Chapter 31: Regional Anesthesia: Upper and Lower Extremity Blocks

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INTRODUCTION

FOCUS POINTS

1. Contrary to adults, most pediatric peripheral nerve blocks are placed under general anesthesia.
2. Peripheral nerve block techniques in children are primarily used as an adjunct to general anesthesia for posteroperative analgesia.
3. The greatest immediate risk of peripheral nerve blocks is local anesthetic systemic toxicity from inadvertent intravascular injection.
4. The interscalene block is most optimal for procedures of the shoulder. It may not be ideal for procedures of the forearm and hand because of the chance of ulnar sparing.
5. The supraclavicular block provides a dense blockade from the humerus to the hand.
6. The infraclavicular block provides good analgesia from the humerus to the hand and is conducive for indwelling catheter placement.
7. The axillary approach to the brachial plexus is optimal for procedures distal to the elbow. It misses the musculocutaneous nerve, which needs to be blocked separately.
8. The femoral nerve block can be used for many surgical techniques involving the thigh and knee, such as skin grafts, mid to distal femur osteotomies, and knee arthroscopies. It can also serve as an adjunct to procedures distal to the knee requiring analgesia to the medial aspect, which is innervated by the saphenous nerve.
9. The sciatic nerve can be blocked at multiple locations along its course. It is useful for surgical procedures of the hip, thigh, and knee. It is very useful for procedures of the distal lower extremity but needs to be supplemented with a saphenous nerve block for complete analgesia.
10. The lumbar plexus provides coverage of three peripheral nerves (femoral, obturator, and lateral femoral cutaneous) at a very proximal location, making it a good block for proximal femur and hip procedures.

The advancement in ultrasound technology and development of pediatric appropriate equipment have led to the increased use of regional anesthesia in infants and children. Additionally, the increased awareness of the potential neurotoxic effects of certain anesthetic agents on the developing brain has further prompted interest.[1] Although pediatric regional anesthesia is mostly used as an adjunct to general anesthesia or to provide postoperative analgesia, many techniques can be used as an alternative to general anesthesia when it may be difficult or dangerous. It can also be used in the treatment of a variety of acute and chronic pain conditions. The Pediatric Regional Anesthesia Network (PRAN), and the French-Language Society of Pediatric Anesthesiologist (ADARPEF) multi-institutional projects reporting the use and incidence of complications of pediatric regional anesthesia, has concluded that regional anesthesia can be commonly performed in children at a very low complication rate.[2–4]

INDICATIONS

The choice of anesthesia and regional anesthetic techniques are determined by the comorbidities of the patient and with in-depth consideration of the potential risks and benefits. Important considerations include the type of surgery, surgeon preference, the experience of the anesthesiologist, and the physical and cognitive state of the patient.[5] Peripheral regional nerve blockade can improve postoperative pain and patient and/or parent satisfaction. Additionally, it can reduce general volatile anesthetics requirements thereby potentially reducing neurotoxcity, providing benefits in patients with a history of postoperative nausea and vomiting, and improving intraoperative hemodynamic stability in patients with a tenuous hemodynamic status.[6]

CONTRAINDICATIONS

Absolute contraindications include patient or parental refusal, infection at the injection site, and an allergy to local anesthetics. Most other contraindications are relative and require weighing the risks and benefits to determine if the patient is a good candidate. Bleeding diatheses, resulting from genetic or acquired defects, increase the risks of hematomas with peripheral nerve blocks. Blood stream infections are also relative contraindications. Although most anesthesiologist may perform a single injection nerve block, catheter placement should generally be avoided in true bacteremia. Lastly, patients with preexisting peripheral neuropathies may be at increased risk for permanent nerve damage with nerve blockade.

SPECIFIC PEDIATRIC CONSIDERATIONS

There are distinct differences between adult and pediatric regional anesthesia. A major difference is that regional anesthesia is usually performed under general anesthesia or deep sedation. Anatomic structures are smaller and in closer proximity to each other and to vessels. Therefore, equipment should be appropriate for the patient size in order to increase safety. Also, there is a lower concentration of plasma protein binding in infants so meticulous attention to dosing is warranted to minimize the risk of local anesthetic toxicity.

CHOICE OF ANESTHETIC AND DOSING

The majority of pediatric regional anesthesia is performed with either 0.25% bupivacaine or 0.2% ropivacaine. At these concentrations, the degree of motor blockade is generally minimal while providing good sensory analgesia. For continuous infusions through a catheter, bupivacaine or ropivacaine concentrations of 0.1% to 0.125% are usually effective. In pediatric patients, the dose of local anesthetic is weight dependent. Higher concentrations of bupivacaine or ropivacaine (0.5%) can be used during surgical anesthesia where greater motor blockade is required, but with careful attention to patient size and toxic dosing limits. Since the greatest risk of regional anesthesia in children is local anesthetic toxicity, the total dose of bupivacaine should not exceed 3 mg/kg. The risk is highest during the initial bolus, thus the lowest effective volume and concentration should be used. For continuous infusions, it is recommended that the dose of bupivacaine be less than 0.3 to 0.4 mg/kg/h in children and less than 0.2 to 0.25 mg/kg/h in infants less than 6 months of age.[7,8] Late signs and symptoms of local anesthetic toxicity (seizures, arrhythmias, cardiovascular collapse) may be the only indication of a problem since most pediatric regional techniques are performed under general anesthesia. Treatment consists of airway management, seizure suppression, management of cardiac arrhythmias, and administration of intralipid. The initial bolus dose of 20% intralipid is 1.5 mL/kg followed by a continuous infusion started at 0.25 mL/kg/min, which can be doubled to achieve cardiac stability.[9]

UPPER EXTREMITY BLOCKS

The brachial plexus can be blocked at several sites. It originates from the C5 through T1 nerve roots and forms trunks, divisions, cords, and finally terminal nerves. The brachial plexus provides complete sensory and motor innervation of the arm, except the medial and posterior proximal upper arm, which is innervated by the intercostobrachial nerve (T2).[10]

