reliably performed with

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ultrasound guidance. They are both interfascial plane blocks.

The Pecs-1 targets lateral and medial pectoral nerves. A linear probe is placed in the midclavicular line, and local anesthetic is deposited between the pectoralis major and pectoralis minor.

The Pecs-2 block targets the intercostal nerves and the long thoracic nerve. A linear probe is placed sagittally along the anterior axillary line and local anesthetic is deposited between the lateral edge of the pectoralis minor and the serratus anterior muscle.

Summary of Ultrasound-Guided Truncal Blocks

Table 53.1 Summary of the commonly performed truncal blocks

Block	Probe placement	Transducer orientation	Plane of injection	Clinical indications
Tap block	Midaxillary line, parallel to subcostal margin and iliac crest	Transverse	Between internal oblique and transversus abdominis	Somatic analgesia for incisions in upper and lower anterior abdominal wall
Rectus sheath block	Lateral to linea alba, superior to iliac crest	Transverse	Between rectus abdominis and posterior rectus sheath	Somatic analgesia for midline incisions in anterior abdominal wall
Ilioinguinal-iliohypogastric block	Posterior and superior to ASIS, parallel to line between ASIS and umbilicus	Transverse/ oblique	Medial to acoustic shadow of ASIS, between internal oblique and transversus abdominis	Somatic analgesia for incisions in the right or left iliac fossa of the abdomen
Pecs-1 block	Infraclavicular, in the midclavicular line	Transverse	Between the pectoralis major and pectoralis minor	Somatic analgesia for chest wall
Pecs-2 block	Anterior axillary line, over 3rd or 4th rib	Sagittal	Pectoralis minor and serratus anterior	Somatic analgesia for chest wall
Quadratus lumborum block	Parallel to the iliac crest, toward posterior axillary line	Transverse	Lateral, anterior, or posterior to QL muscle	Analgesia for abdominal wall
Paravertebral block	Lateral to spinous processes	Sagittal	Between the costotransverse ligament and pleura	Analgesia for thoracic and abdominal surgeries
Erector spinae block	Lateral to spinous processes	Sagittal	Between erector spinae and transverse process	Analgesia for thoracic surgeries

Suggested Reading

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