REVIEW ARTICLE

Ultrasound-guided peripheral and truncal blocks in pediatric patients

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ABSTRACT

Ultrasound has added a feather in the cap of the anesthesiologists as real-time nerve localization and drug deposition around the nerve structure under real-time guidance is now a reality, as the saying "seeing is believing" has been proven true with the advent of ultrasound in anesthesia. Pediatric patients are a unique group regarding their anatomical and physiological features in comparison with adults; regional blocks in adults with the anatomical landmark and surface marking are almost uniform across the adult population. The landmark technique in pediatric patients is not reliable in all patients due to the variability in the age and size; the advent of ultrasound in assisting nerve localization has changed the way regional blocks are achieved in children and the range of blocks performed on adults can now be performed on pediatric patients; with advances in the technology and dexterity of ultrasound equipment, the chances of success of blocks has increased with a smaller dose of the local anesthetic in comparison to the traditional methods. Anesthesiologists are now able to perform blocks with more accuracy and avoid complications like intravascular injection and injury to the pleura and peritoneum during routine practice with the assistance of high-frequency transducers and top of the range portable ultrasound machines; catheters can be inserted to provide a continuous analgesia in the postoperative period. This review article describes the common peripheral blocks in pediatric patients; the readers are encouraged to gain experience by attending workshops, hands-on practice under supervision, and conduct random controlled trials pertaining to ultrasound-guided blocks in the pediatric age group. The recent literature is encouraging and further research is promising; a wide range of blocks being described in detail by many prominent experts from all over the world.

Key words: *Ultrasound guided, pediatric, peripheral and truncal blocks*

INTRODUCTION

Ultrasound has revolutionized the perioperative pediatric anesthesia practice including intravascular access, regional anesthesia like brachial plexus blocks, sciatic, femoral and neuraxial blocks. Ultrasound machine has evolved from a bulky and confusing machine to the one which is compact and user friendly, thus enabling easy mobility and excellent imaging of structures of interest. Regional blocks in adults with the use of the latest ultrasound technology has been in practice for over a decade and almost all blocks performed in adults can be performed in pediatric patients with a few limitations like the interscalene block as shoulder surgery is rarely performed in the pediatric age group.[1] The other major difference between the adult and pediatric populations is that the latter are not a homogenous population in anatomical similarities as the former.[2] The pediatric patients range from a neonate to an adolescent. The depth of the nerves and plexus varies with age ranging from 2 to 3 mm in a neonate, 4 to 5 mm in a 5 year old child, and 10 mm in a 10-year-old child; hence the equipment should be able to adjust to these variations. Nerve stimulation-assisted peripheral nerve blocks (PNBs) is the conventional technique, but is associated with multiple attempts and a high failure rate in the pediatric population; the risk of nerve injury in this blind technique is high as the patient is either heavily sedated or under general anesthesia before the nerve block is attempted. Ultrasound guidance (USG) has overcome many of these limitations of nerve-stimulated PNBs as plexus, nerves, spinal cord, caudal epidural space, and the surrounding structures like blood vessels, tendons, muscles, ligaments, and bony structures can be easily

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identified after appropriate training.[3] There is no consensus even among experts as to what number of blocks does an anesthesiologist need to complete and at what number be certified as a practitioner of USG blocks. Pediatric patients have areas around nerves and plexus tightly bound which is unique to this population thereby increasing the success of regional blocks if the drug is deposited around the nerve or plexuses appreciated better under USG.[4] Needle entry in USG blocks is more parallel to the skin than in the nerve-stimulated technique, and hence the needle traverses more structures under the ultrasound beam resulting in offsetting all anatomical landmarks and skin markings of the conventional method; an anesthesiologist has to learn to manipulate longer needles.[5,6]

The visualization of the tip is of utmost importance to avoid injury to the nerve or inadvertent intravascular injection. The readers are strongly recommended to move either the needle or the transducer and not both together and keep the needle under vision all the time; if the needle tip is not visualized, the transducer has to be appropriately positioned to bring the needle tip into focus.