Interscalene Brachial Plexus Block

Background and Indications

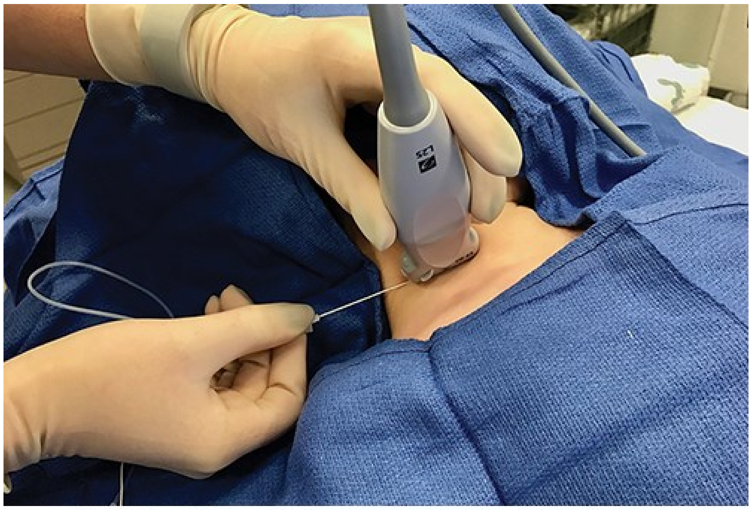
The interscalene brachial plexus block targets the roots and proximal trunks as they emerge between the anterior and middle scalene muscles at the level of the cricoid cartilage. It provides anesthesia to the upper arm and shoulder and is therefore useful for surgeries of the proximal humerus and shoulder. However, it may not consistently anesthetize the ulnar distribution of the upper extremity since the inferior roots are frequently missed.[11,12]

Patient Position

The patient is supine with the head turned away from the operative side (Figure 31-1).

Figure 31-1

Interscalene surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)



Equipment

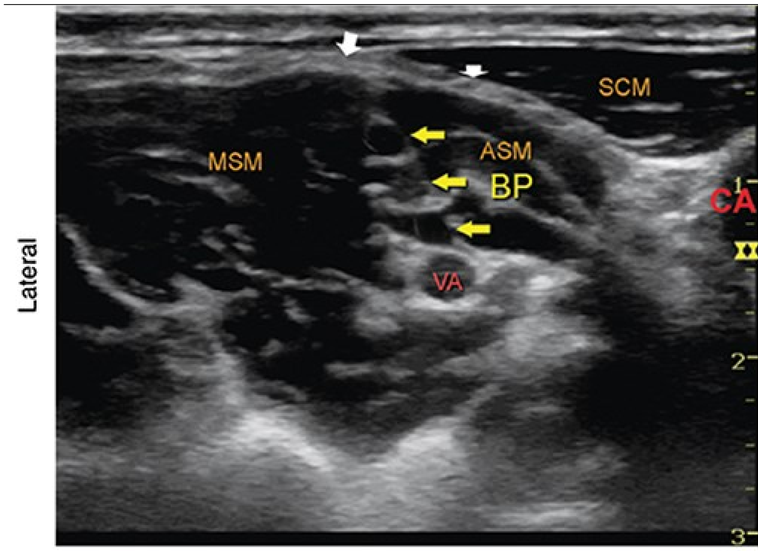
A high-frequency linear transducer (10 to 18 MHz) with a small footprint is recommended depending on the size of the patient. A 22–24G, 2-in., blunt needle can be used.

Technique

The transducer is placed in a transverse oblique orientation in the supraclavicular fossa. Once the subclavian artery and brachial plexus are identified, the ultrasound probe is then moved cephalad to the level of C6 where the brachial plexus roots and/or trunks can be visualized as hypoechoic circles between the anterior and middle scalene muscles (Figure 31-2). The needle is inserted in-plane with the probe and advanced from lateral to medial toward the roots. Once the needle is adjacent to the roots, local anesthetic is injected, after negative aspiration, in small 2- to 3-mL aliquots until circumferential spread around the plexus is achieved. Catheters can be placed via an insulated stimulating Tuohy needle and should be directed slightly more cephalad.

Figure 31-2

Interscalene nerve block ultrasound image. (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.)



Interscalene brachial plexus

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Local Anesthetic

Total volume is dependent on the size and weight of the patient. Typically, 0.2 to 0.3 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine provides an effective analgesic block. The total dose should not exceed 3 mg/kg.

Complications

The interscalene block has multiple potential adverse effects. The close proximity of the vertebral artery increases the risk of intraarterial injection and seizures. Inadvertent intrathecal or epidural injection can occur due to the proximity of the vertebral column. Other side effects include blocking other nearby nerves such as the phrenic nerve, which can lead to hemidiaphragm paralysis and respiratory failure in patients with inadequate pulmonary reserve. Other nerves that can be blocked include the recurrent laryngeal nerve resulting in unilateral vocal cord paralysis (dyspnea and hoarseness), and sympathetic chain blockade leading to Horner's syndrome (ptosis, anhidrosis, and myosis).

Supraclavicular Brachial Plexus Block

Background and Indications

The supraclavicular approach targets the trunks and/or divisions where they pass between the first rib and clavicle. The plexus is tightly oriented at this level and blockade produces excellent anesthesia of the humerus, elbow, forearm, and hand. It is mostly used for surgical procedures distal to the shoulder.

Patient Position

The patient is supine with the head turned away from the operative side.

Equipment

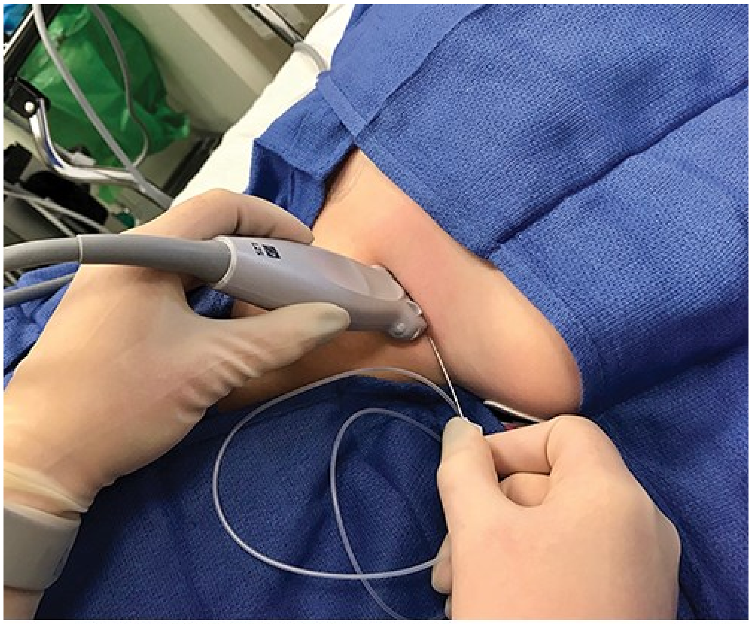
A high-frequency linear transducer is recommended depending on the size of the patient. A 21–23G, 2-in., blunt, simulating needle can be used.

