Chapter 32: Regional Anesthesia: Truncal Blocks

Susan E. Eklund; Walid Alrayashi

INTRODUCTION

FOCUS POINTS

1. Most peripheral nerve blocks in children are performed under general anesthesia.
2. Transversus abdominus plane (TAP) blocks may provide analgesia for lower abdominal surgery (T10-L1).
3. Complications associated with TAP blocks include peritoneal or bowel injury.
4. Quadratus lumborum (QL) blocks can block a wide range of dermatomes of the anterior abdominal wall, roughly T7-L1. In addition, spread to the paravertebral space can provide analgesia for peritoneal or visceral pain.
5. Rectus sheath blocks provide analgesia to the anterior abdominal wall and are often used as complements to TAP or QL blocks, especially above the umbilicus.
6. Paravertebral (PV) blocks are primarily used for thoracic surgeries.
7. Complications associated with PV blocks are related to the proximity of this deep space to the pleura (pneumothorax). Other complications are inadvertent vascular puncture or intrathecal/epidural injection.

As the name implies, truncal blocks deliver local anesthetic to nerve trunks, or bundles of nerves, rather than a specific, individual nerve. While trunks may form close to the spinal cord, they are bilateral rather than midline structures, and thus truncal blocks are unilateral. Also, since trunks are distal to the central nervous system, side effects of neuraxial blocks, such as urinary retention, nausea and vomiting, and bilateral motor blockade, can be avoided with truncal blocks.

Truncal blocks take advantage of tissue planes and allow for local anesthetics to spread within the plane to the intended neurovascular bundle or bundles. As with most regional blocks, the placement of truncal blocks is augmented using ultrasound, which has become the standard of care when performing most peripheral regional anesthetics.

LOCAL ANESTHETICS

The pediatric considerations, mechanisms, and metabolism of local anesthetics are covered in Chapter 8 and will not be repeated here. However, it is important to note that because truncal blocks are not targeting a specific nerve, but rather a plane, the spread of local anesthetic is crucial to the success of the block. Therefore, in smaller children and infants, it may be necessary to use a more dilute local anesthetic to increase the total volume of medication that may be delivered safely.[1] Dilute local anesthetic is usually effective in young, small children due to ongoing myelination at young ages that renders nerves susceptible to sodium channel blockade with lower concentrations.

BLOCK METHODOLOGY

As with many regional blocks, truncal blocks are often single-shot injections, but catheters may also be placed for continuous infusions or intermittent boluses. Equipment for truncal blocks is the same for other regional blocks: ultrasound with linear or curvilinear probe depending on target depth, sterile prep, drape, probe cover, short-beveled or Tuohy needle, catheter and supplies if applicable, sterile gloves, and local anesthetic.

As with many blocks performed in pediatric patients, truncal blocks in children are often performed with the patient under general anesthesia.[2,3] Most commonly, truncal blocks are performed with the needle in-plane with the ultrasound probe such that the needle may be visualized for the entire placement. To perform a single-shot block, a 22G short-bevel needle or similar is advanced to the plane where local anesthetic is to be deposited. Hydro-dissection with small aliquots of saline (0.5 to 1 mL) may be used to identify the potential space of the plane. If a catheter is to be placed, an 18G echogenic Tuohy needle is introduced, through which the initial dose of local anesthetic may be administered, followed by the catheter. In either case, the length of the needle and the type of ultrasound probe depend on the age and size of the patient; for an average-size adult, a medium-length needle is typically sufficient (80 mm) and a linear probe (10 to 15 Hz) provides enough depth to visualize the target plane.

TRANSVERSUS ABDOMINUS PLANE (TAP) BLOCK

Overview

Transversus abdominus plane (TAP) blocks are one of the most commonly performed truncal blocks for both pediatric and adult perioperative patients having abdominal surgery. Rafi first described the landmark technique in 2001,[4] and ultrasound guidance was then described by Hebbard et al in 2007.[5]

Anatomy

The classic landmark technique describes insertion of the needle in the lumbar triangle of Petit, posterior to the most superior aspect of the iliac crest. The internal oblique is the floor of the triangle and serves as a landmark for the neurovascular plane beneath which the T7-L1 neurovascular bundle travels. The correct plane is then identified by two “pops” through the fascial planes. With ultrasound guidance, the probe is initially positioned in the triangle of Petit. Using dynamic ultrasound scanning in the lateral-medial axis, the layers from superficial to deep can be identified as the adipose tissue, external oblique (EO), internal oblique (IO), and transversus abdominal muscle (TA) (Figures 32-1 and 32-2). The peritoneum can be identified by the presence of bowel loops seen below the transversus abdominus muscle.