ULTRASOUND: TECHNICAL CONSIDERATIONS

Pediatric patients have a higher body water content in comparison to adults; under USG, this is an advantage as it makes the identification of structures like nerves and plexus easier due to a characteristic appearance under the ultrasound beam. Here the bones are less ossified than the adults and hence the ultrasound beam can give very distinctive and good quality images. Nerves, plexus, and other structures lie superficial in infants and young children and hence are easy to visualize and identify; the spinal cord, caudal space, cauda equina, spines, and transverse processes can be visualized as the bones are less ossified than in older children or adults. On the other hand, individual nerves in premature or newborn infants are difficult to visualize as they are a less than a millimeter to a few millimeters in diameter and are very superficial. An anesthesiologist experienced in pediatric ultrasound regional anesthesia will need a high-frequency ultrasound transducer with good quality and high-resolution images. The size of the probes is also a drawback in the pediatric practice as the probes are designed for use in the adult population; the high frequency linear (HFL) probes are designed in different sizes, e.g. 38 mm, 25 mm, and a specially designed hockey-stick-shaped probe which is useful in infants and young children. The frequency of these above-mentioned probes ranges from 15 megahertz (MHz) to 6 MHz which produces very good resolution images of almost all the structures of interest for USG blocks. Needles have also undergone many modifications to be now used with USG in the pediatric patients, e.g., needles with and without insulation, etching to increase reflection of ultrasound waves, and nontraumatic beveled needles which reduce the risk of injury to the nerves in comparison to the sharp beveled needles. Nerve stimulation is possible with certain types of needles provided with insulation and facility to connect the needle to a nerve stimulator; the sizes of the needle vary according to the age and depth of the block, e.g., 25 mm (24 SGW), 50 mm (22 SWG), 100 mm, and 150 mm needles (Stimuplex B Braun, Germany).

ULTRASOUND: GEL AND STERILE PROBE COVERS

The ultrasound needs a conducting gel to overcome the impedance offered by the skin to the sound waves at the transducer–skin interface. It should be made sure that there are no air bubbles between the transducer and the skin; the gel should not be irritating to the skin and should not affect the transducer material and should be nonsticky and easy to clean from the skin as well as from the transducer's surface. There is a controversy over gel being carried by the needle to the vicinity or inside the nerve and the effect of this gel as it may be unsterile in many blocks. Sterile gel has been recommended by many authors but the same question is still unanswered as to the effect of the gel material on the nerve or the plexus. The ultrasound transducers are not sterile and they cannot be autoclaved; chemical or gaseous sterilization will damage the transducer which is a limitation to the introduction of sterile catheters or central neuraxial blocks which need very strict aseptic precautions. Several sterile covers are available commercially but they will have to be used with ultrasound gel (no air between the cover and transducer), and good skin contact is a must.

Upper limb blocks

Interscalene brachial plexus nerve block

An interscalene block is an uncommonly used block in pediatrics and preferably performed by an anesthesiologist with previous experience in USG pediatric blocks. The interscalene approach has been utilized for continuous analgesia by the placement of indwelling catheter [Figure 1].[7]

Indications: Surgical procedure around the shoulder and upper arm.

Position: In the supine position with hands adducted close to the trunk, face turned to the opposite side of the block; a small roll under the shoulder may help in pediatric patients due to a short neck compared to adults.

Equipment: 25-mm, 38-mm, or 25-mm hockey stick HFL transducer, 13-6 MHz, sterilizing solution like iodine, sterile probe cover (if a catheter is introduced), sterile gel, 25-mm or 50-mm short bevel needle appropriate to the age of the patient and with or without stimulation facility.

Technique: After aseptic precautions, sedation, or general anesthesia, a transverse scan is preferred to identify the structures in the neck starting from the midline structures like trachea and thyroid gland and the probe is moved laterally to identify the carotid artery and internal jugular vein and the sternocleidomastoid muscle just above the vascular structures; at the level of the cricoid cartilage, the probe is positioned laterally and moved caudal to identify the interscalene muscles and the structures between the two muscles visualized as hypoechoic round structures lined by a hyperechoic border and arranged one below the other (roots of C5 to T1); the probe is adjusted by either tilting or rotating to optimize the image; a 25–50 mm needle is introduced in the out-of-plane or inplane technique; the tip of the needle is directed to the space between the middle and anterior interscalene muscle to deposit the local anesthetic under real time. The spread of the local anesthesia andan increase in the interscalene groove is a sign of a successful block.

Complications: Intrathecal, epidural injection, accidental intraneural injection, intravascular injection, phrenic nerve and recurrent nerve block.

Supraclavicular brachial plexus nerve block

Supraclavicular plexus block is a more commonly used block and can be used for surgery below the elbow including the hand [Figure 2].

Indications: Anesthesia/analgesia for the arm, forearm, and hand.