Technique

The transducer is placed in a transverse orientation in the supraclavicular fossa above the clavicle (Figure 31-3). Lateral to the subclavian artery and above the first rib and pleura, the brachial plexus is visible as a cluster of hypoechoic structures (Figure 31-4). The needle is advanced from the lateral end of the probe and directed in-plane toward the artery until the tip is deep to the plexus immediately above the first rib. After negative aspiration, injection of local anesthetic should lift the plexus superiorly off the first rib.

Figure 31-3

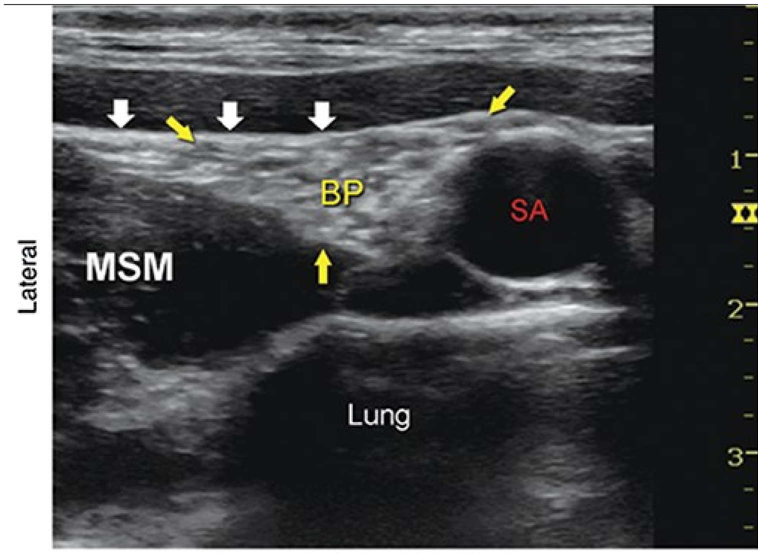
Supraclavicular surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)



Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-4

Supraclavicular nerve block ultrasound image. (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.)



Supraclavicular block

Local Anesthetic

Total volume is dependent on the size and weight of the patient. For most patients, 0.2 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is sufficient to produce an adequate block, whereas 0.5% concentrations can be used for surgical anesthesia and increased motor blockade.

Complications

Blockade of the plexus at this level can also cause recurrent laryngeal nerve and phrenic nerve paresis and Horner's syndrome. Given the proximity of the pleura and vascular structures, there is a risk of vascular puncture and pneumothorax.

Infraclavicular Brachial Plexus Block

Background and Indications

The infraclavicular approach blocks the cords of the brachial plexus where the cords surround the axillary artery. It can be used for surgeries involving the proximal humerus, elbow, forearm, and hand. This location is more conducive than the supraclavicular approach to the placement of catheters for postoperative analgesia, as the muscles provide a good anchor and has been shown to have reduced dislodgement rates.[13,14]

Patient Position

The patient is supine with the head turned away from the operative side. The arm is abducted and the elbow flexed at 90 degrees.

Equipment

A high-frequency 25-mm or 35-mm linear transducer is recommended depending on the size of the patient. A 21–23G, 2-in. or 4-in., blunt, stimulating needle can be used.

Technique

The transducer is oriented along the sagittal plane in the deltopectoral groove, medial and inferior to the coracoid process (Figure 31-5). The axillary artery is identified and if pleura is visualized, the probe can be moved laterally until pleura is no longer in view. The cords are hypoechoic structures located lateral, medial, and posterior to the artery (Figure 31-6). The needle is inserted in-plane at the cephalad border of the transducer and advanced caudally toward the cords. The needle should be advanced past the lateral cord to the posterior border of the artery where the posterior cord is located. Local anesthetic injection at this point will produce a U or horseshoe shape spread targeting all three cords of the brachial plexus. Upon withdrawing the needle, a second injection of local anesthetic anterior to the artery will ensure distribution of local anesthetic to all three cords. Catheters are best placed inferiorly to the plexus or between the lateral and posterior cords.

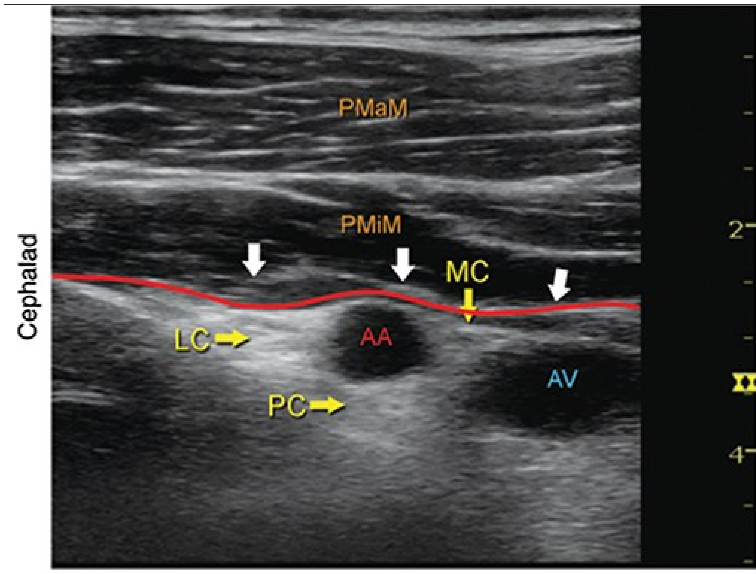
Figure 31-5

Infraclavicular surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-6

Infraclavicular nerve block ultrasound image. (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.)



Infraclavicular block

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Local Anesthetic

Total volume is dependent on the size and weight of the patient. For most patients, 0.2 to 0.3 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is required to produce effective blockade.

Complications

Pneumothorax and chylothorax (with a left-sided block) are possible. Inadvertent vascular puncture is also a risk given the proximity of the cords around the axillary artery.

Axillary Brachial Plexus Block

Background and Indications

The axillary approach to the brachial plexus targets the terminal branches consisting of the ulnar, median, radial, and musculocutaneous nerves. The ulnar, median, and radial nerves have variable positions around the axillary artery but typical locations are as follows: the median nerve lies superior, the radial artery lies deep or posterior, and the ulnar nerve lies inferior or superficial. The nerves can be visualized as hyperechoic cirlcles around the artery. The musculocutaneous nerve exits the nerve sheath early, appearing as a hyperechoic structure between the biceps and coracobrachialis muscles, and needs to be blocked separately. The axillary nerve block can be used for surgeries of the elbow, forearm, and hand. It may need to be supplemented with blockade of the musculocutaneous nerve, which innervates the lateral aspect of the forearm.

Patient Position

The patient is supine with the arm abducted 90 degress, externally rotated and the elbow flexed at 90 degrees.

Equipment

A high-frequency, 25- or 35-mm transducer is recommend depending on the size of the patient. A 21–23G, 2-in., blunt, stimulating needle can be used.