Figure 32-1

Transverse section of abdominal wall. (Reproduced with permission, from Karmakar MK, Soh E, Chee V, et al., eds. *Atlas of Sonoanatomy for Regional Anesthesia and Pain Medicine*. 2018. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)

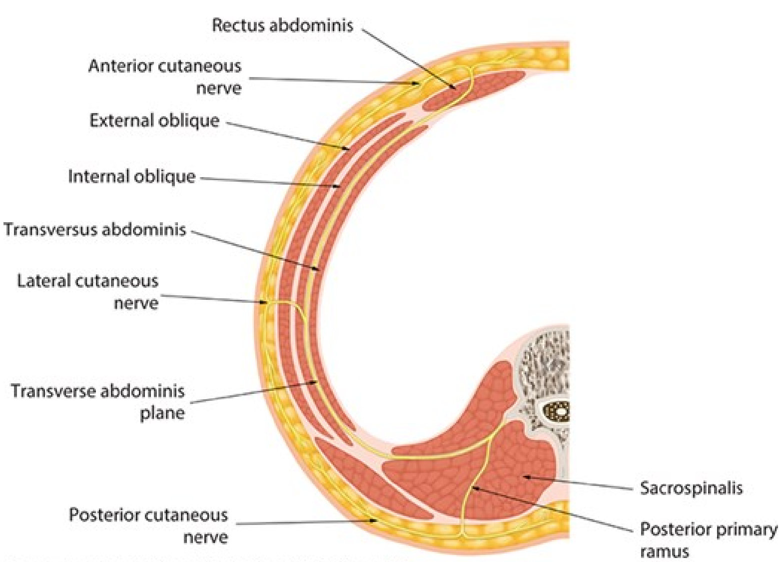

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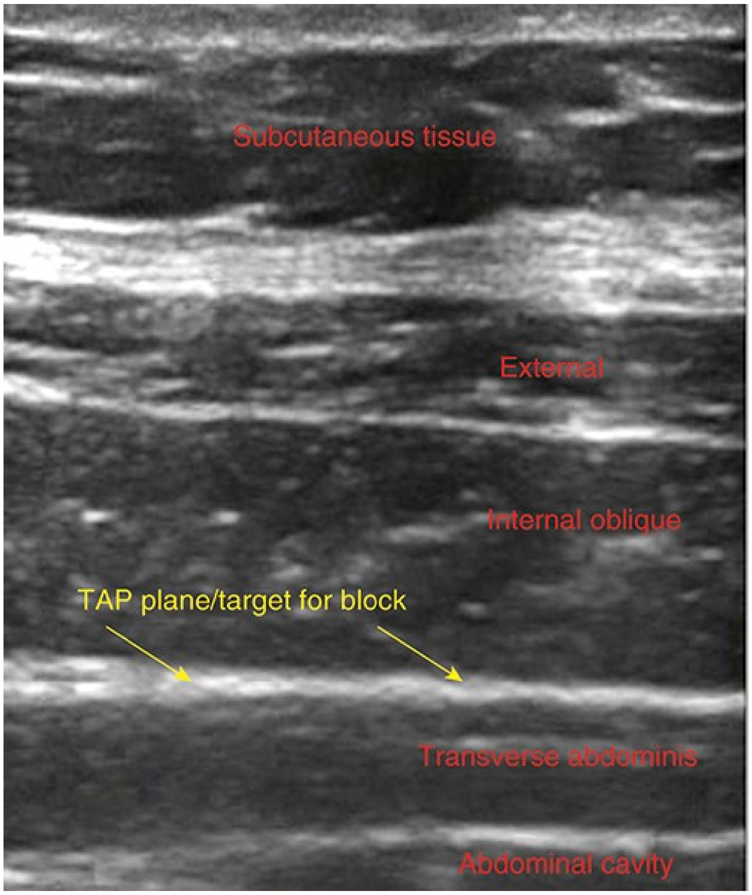
Figure 32-2

Ultrasound image for transversus abdominus plane (TAP) block. (Reproduced with permission, from Atchabahian A, Gupta R. *The Anesthesia Guide*. 2013. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)



Indications/Areas Covered/Surgery

TAP blocks may provide analgesia for lower abdominal surgery (T10-L1), including laparoscopic surgeries, colectomy or small bowel resection, ostomy creation or closure, and Pfannenstiel incisions. Oblique subcostal TAP blocks have been described,[6] and cover upper abdominal incisions' however, they are not commonly performed in pediatric patients.