Position: In the supine position with the arms adducted, with a roll under the shoulder and face turned to the opposite side of the limb to be block; it usually is difficult to manipulate the probe in the supraclavicular area due to the supraclavicular fossa and the clavicle.

Equipment: 25-mm, 38-mm, or 25-mm hockey stick HFL transducer, 13-6 MHz HFL, sterilizing solution like iodine, sterile probe cover (if a catheter is introduced), sterile gel, 25-mm or 50-mm short bevel needle appropriate to the age of the patient.

Technique: The ultrasound transducer is positioned in the posterior triangle of the neck at the level of the cricoid cartilage with a coronal oblique orientation and moved caudal to identify the interscalene groove keeping the focus on the brachial plexus; it is observed that the roots which were arranged on the top of one another start to form a "honey comb" or a "bunch of grapes" lying adjacent to each other; as they approach the supraclavicular area, they lie lateral to the subclavian artery on the first rib. The needle is directed inplane to the probe from the lateral to the medial side visualizing the entire needle and directing the tip close to the cords and injecting the local anesthetic all around the cords; care should be taken to not enter the subclavian artery (intravascular injection) or advance beyond the first rib (pneumothorax).

Infraclavicular brachial plexus nerve block

The brachial plexus passes behind the clavicle to enter the axilla. In the infraclavicular region, it lies superolateral to the axillary vessels and cephalad to the chest wall. The plexus lies deep to the skin, pectoralis major, and clavipectoral fascia, which splits to enclose the pectoralis minor muscle. Above the clavicle, the trunks form divisions that continue to form the cords of the plexus in the axilla. The cords of the plexus form around the second part of the axillary

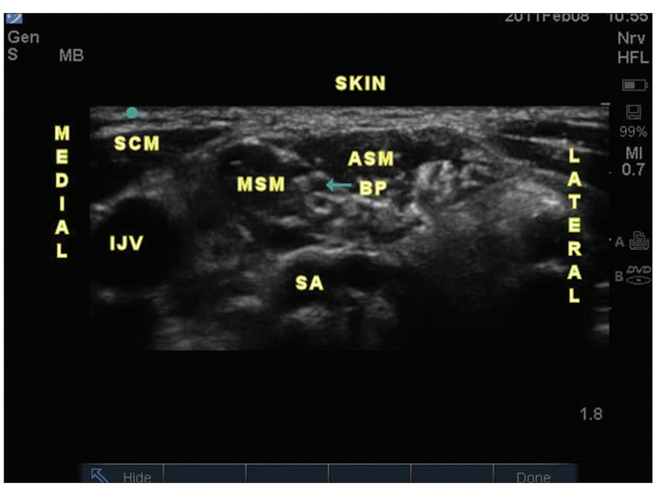

Figure 1: Interscalene brachial plexus. SCM = sternocleidomastoid, MSM = scaleneus medius, ASM = scaleneus anterior, IJV = internal jugular vein, SA = subclavian artery, BP = brachial plexus

Figure 2: Supraclavicular brachial plexus. SA = subclavian artery. Arrow indicates brachial plexus

artery. The divisions of the artery are named in relation to the pectoralis minor muscle. The axillary artery becomes the subclavian artery at the lateral edge of the first rib [Figure 3].[8]

Indication: The indications of this block are very similar to the above-mentioned block.

Position: The patient is positioned supine, the arm is adducted close to the trunk and the elbow is flexed 90° with the hand resting on the abdomen.

Technique: The probe has to be placed laterally close to the corocoid process at right angles to the clavicle; the pectoralis major and pectoralis minor are identified; the axillary artery is identified as a pulsating anechoic structure; the brachial plexus are identified around the artery as three cords, the medial, lateral, and posterior cords; a needle, 25 or 50 mm, is introduced in line or out of plane to the transducer and the drug is deposited around all the three cords; it is recommended to scan the cords away from the anatomical landmark technique as the pleura is very close to the needle path. The USG allows the flexibility to visualize the plexus away from the classical vertical infraclavicular brachial plexus block and the serious complications of the blind procedure are avoided by utilizing a real-time USG.

Complications: Pneumothorax and vascular puncture.

Axillary block

Axillary block is one of the frequently performed blocks in the pediatric age group due to the ease and accuracy of the block and also has the least complications when compared with the other blocks for the upper limb [Figures 4 and 5].[9]

Indication: Surgery of the elbow, forearm, and hand; closed reduction of fractures of the elbow, forearm, and hand for postreduction pain relief.