Technique

The transducer is positioned transverse in the axilla, perpendicular to the axis of the humerus (Figure 31-7). First, the axillary artery and vein should be visualized and then small adjustments are made to see the terminal nerves (Figure 31-8). The needle is inserted in-plane in a superior to inferior orientation. Due to the presence of septae within the sheath at this location, each nerve may need to be targeted separately. The needle is initially directed posteriorly to the axillary artery toward the radial nerve and local anesthetic is injected. The needle is then withdrawn and injection of local anesthetic around the median nerve and then ulnar nerve is complete. The needle can be redirected to target the musculocutaneous nerve with the injection of a small amount of local anesthetic.

Figure 31-7

Axillary surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)

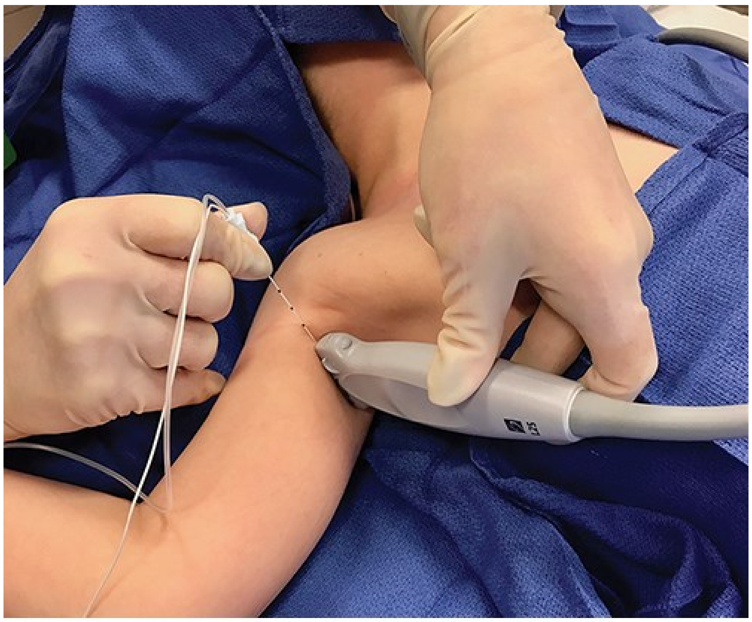


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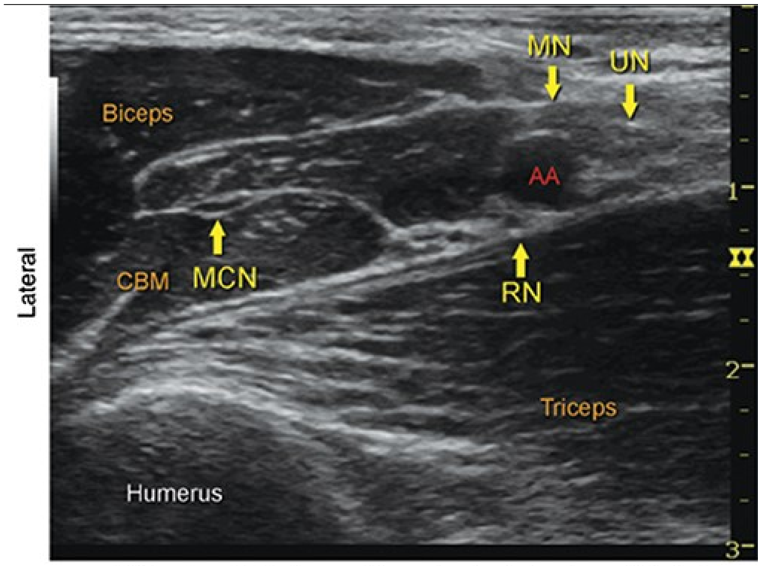
Figure 31-8

Axillary nerve block ultrasound image. (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.)



Axillary brachial plexus with anatomical structures labeled

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Local Anesthetic

Total volume is dependent on the size and weight of the patient. For postoperative analgesia, 0.2 to 0.3 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is adequate. Due to the precise targeting of individual nerves, only a small amount of local anesthetic is required at each nerve target. For the musculocutaneous nerve, 2 to 3 mL is sufficient.

Complications

The axillary approach is associated with a very low complication rate, provided intravascular injection is avoided.

LOWER EXTREMITY BLOCKS

There are several regional block techniques that can be used for surgeries of the hip, knee, foot, and ankle. Traditionally, the caudal approach was used to provide analgesia to the lower extremity. However, recent data supporting the efficacy and lower complication profile of peripheral nerve blocks versus the caudal block will most likely lead to the increasing use of peripheral nerve blocks.

Lumbar Plexus Nerve Block

Background and Indications

The lumbar plexus is derived from L1–4. It provides anesthesia to three main nerves including the femoral, lateral femoral cutaneous, and obturator nerves. The lumbar plexus block can provide anesthesia to unilateral surgical procedures involving the hip, pelvis, and femur.[15] It can be combined with a sciatic nerve block to provide complete anesthesia to the lower extremity. It is also a suitable alternative for patients who have a contraindication to a neuraxial technique.

Patient Position

The patient is at lateral decubitus position with the side to block upright and the knees and hips flexed (Figure 31-9).

Figure 31-9

Lumbar plexus positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Equipment

Depending on the size of the patient and the depth needed to penetrate, a high-frequency linear probe or a curved intermediate frequency probe can be used. Usually, a 21G, 4-in. stimulating needle is used, but in toddlers and very small children, a 21G, 2-in. needle may be adequate. An 18G Tuohy needle can be used for catheter placement.

Technique

It is recommended to use nerve stimulation with ultrasound guidance for the lumbar plexus block with the goal of achieving twitches of the quadriceps muscle at a threshold of 0.5 mA. There are multiple ultrasound-guided approaches to the lumbar plexus. There are various techniques to this block but we describe this one specifically for brevity.

Local Anesthetic

The volume of local anesthetic depends on the age/weight of the patient and the concentration on the desired density and motor blockade. Generally, a volume a 0.2 to 0.4 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is used and the dose should not exceed the maximum toxic dose.

Complications

Due to the proximity of neuraxial structures, there is a risk of epidural or spinal blockade if the needle is directed too medially. Although rare, local anesthetic toxicity from intravascular injection and retroperitoneal hematomas have been reported.

Femoral Nerve Block

Background and Indications

The femoral nerve block can be used to provide analgesia to the anterior thigh and knee and is typically combined with a sciatic nerve block to achieve complete analgesia distal to the mid-thigh.[16] It is useful for surgical procedures including knee arthroscopy, mid to distal femur fractures or osteotomies, and skin grafts or muscle biopsies. The lateral femoral cutaneous nerve also needs to be blocked if the lateral thigh is within the surgical field.