Block Methodology

Most commonly, a TAP block is performed with the patient in the supine position, often post-operatively. For most patients, a linear probe provides adequate depth to visualize the plane between the internal oblique and transversus abdominus, where local anesthetic is deposited.

Specific Complications

Because of the depth of the internal oblique-transversus abdominus plane, peritoneal or bowel injury may occur with TAP blocks.

Considerations

Recent studies have called the efficacy of TAP blocks into question. While meta-analyses have shown some analgesic benefit overall, with reduced opiate consumption and pain scores, the effect sizes are small, the data both scant and heterogeneous, and clinical benefit still unclear.[7,8]

A posterior approach to the TAP block, which aims for local deposition closer to the quadratus lumborum, where the transversus abdominus muscle terminates at the thoracolumbar fascia, has been described to have more reliable analgesia up to T9 in a small group of children.[9]

QUADRATUS LUMBORUM BLOCK

Overview

The quadratus lumborum (QL) block deposits local anesthetic between the quadratus lumborum and the psoas major. It was first described by Blanco and McDonnell,[10] then modified as the "shamrock sign" technique by Sauter et al.[11] The QL block is a posterior extension of the TAP block, and allows for more reliable plane dosing of local anesthetic.

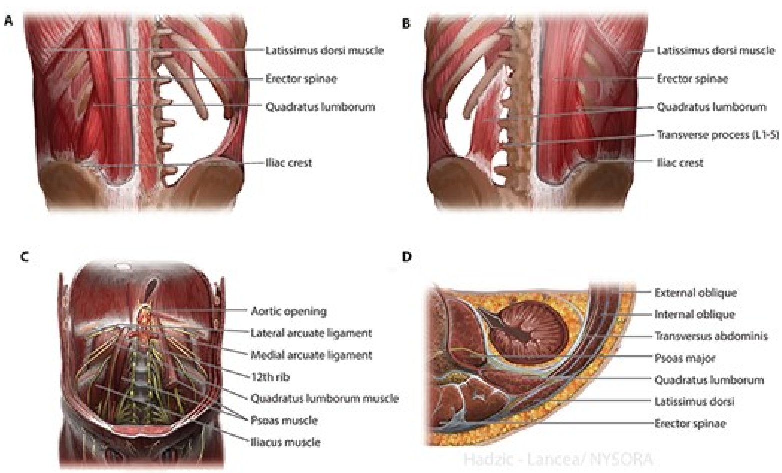
Anatomy and Indications/Areas Covered/Surgery—Surface, Nerves

Like TAP blocks, QL can block a wide range of dermatomes of the anterior abdominal wall, roughly T7-L1. Additionally, due to spread of local anesthetic to the paravertebral space, QL blocks can provide analgesia for peritoneal or visceral pain.[12,13]

QL blocks were initially described for superficial surgeries,[10] and unilateral surgeries,[13,14] but have been also described for laparotomies,[12,15] and hip and femur surgeries in both adults and children,[13,16] as well as Cesarean sections in adult women (Figure 32-3).[17]

Figure 32-3

The quadratus lumborum (QL) muscle in four views: **A.** QL muscle from the back covered by the erector spinae and latissimus dorsi muscles. **B.** QL muscle from the back, with ES and LD muscles removed to show the origin and insertion of the QL muscle. **C.** QL muscle from the front, on the left side the psoas muscle is cut, showing the ventral rami of the spinal nerve roots pass in front of the QL. **D.** QL muscle cross-section showing the surrounding muscles and the QL relation to the kidney. (Reproduced with permission, from Hadzic A. *Hadzic's Textbook of Regional Anesthesia and Acute Pain Management*, 2nd ed. 2017. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)



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Block Methodology

Local anesthetic is deposited with short-beveled single-shot needle or a 22G Tuohy needle.