Position: The arm to be blocked is externally rotated and abducted 90° at the shoulder and flexed 90° at the elbow.

Equipment: 25-mm, 38-mm, or 25-mm hockey stick transducer, 13-6 MHz.

Technique: The transducer is placed high in the axilla in a transverse position to visualize the axillary artery as an anechoic pulsating round structure; one or more axillary veins are adjacent to the artery, the median nerve lies superior and medial to the artery, the radial nerve lies posterior–lateral to the artery, and the ulnar nerve lies caudal to the artery; the musculocutaneous nerve lies in the corachobrachialis muscle as it pierces the muscle and is away from the other three nerves. After the identification of the four nerves, a 25- to 50-mm insulated needle

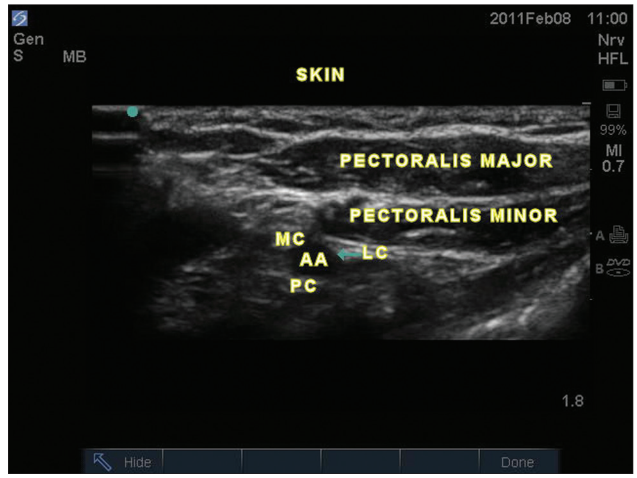

Figure 3: Infraclavicular brachial plexus. AA = axillary artery, MC = medial cord, PC = posterior cord, LC = lateral cord

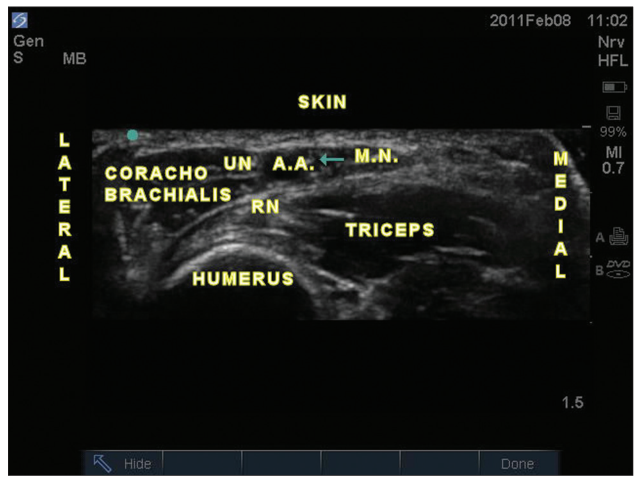

Figure 4: Axillary brachial plexus block. AA = axillary artery, MN = median nerve = RN = radial nerve, UN = ulnar nerve

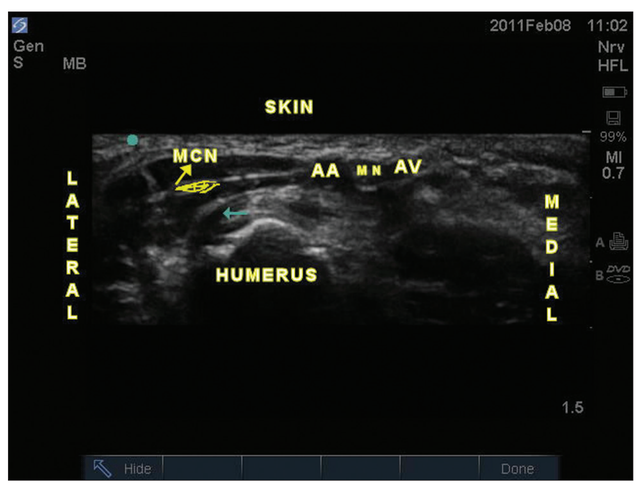

Figure 5: Axillary brachial plexus. MCN = musculocutaneus nerve, AA = axillary artery, AV = axillary vein, MN = median nerve

as appropriate to the age is used in an inline technique where the needle is introduced parallel to the beam of the ultrasound facilitating the visualization of the whole needle as it approaches the nerves; local anesthetic is deposited around these nerves after negative aspiration for blood and visualization of the tip outside the nerve substance in real time. A nerve stimulator may be employed before a good experience in USG is gained to assist and guide in identifying the motor responses as in the nerve-stimulated axillary block. A musculocutaneous nerve (MCN) block will need the needle to be introduced by a separate puncture of the skin from the lateral aspect of the axilla and anesthetic to be deposited around it; hence the axillary block is considered as a multiple injection block.