Patient Position

The patient is supine with the hip slightly externally rotated.

Equipment

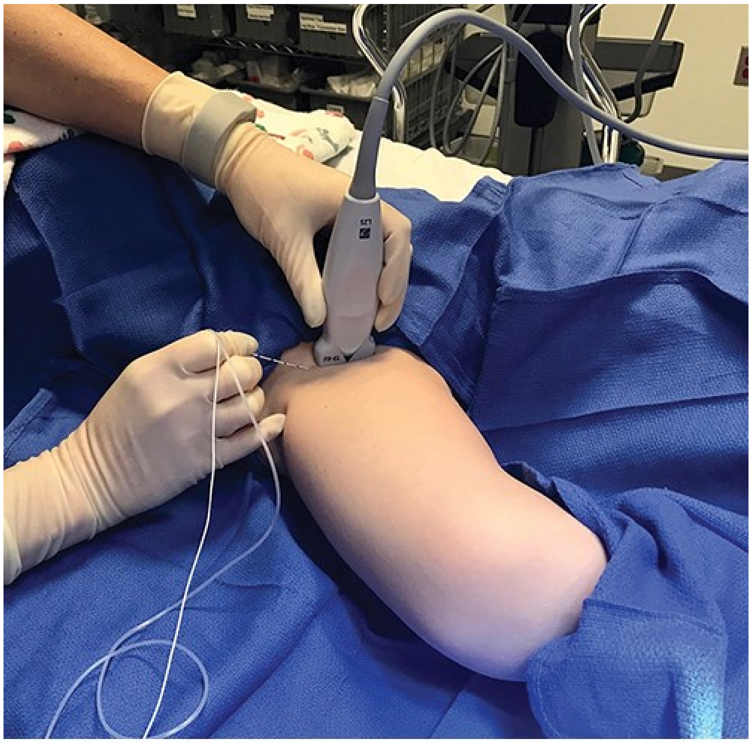
A high-frequency linear transducer and a 21–23G, 2-in., blunt, simulating needle is usually sufficient. An 18G insulated Tuohy needle can be used for catheter placement.

Technique

The transducer is placed in a transverse orientation in the inguinal crease (Figure 31-10). The femoral artery is identified and the nerve is lateral to the artery and deep to the fascia iliaca (Figure 31-11). The needle is inserted in-plane at the lateral end of the probe and advanced medially through the fascia iliaca toward the femoral nerve. A loss of resistance or “pop” may be felt as the needle passes through the fascia lata and fascia iliaca. The local anesthetic is injected and should be seen surrounding the nerve. If nerve stimulation is used, a quadriceps femoris muscle response is sought at a threshold of approximately 0.5 mA.

Figure 31-10

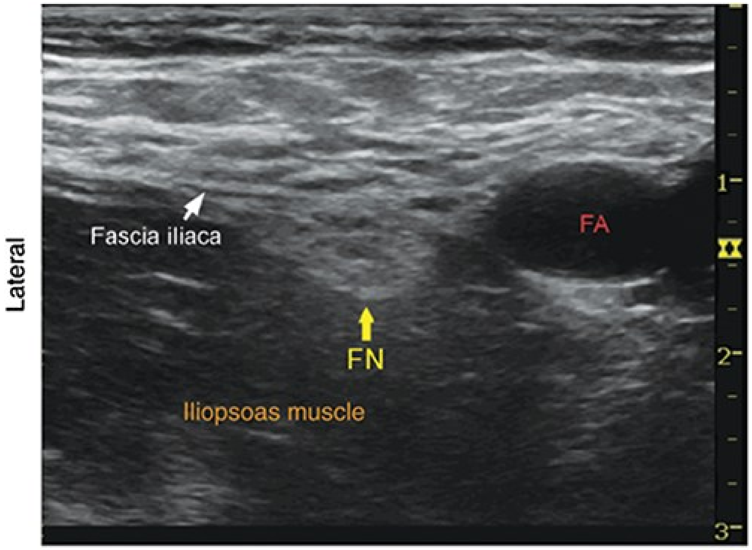
Femoral nerve block surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)



Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-11

Femoral nerve block ultrasound image. (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.)



Femoral nerve block

Local Anesthetic

The volume is dependent on the size of the patient and the concentration on the desired degree of motor blockade. Usually, 0.2 to 0.4 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is effective for postoperative analgesia.

Complications

Careful aspiration and incremental injection can help to avoid intravascular injection and local anesthetic toxicity. If an arterial puncture occurs, pressure should be held for 5 to 10 minutes to decrease the risk of a hematoma.

Saphenous Nerve Block

Background and Indications

The saphenous nerve is a purely sensory nerve. It provides cutaneous innervation to the medial side of the calf and foot. It can be used as an adjunct block to the sciatic nerve block for complete sensory blockade of the lower leg and foot. The saphenous nerve block is useful for surgeries of the medial aspect of the lower leg and ankle (when combined with the sciatic nerve block).[17]

Patient Position

The patient is supine with the hip slightly externally rotated.

Equipment

A high-frequency hockey stick or linear transducer and a 21-23G, 2-in., blunt, simulating needle are usually sufficient.

Technique

This block is performed approximately at the mid to distal third of the thigh (Figure 31-12). The transducer is placed in a transverse orientation over the mid to distal third of the thigh (Figure 31-12). The femur is located and probe moved medially until the superficial femoral artery is identified under the Sartorius muscle (Figure 31-13). The vastus medialis is anterolateral at this location. The saphenous nerve may be difficult to visualize on ultrasound, but it usually lies in the fascial plane between the sartorius and vastus medialis muscles (Figure 31-13). The needle is inserted in-plane until the needle tip is between the artery and the Sartorius muscle. Nerve stimulation is not needed since the saphenous nerve is purely sensory. Only a small volume of local anesthetic is necessary and results in expansion of the fascial plane between the Sartorius muscle and the vastus medialis muscle.