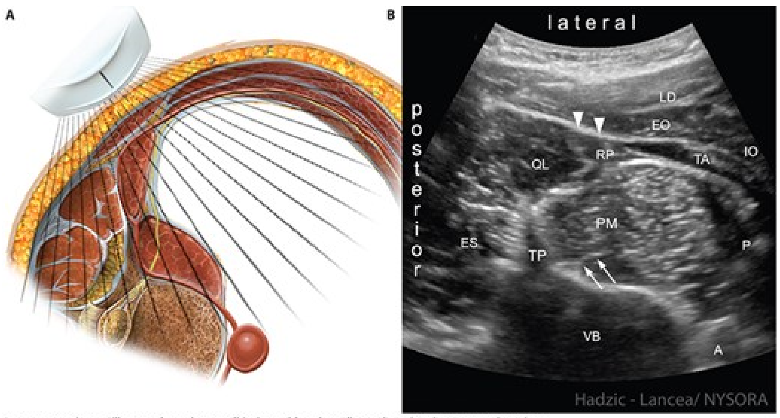
The patient may be positioned prone or lateral for the posterior approaches, or supine with an ipsilateral hip wedge ("sloppy lateral") for an anterior approach. For the posterior approach, a curvilinear probe provides optimal ultrasonographic imaging "shamrock" landmarks characteristic of QL block: the QL as it meets L4 transverse process (superficial), the erector spinae (posterior), and the psoas major (anterior).[11]

For the anterior approach, a linear probe is usually sufficient. The QL is identified in the posterior axillary line, where the thoracolumbar fascia joins the anterior surface of the QL. From this position, scanning anteriorly shows the TAP planes, which can be used to confirm position. Typical of many regional blocks, the needle is introduced in-plane.

The QL can be performed with three different approaches: QL1, QL2, and QL3 (Figure 32-4).

Figure 32-4

A. Lateral abdominal wall with ultrasound probe. **B.** Ultrasound image of the lateral abdominal wall. QL, quadratus lumborum; PM, psoas major; ES, erector spinae; TP, transverse process; VB, vertebral body (L4); TA, transverse abdominis; IO, internal oblique; EO, external oblique; LD, latissimus dorsi; RP, retroperitoneal space; P, peritoneal space; A, aorta; arrows, lumbar plexus; arrow heads, transversus abdominis aponeurosis. (Reproduced with permission, from Hadzic A. *Hadzic's Textbook of Regional Anesthesia and Acute Pain Management*, 2nd ed. 2017. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)



QL1

The needle is advanced anterior to posterior to the point where the abdominal muscles taper together and the QL muscle begins. LA is deposited at this junction, medial to the QL and lateral to the EO/IO/TAP muscles.

QL2

The needle is introduced in a similar fashion and location to the QL1. However, the local anesthesia is deposited more posterior and superficial, between the QL and the EO/erector spinae.

QL3

The QL3 uses a posterior approach, going through the paravertebral muscle, through the posterior-medial portion of the QL, and depositing local at the anterior thoracolumbar fascia, just superficial to the psoas major.

Considerations

As with TAP blocks, there is a risk of injury to the peritoneum and bowel. The kidney lies just anterior and deep to the QL beneath the perinephric fat bilaterally. The liver and spleen are near the block sites, particularly in small children where overall anatomy is small. The local vasculature includes lumbar branches from the aorta.

RECTUS SHEATH (RS) BLOCK

Overview

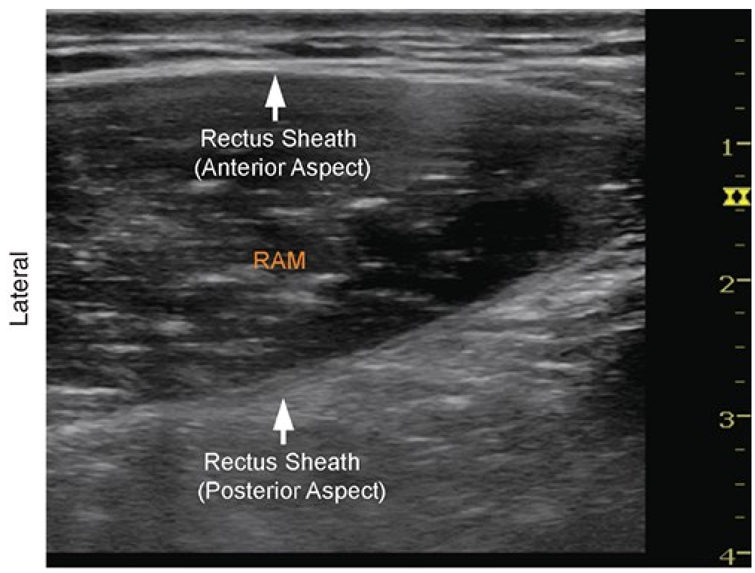
Rectus sheath (RS) blocks provide analgesia to the anterior abdominal wall and are often used as complements to TAP or QL blocks for the upper portion of the abdomen, often above the umbilicus. Its use was first described in children in 1996 by Ferguson et al.[18]