Complications: Intravascular injection and intraneural injection.

Median nerve block

The median nerve can be viewed at the elbow medial to the brachial artery and deep to the basilic vein in the antecubital fossa, and in the forearm medial to the radial artery, medial and superficial to the radius. A needle is introduced from the radial side in line with the transducer and guided adjacent to the nerve avoiding the blood vessels; local anesthetic is injected to surround the nerve; adjustments to the needle may be required to ensure appropriate injection.[10] The midarm is the ideal area to block the median nerve as no blood vessels are present around the nerve.

The median nerve can be blocked just proximal to the wrist; care has to be taken to not cause a nerve entrapment among the tight tendons and flexor retinaculum which can lead to a compartment syndrome (carpal tunnel syndrome).

Ulnar nerve block

The ulnar nerve should never be blocked at the elbow where it lies superficial as it may cause nerve entrapment and ischemia due to the pressure of local anesthetic injected in the groove formed by the olecranon and medial epicondyle. The ulnar nerve is blocked distal to the elbow and just above the wrist where it is easy to identify it as a structure lying medial to the ulnar artery; when blocking the ulnar nerve at the wrist, it has to be proximal to the division of the ulnar nerve to include the dorsal cutaneous branch which supplies the dorsomedial aspect of the hand. The ultrasound probe is placed on the anterior surface of the forearm and an appropriate image of the median nerve is procured; the needle is passed in line with the probe directing the needle close to the nerve and local anesthetic is injected around the nerve after negative aspiration for blood; the nerve can be traced proximally where it is away from the artery to avoid arterial puncture or accidental intravascular injection; this emphasizes the importance of needle tip visualization prior to an injection close to vascular structures.

Radial nerve block

The radial nerve is to be blocked above the elbow before it divides into a superficial and a deep branch; ideally just after it traverses the groove on the humerus, it travels to the forearm between the brachioradialis and brachialis muscle. The probe is place laterally at the antecubital fossa and after identifying the nerve probe is moved proximal to obtain a optimal image of the nerve by angulating or rotating the probe on its axis, needle is directed in plane to reach the nerve and local anesthetic is deposited around the nerve to surround it; repeated positioning of the needle may be needed to surround peripheral nerves with local anesthetic.

Musculocutaneous nerve block

MCN is the only nerve which leaves the axillary sheath high in the axilla and hence missed in the classical axillary plexus block; it is blocked separately during an axillary plexus block; the nerve can be visualized and blocked under USG, and the nerve may have variations in its location.[11] The axilla is scanned to identify the axillary artery; in the axial plane, the probe is moved lateral from the axillary artery and moved distally to obtain a good image of the MCN between the biceps tendon and the two parts of coracobrachialis muscle as a hyperechoic structure with hypoechoic fascicles within the nerve substance. A needle, 25 mm or 50 mm appropriate to the patient's age, is introduced from the lateral side in line with the probe and directed toward the nerve; local anesthetic is injected to surround the nerve [Figure 5].

Truncal nerve blocks

Rectus sheath block

The rectus abdominis is a vertical muscle of the anterior abdominal wall. The muscle is divided into compartments by linea alba, linea semilunaris, and transverse fibrous bands. The rectus sheath (formed by aponeuroses of three abdominal muscles) is attached tightly to the rectus muscle anteriorly and forms a potential space with a loose attachment posteriorly which can be accessed under USG to block the nerves supplying the area around the umbilicus, which arise from T_9, T_{10}, and T_{11} intercostal nerves and travel between the internal oblique and transverse abdominis muscles; the nerves run anteriorly through the rectus muscle to supply the sensation to the paraumbilical area.[12]

Indications: Analgesia for surgery around the umbilicus like epigastric hernia, para umbilical hernia, pyloromyotomy, laproscopic surgery, and midline abdominal incisions.