Figure 31-12

Saphenous nerve block surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)

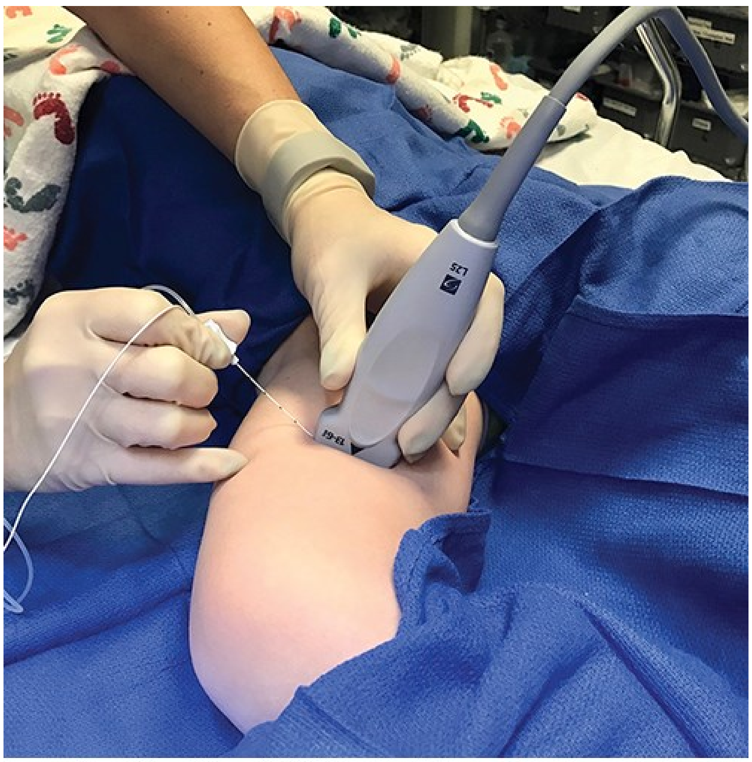


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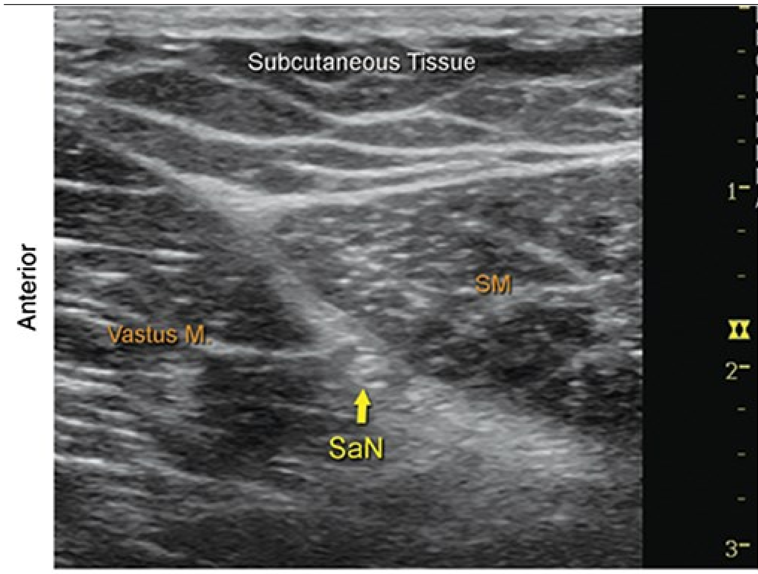
Figure 31-13

Saphenous nerve block ultrasound image. (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.)



Saphenous nerve block above knee

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Local Anesthetic

Only a small volume of local anesthetic is required. Typically, 0.15 to 0.25 mL/kg (max 10 mL) of 0.25% bupivacaine or 0.2% ropivacaine is injected.

Complications

Nerve injury can occur if too much local anesthetic is injected due to increased pressure in the small compartment. There is also a risk of intravascular injection and local anesthetic toxicity.

Sciatic Nerve Block

The sciatic nerve is formed by the nerve roots of L4–5 and S1–3. It provides motor innervation to the hamstrings and all of the lower extremity muscles distal to the knee. It also provides sensory innervation to the posterior thigh and knee as well as the lower extremity distal to the knee except for the anteromedial skin, which is innervated by the saphenous nerve. A sciatic nerve block can be used for procedures involving the posterior thigh/knee, fractures of the leg and ankle, foot surgery, and amputations. For certain surgical procedures, a femoral or saphenous nerve block may be needed as an adjunct to provide complete analgesia.[18,19] It can be blocked at multiple spots along its course. This demonstrates one of many various approaches to the sciatic nerve block. Nerve stimulation is recommended in addition to ultrasound guidance to enhance nerve localization due to the depth of the sciatic nerve at certain locations. Twitches of the hamstring, calf, and foot muscles can be elicited with the goal of achieving foot inversion or plantar flexion at 0.5 mA.

Subgluteal Sciatic Block

Background and Indications

See Section “Sciatic Nerve Block.”

Patient Position

The patient is at lateral position with the legs flexed at the hip and knee or prone.

Equipment

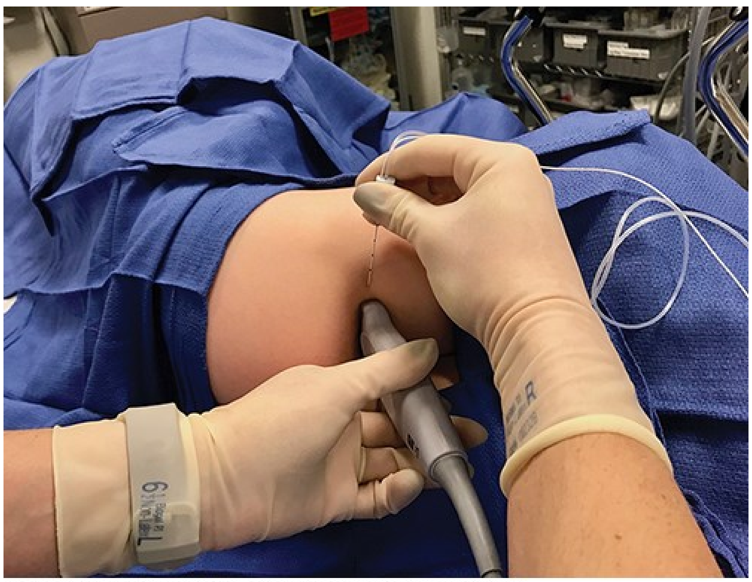
The transducer choice is dependent on the size of the child and the anticipated depth of the nerve. A high-frequency linear probe can be used in children <30 kg, but an intermediate-frequency curvilinear probe may be needed to improve ultrasound penetration in larger patients, where the sciatic nerve is deeper. A 21–22G, 2-in. or 4-in. stimulating needle should be used depending on the size of the patient. An 18G Tuohy needle can be used for catheter placement.

Technique

The greater trochanter and ischial tuberosity can be palpated and the probe should be placed transverse between these two landmarks (Figure 31-14). The sciatic nerve appears as a hyperechoic, wide and flat structure deep to the gluteus maximus muscle (Figure 31-15). The needle is inserted in-plane at the lateral border of the probe and advanced medially. When the needle tip is positioned adjacent to the nerve, local anesthetic can be visualized surrounding the nerve.