Anatomy/Block Technique—Surface, Nerves

While the anterior abdominal wall has innervation from T6-L1, the anterior rami of T8-11 contribute to periumbilical sensation and are the main target of the RS block. With the patient supine, local anesthesia is deposited between the posterior aspect of the rectus sheath and the anterior portion of the rectus abdominus muscle (Figure 32-5). The linea alba is a midline structure that can be identified with ultrasound to aid in placement of bilateral blocks. As with other blocks, catheter placement is feasible.[19]

Figure 32-5

Rectus sheath block. Labeled ultrasound anatomy of the rectus abdominis sheath. RAM, rectus abdominis muscle. (Reproduced with permission, from Hadzic A, eds. *Hadzic's Peripheral Nerve Blocks and Anatomy for Ultrasound-Guided Regional Anesthesia*, 2nd ed. 2012. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)



Rectus sheath block

Indications/Areas Covered/Surgery

Typically, the peri- and supra-umbilical trunks are targeted by RS blocks, while lower abdominal incisions are blocked with QL blocks (see Section "Quadratus Lumborum Block"). Candidates for RS blocks often include midline laparotomy with extension above the level of the umbilicus, certain subcostal incisions for liver surgery, and incisions above level of umbilicus.

Considerations

A meta-analysis of five studies by Hamill et al in 2016 showed benefit of RS block in children, although the researchers noted heterogeneous data.[7]

PARAVERTEBRAL (PV) BLOCK

Overview

The PV block was initially described in children by Lonnqvist in 1992.[20] Since that time, it has become a mainstay of pediatric regional anesthesia for a wide range of surgical procedures.[21] While initially it was performed using a landmark technique, use of ultrasound is now common practice.[22]

Anatomy

The PV block targets spinal nerves just lateral to the neuraxiom, before the formation of the intercostal and thoracoabdominal nerves (Figure 32-6). To perform the block, the patient is positioned in the lateral position with the operative side up. In the landmark technique, the transverse process is identified, and the paravertebral space is found by “walking off” the needle in the caudal direction until a loss of resistance is appreciated. While Marhofer and colleagues initially described an out-of-plane ultrasound-guided placement of PV block in adults in 2010,[23] Boretsky and colleagues described in-plane ultrasound-guided technique in children in 2013.[22] In the in-plane technique, the ultrasound is positioned over the spinous process, then moved just lateral to show the transverse process and pleura (Figure 32-7). The needle is continuously visualized as it is advanced in-plane lateral to medial through the erector spinae and intercostal muscles toward the lower portion of the transverse process. Just beyond the internal intercostal membrane, small aliquots of normal saline are used to assess depression of the pleura to confirm needle tip position in the paravertebral space. Once confirmed, local anesthetic may be administered and a catheter placed, if desired.

Figure 32-6

Paravertebral region. (Reproduced with permission, from Karmakar MK, Soh E, Chee V, et al., eds. *Atlas of Sonoanatomy for Regional Anesthesia and Pain Medicine*. 2018. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)

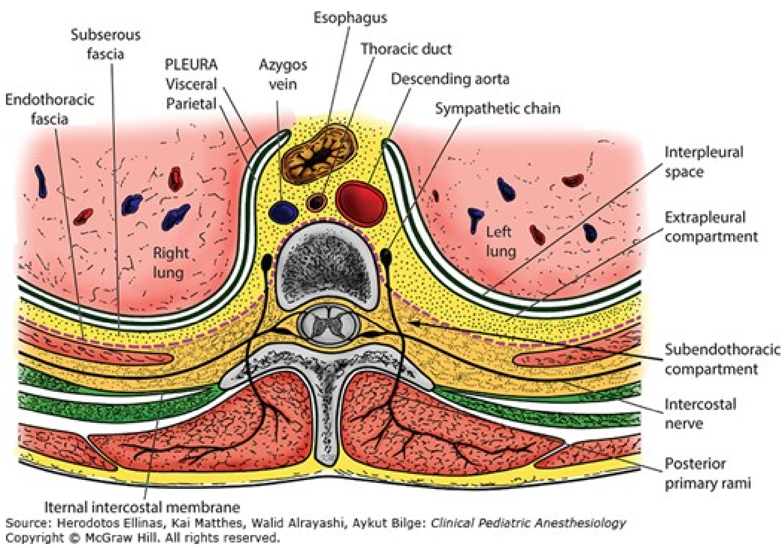
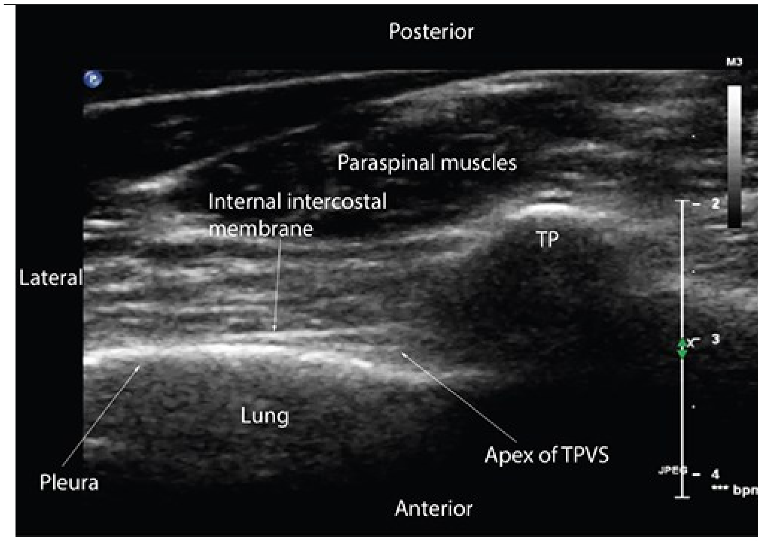