Equipment: A high-frequency (preferably13–15 MHz) linear probe, 25 mm, 38 mm, or short bevel tip 25-50 mm needle

Technique: The ultrasound probe is positioned transverse to the midline and moved laterally till the linea semilunaris is identified; medial to this the probe is adjusted to get an appropriate image of the posterior rectus sheath where local anesthetic is deposited in the potential space under real-time guidance by the inline technique. The needle is introduced 0.5–1 cm medial to the linea semilunaris cephalad or caudad to the umbilicus; this has to be repeated on the contralateral side.

Complications: Intraperitoneal injection, abdominal visceral injury.

Ilioinguinal/Iliohypogastric nerve block

Ilioinguinal nerve (IIN), and iliohypogastric nerve (IHN) arise from the lumbar plexus and emerge lateral to the psaoas muscle, pass obliquely to quadratus lumborum and iliacus, and perforate the tranversus abdominus muscle lying anterior to the iliac crest; the nerves then pierce the internal oblique muscle to travel between the internal oblique and tranverse abdominis muscles and descend caudally and medially entering the spermatic cord [Figure 6].

Indication: Analgesia for surgery involving the inguinal area like herniotomy, and orchidopexy.

Equipment: High-frequency linear probe 13MHz, 25 mm or hockey stick probe, 25 mm short bevel 22G needle.

Technique: The probe is placed in an anterior–posterior orientation to the patient adjacent to the anterior superior iliac spine; the probe is adjusted to visualize the three muscles; the outer muscle is the external oblique, under this is the internal oblique, and the thin layer of muscle under the internal oblique is the transverse abdominis; the probe is moved laterally and focused on the two nerves within the layers of the muscles; a 25-mm short bevel needle is passed medial to lateral in plane and the drug is deposited around the nerves after negative aspiration of blood.[13]

Complication: Peritoneal injection, intra-abdominal visceral injury, intravascular injection.

Lower limb nerve blocks

Sciatic nerve block

Sciatic nerve originates from contributions from the lumbar and sacral plexus (L_4–S_3). It travels beyond the pelvis through the greater sciatic foramen under the pyriformis muscle; in the gluteal region the sciatic nerve courses below the gluteus maximus muscle superficial to superior and inferior gemelles muscles, obturator internus and quadratus femoris muscle; it runs between the greater trochanter and ischial tuberosity.[14] The sciatic nerve travels down the leg between the muscles anterior to the hamstring muscles (semimembranosis, semitendinosis, short and long head of biceps femoris and lateral to the adductor magnus, and posterior and lateral to the popliteal vessels) [Figure 7]. The sciatic nerve divides at a variable distance from the popliteal crease (5–10 cm) into tibial and common peronial components; the tibial component becomes more superficial as it moves distally accompanying the popliteal vessels in the distal popliteal fossa; the common peroneal nerve moves laterally to a position medial to the tendon of the biceps femoris as it moves down posterior and lateral to the knee.

Indications: Analgesia and anesthesia for any surgery of lower leg and foot usually accompanied by a femoral, obturator, or saphaneous nerve block.

Equipment: 10–8 MHz linear array probe in infants and small children, and 5-2 MHz curved array probe in children above 10 years; 50-mm short beveled needle in small children and 100-mm short beveled needle in older children.

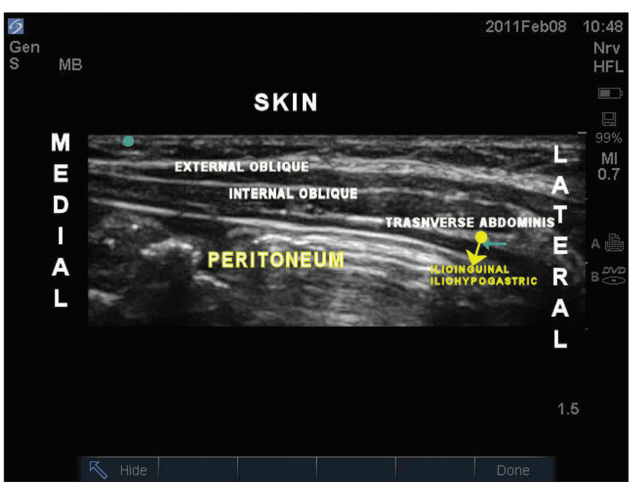

Figure 6: Transverse abdominis plane and ilioinguinal and iliohypogastric nerves (arrows)