Figure 31-14

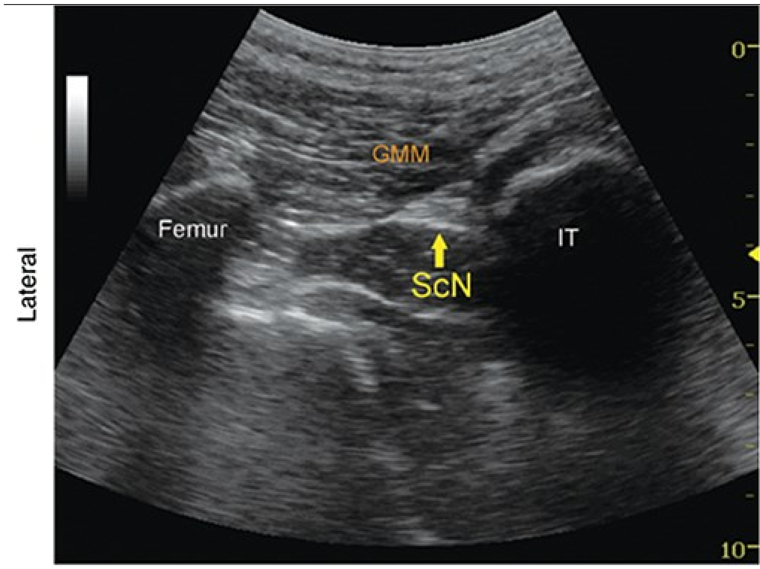
Subgluteal nerve block surface anatomy showing probe and needle positioning. (Used with permission, from Dr. Tricia Vecchione, Johns Hopkins University School of Medicine.)



Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-15

Subgluteal sciatic nerve block ultrasound image. (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.)



Sciatic nerve block-posterior approach

Local Anesthetic

Typically, 0.1 to 0.2 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is used.

Complications

Neural damage from intraneural injection can occur. Color Doppler may be used to identify vessels to decrease the risk of vascular puncture.

Popliteal Sciatic Block

Background and Indications

The popliteal sciatic block is a popular approach for surgical procedures below the knee. At this location, the sciatic nerve bifurcates into the tibial and common peroneal nerves.[20]

Patient Position

The patient position is supine, lateral, or prone.

Equipment

A high-frequency linear probe and a 21G or 22G, 20-in. or 4-in. stimulating needle depending on the size of the patient should be used. An 18G Tuohy needle can be used for catheter placement.

Technique

The probe is placed transverse in the popliteal crease (Figure 31-16). The popliteal vessels are identified and the tibial nerve appears as circular hyperechoic structure superficial to the vessels. As the probe is moved cephalad, the tibial and common peroneal nerves join to form the sciatic nerve (Figure 31-17). When the birfurcation is identified, the needle is inserted in-plane at the lateral edge of the probe. When the needle is adjacent to the sciatic nerve, local anesthetic is injected and should be seen surrounding the nerve.

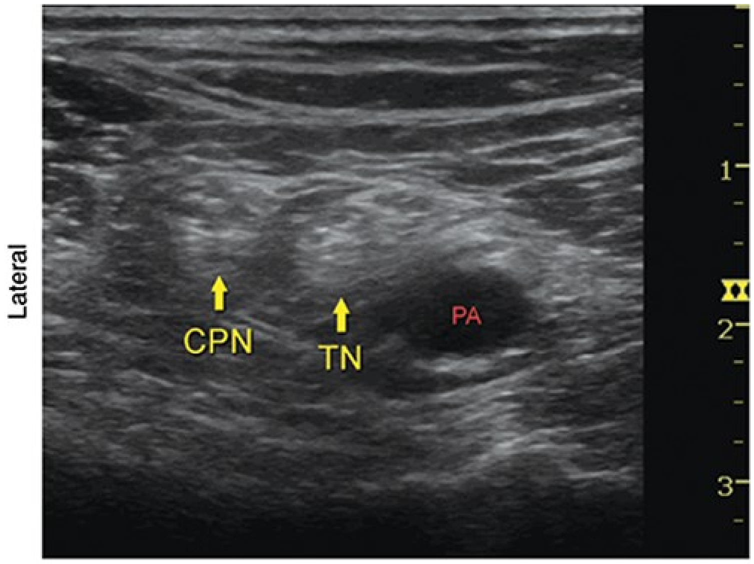
Figure 31-16

Popliteal sciatic nerve block surface anatomy showing probe and needle positioning. (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.)

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-17

Popliteal sciatic nerve block ultrasound image. (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.)



Common peroneal and tibial nerve-3 cm above popliteal crease, labeled

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi, Aykut Bilge: *Clinical Pediatric Anesthesiology*

Local Anesthetic

Typically, 0.1 to 0.2 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine is used.

Complications

Intravascular or intraneural injections are possible.

Ankle Block

Background and Indications

There are five nerves that must be blocked to provide complete anesthesia for surgeries of the ankle or foot. The sural nerve, the superficial and deep peroneal nerves, and the posterior tibial nerve are branches of the sciatic nerve while the saphenous nerve is a branch of the femoral nerve. The ankle block provides analgesia for surgical procedures such as club foot repair, polydactyly reconstruction, foot osteotomies, and foreign body removals.

Patient Position

The patient is supine with a holster under the foot.