Figure 32-7

Ultrasound thoracic paravertebral region. Transverse sonogram of the right thoracic paravertebral region using a high-frequency linear transducer with the ultrasound beam being insonated over the transverse process. Note how the acoustic shadow of the transverse process (TP) obscures the thoracic paravertebral space (TPVS). The hypoechoic space posterior to the parietal pleura and anterolateral to the TP is the apex of the TPVS, or the medial limit of the posterior intercostal space. (Reproduced with permission, from Karmakar MK, Soh E, Chee V, et al., eds. *Atlas of Sonoanatomy for Regional Anesthesia and Pain Medicine*. 2018. https://accessanesthesiology.mhmedical.com. Copyright © McGraw Hill LLC. All rights reserved.)



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Indications/Areas Covered/Surgery

PV blocks are primarily used for thoracic surgeries; however, they have been used in wide-ranging surgeries in the entire thoracoabdominal region, including laparotomy; ostomy creation and take-down; liver, kidney, and lung transplantation; periacetabular osteotomy; ventral and inguinal hernia repair; and several others.[24]

Specific Complications/Contraindications

As the paravertebral space is a deep potential space, bleeding concerns are similar to that of neuraxial anesthetics. In the thoracic region, pneumothorax is a concern.[24]

ERECTOR SPINAE PLANE (ESP) BLOCK

Overview

Erector spinae plane (ESP) blocks are an emerging regional anesthetic modality first described in 2016,[25] which deposits local anesthetic between the erector spinae muscle and the underlying transverse process. Thus far, ESP blocks have been predominately described in case series and case reports; however, initial data for analgesia for several types of surgery are promising.[25–31]

Anatomy

The erector spinae muscles lie along each side of the spine, superficial to the transverse processes (TPs). ESP blocks are hypothesized to anesthetize the dorsal and ventral rami of thoracic nerves and the sympathetic chain.[29,31]

Indications/Areas Covered/Surgery

ESP blocks have been described for surgeries at all thoracoabdominal dermatomes (cervical, thoracic, lumbar), with a predominance in thoracotomies or rib fractures as well as hip and femur surgeries.[29]

Block Methodology

ESP blocks are often performed with the patient in the lateral position, with the surgical or block side up. Prone positioning is another option. The ultrasound transducer is placed over the TP and the needle is introduced in-plane, through the erector spinae muscle to the TP. Local anesthetic is deposited such that the erector spinae muscle is hydro-dissected away from the TP. A catheter may be introduced during placement of the initial block for subsequent intermittent boluses or continuous infusion.

Considerations

Data about the safety and efficacy of ESP blocks are limited. Unlike PV blocks and neuraxial anesthetics, ESP blocks are placed in a more superficial plane, so there is theoretically enhanced safety in terms of bleeding risk; however, this has yet to be born out in the literature.

OTHER TRUNCAL BLOCKS

The serratus anterior, PECS I and II, and ilioinguinal blocks are also truncal blocks. While their use is more common in adults, use in pediatric patients is limited. In the case of ilioinguinal blocks, the ease of caudal blocks in infants and young children likely skews regional anesthetics toward caudal instead of truncal blocks.

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