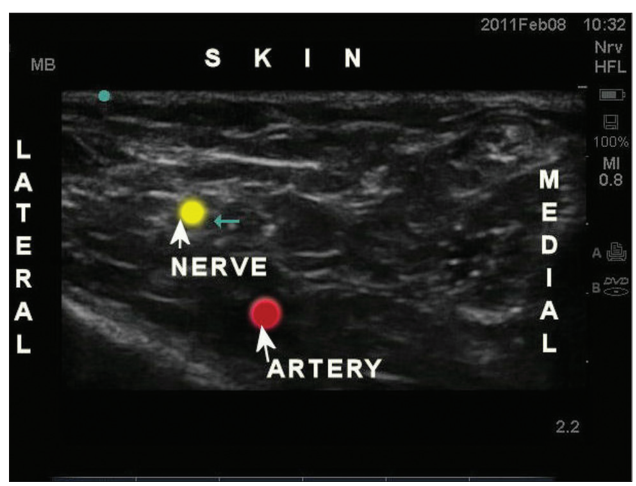

Figure 7: Sciatic nerve in the popliteal area

Position: Traditional Sim's position is preferred for the gluteal approach of the ultrasound-guided block; in the subgluteal block, the thigh is flexed to the right angle to the body and the knee is flexed at right angles to the thigh. In the popliteal block, the patient is supine with the leg elevated and the probe placed on the popliteal fossa.

Technique: Subgluteal and popliteal approaches are commonly practiced in pediatric patients; in the subgluteal approach, the probe is placed at the midpoint between the greater trochanter and ischial tuberosity to visualize the sciatic nerve in a cross section; due to the small footprint, only the greater trochanter can be visualized adjusting the probe to obtain an optimal image of sciatic nerve; to distinguish it from surrounding tendons and tissue, some experience is needed as there are no surrogate markers like arteries and veins which is a drawback of this technique.

The popliteal approach is easier to master as the sciatic nerve is accompanied by the popliteal artery and vein in proximity of the nerve. The probe is placed across the popliteal fossa laterally oriented with the patient in a supine position; the popliteal artery is identified as an anechoic pulsating structure; adding the color Doppler function will reveal pulsations of the artery and scanning lateral and posterior to the artery will reveal a hyperechoic the sciatic nerve. The nerve has to be blocked before it divides; as the division is at a variable distance from the popliteal crease, hence direct visualization of the nerve has an advantage over the landmark technique. A 25- to 50-mm needle is introduced by the inline technique where the needle enters parallel to the probe midpoint of the thigh in the anterior posterior plane and the drug is deposited around the nerve. In the prone position, the needle can be introduced either in line or out of plane.

Complications: Intravascular injection in the popliteal approach and intraneural injection if the needle tip is not visualized accurately in the transgluteal approach.

Femoral nerve block

The femoral nerve is the largest branch of the lumbar plexus, derived from the second through fourth lumbar root; the nerve descends through the psoas muscle, exiting the muscle near its lower border and travels on the iliacus muscle under the inguinal ligament to lie lateral to the femoral artery; it immediately divides into an anterior and posterior branch [Figure 8].

Indications: Analgesia/anesthesia around the anterior thigh and knee and if combined with the sciatic nerve is effective for any surgery below the mid-thigh.

Equipment: Linear array high-frequency probe, 25 mm 13-6 MHz, 25 mm-50 mm short bevel needle.

Technique: The probe is placed parallel to the inguinal ligament at its level and the artery is visualized as a round anechoic pulsating structure; color Doppler can be helpful during the location of the artery; once the artery is located, the adjustment of the probe orientation lateral to the artery reveals the femoral nerve; an artifact of the artery (posterior acoustic enhancement) may be confused for the nerve; the use of a nerve stimulator will confirm the location of the nerve [Figure 9]. The needle can be inserted in plane or out of plane; the former technique has the disadvantage of a long distance for the needle to travel and to pierce the fascia iliaca; the advantage is that the whole needle is visualized when inserted parallel to the ultrasound beam. The out-of-plane technique is preferred to avoid patient discomfort and if a catheter insertion is planned; the disadvantage is that the visualization of the needle is limited to a spot rather than the whole needle. Local anesthetic is injected proximal, to avoid the division of the femoral