Equipment

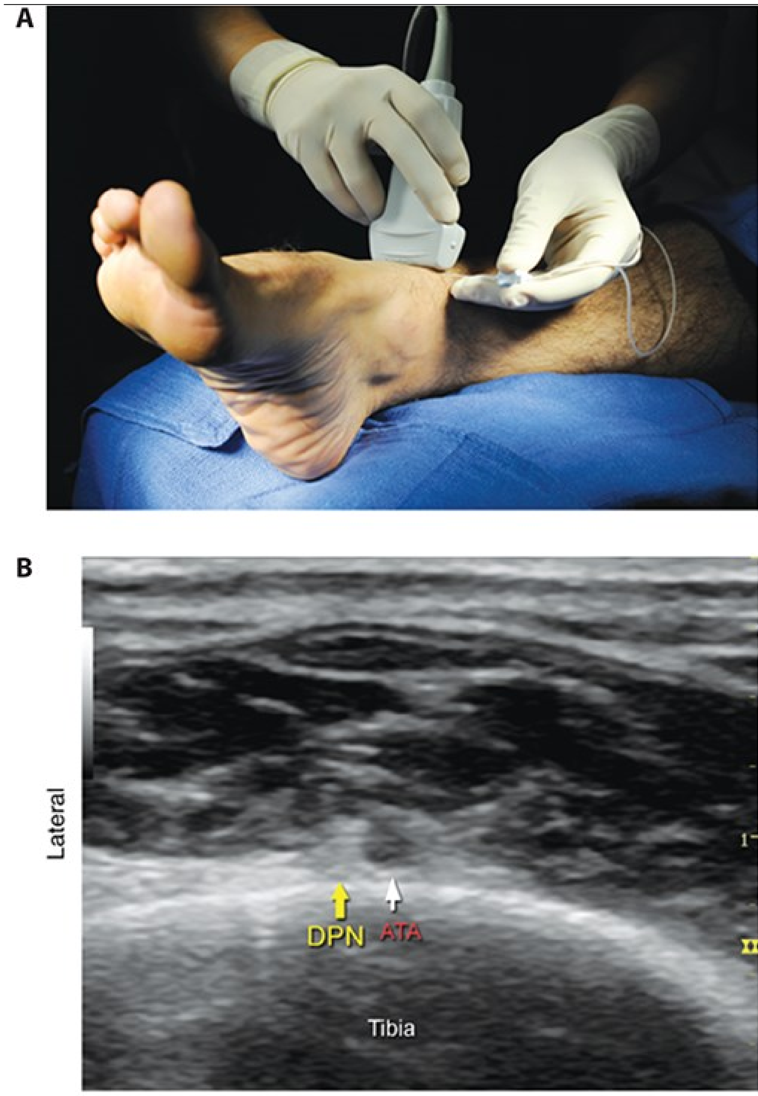
A small footprint linear or "hockey stick" high-frequency transducer is optimal if performing the block under ultrasound guidance. A 22–25G, 3–5 cm needle is used.

Technique

Ultrasound guidance may be helpful when blocking the deep nerves such as the deep peroneal and the posterior tibial nerves. The deep peroneal nerve can be found between the extensor hallucis longus tendon and the extensor digitorum longus tendon. Inserting the needle lateral to the anterior tibial artery can block this nerve. The probe is placed in a transverse orientation at the anterior surface of the ankle and the nerve can be seen as a hyperechoic structure lateral to the artery (Figure 31-18). The posterior tibial nerve is located posterior to the medial malleolus adjacent to the posterior tibial artery. The needle is inserted between the medial malleolus and the Achilles tendon and directed posterior to the artery. For the ultrasound-guided technique, the probe is placed transverse posterior to the medial malleolus (Figure 31-19A). The nerve can be seen as a hyperechoic structure posterior to the artery (Figure 31-19B). The saphenous nerve is located adjacent to the vein anterior to the medial malleolus. It can be blocked by infiltrating the area anterior to the medial malleolus. The sural nerve is blocked by inserting the needle between the lateral malleolus and the calcaneus. The superficial peroneal nerve is blocked by injecting local anesthetic subcutaneously in a ring-like fashion from the medial to the lateral malleolus.

Figure 31-18

A. Deep peroneal nerve block surface anatomy showing probe and needle positioning. **B.** Deep peroneal nerve block ultrasound image. (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.)

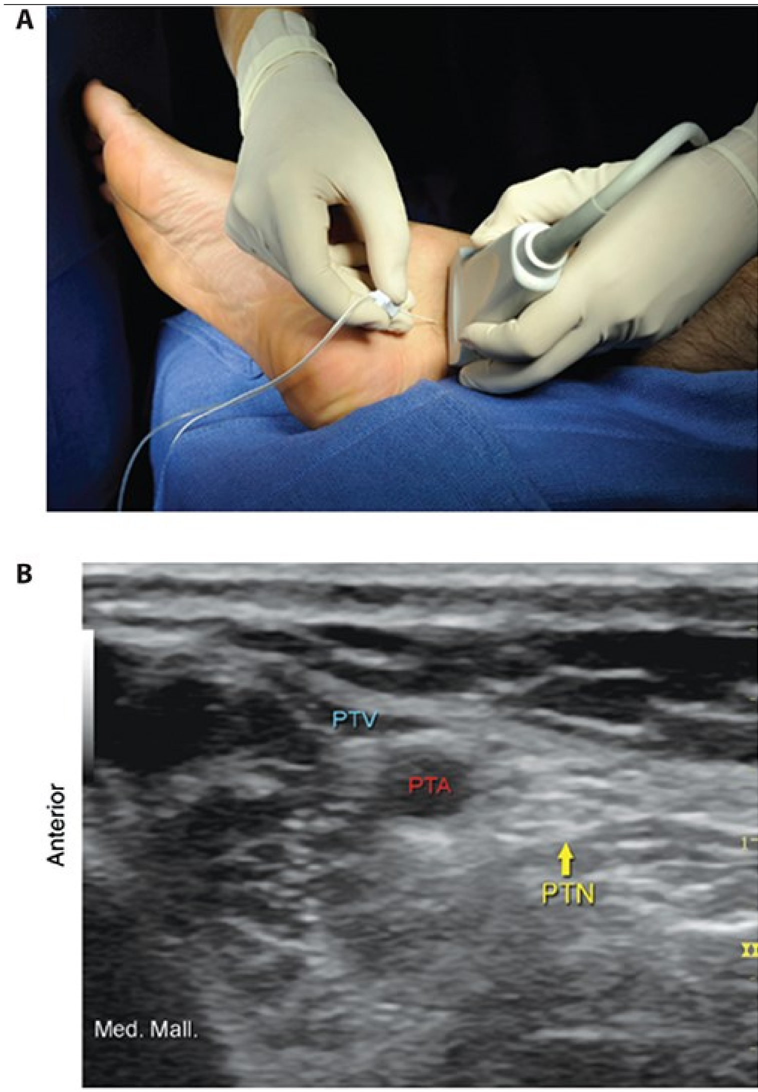


Ankle block-deep peroneal nerve

Source: Herodotos Ellinas, Kai Matthes, Walid Alrayashi,
Aykut Bilge: *Clinical Pediatric Anesthesiology*

Figure 31-19

A.Posterior tibial nerve block surface anatomy showing probe and needle positioning. **B.** Posterior tibial nerve block ultrasound image. (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.)



Ankle block-posterior tibial nerve

Local Anesthetic

The total volume of local anesthetic will depend on the size of the child. Typically, 0.1 mL/kg of 0.25% bupivacaine or 0.2% ropivacaine may be used. Generally, 1 to 3 mL is sufficient to anesthetize each nerve. Epinephrine should not be added to the local anesthetic solution for the ankle block as this can lead to limb ischemia.

Complications

Vascular puncture is a risk; therefore, careful aspiration should be performed prior to injection of local anesthetic. Large volumes of local anesthetic may cause nerve damage from compression in this small, noncompliant space.

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