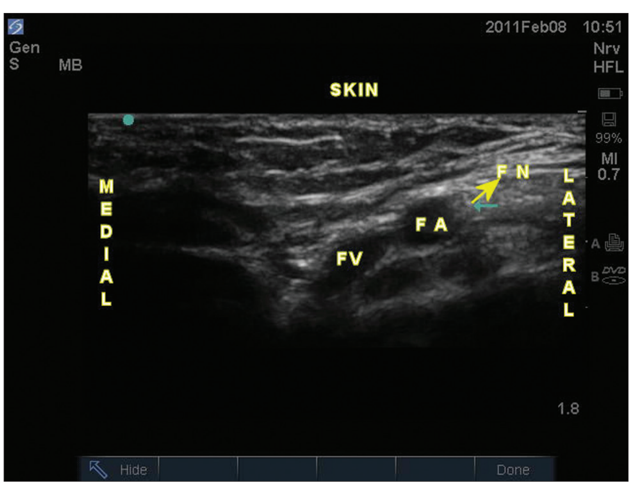

Figure 8: Femoral nerve (FN), femoral artery (FA), femoral vein (FV)

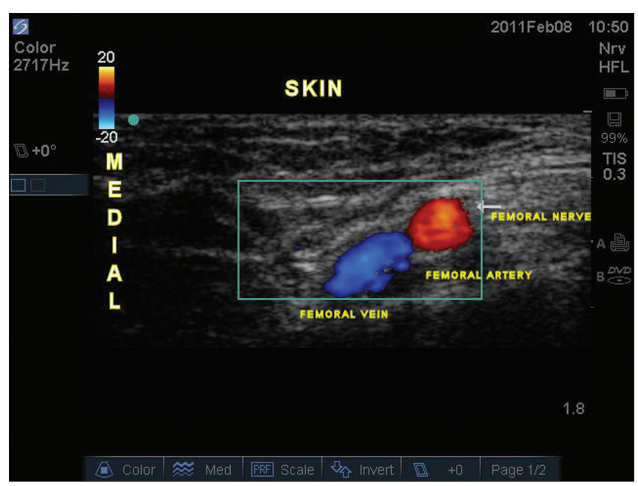

Figure 9: Color Doppler view of the femoral area

nerve, and posterior to it, visualizing the nerve to be lifted, and surrounded by the injectate.[15]

Complications: Intravascular or intraneural injection of local anesthetic. Regional anesthesia (RA) in pediatric patients is conducted either after general anesthesia (GA) or heavy sedation; a concern for injury to neural structures during conducting blocks under heavy sedation or GA and guidelines to a safe practice are well described elsewhere; the popularity of regional blocks is on the rise as it carries many advantages when used as a single modality of anesthesia or combined with any of the other available amalgamations or choices in the anesthesia practice.[16,17] RA in children has limitations with the nerve stimulation (NS) technique as the success rate is not encouraging; intraneural injections and intravascular injections go undetected.[18] The local anesthetic drugs to be used in the NS technique are large in volume in comparison to the USG blocks aiming to reduce the failure rate and patchy blocks. The advent of USG and the transducers with high frequencies and appropriate size has eliminated the limitations of earlier techniques to a large extent; ultrasound carries its own inherent disadvantages and one of the most commonly stated is the initial cost of the machine, training, expertise, and initial failures are few of the other disadvantages.[19] The amount of local anesthetic used in USG is usually in amounts sufficient to encircle the target under real time and expertise is needed to ascertain that the drug is in close contact with the nerve and not within tissue surrounding the nerve.[20] Sound knowledge of anatomy and anatomical surface marking is an essential requirement before venturing into the practice of regional anesthesia in any age group; sonoanatomy is the study of anatomy under the ultrasound beam which is a prerequisite before attempting any USG blocks.[21] There are many articles, text books, and various resources on the web to guide an interested anesthesiologist to understand the anatomy of the structures of interest under the ultrasound probe; unfortunately there is no alternative to hands-on practice of probe maneuvering, needle trajectory control, and recognition of drug deposition around the target nerve. [22] These skills are learnt by attending workshops and courses which are conducted regularly in different centers which have mastered USG. This review contains some descriptions of the indications, equipment, and techniques to help directing the reader to understand the basic concept of each block in general and conduct the block in pediatric patients; with safety and success being the endpoints. The terminology used in ultrasound like anechoic, hyperechoic, and hypoechoic are unfamiliar to beginners and hence a complete understanding of these terms and knowing our limitations according to the exposure or practice of the individual will be a guide to practice these blocks in children.[23] The readers should also understand the limitations of the ultrasound in neuraxial blocks whose description is out of scope in this article; there are many articles from experts in this field in the literature; the readers interested in neuraxial blocks are encouraged to read these article for more information.

Pediatric ultrasound-guided blocks are included in many general ultrasound literatures; with time and expertise, the research and randomized studies in the pediatric age group will increase and there is a huge scope for further randomized controlled studies.

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