

How and why to use ultrasound for regional blockade

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Abstract : The practice of regional anaesthesia will be probably forever changed by the introduction of ultrasonography into everyday clinical practice. The ability to now visualise directly the spread of local anaesthetic solution and its relationship with the nerve allows for immediate adjustments to needle position and/or local anaesthetic volume and spread resulting theoretically in improved block performance through faster onset, reduced local anaesthetic volumes and higher success rates. However, whether US guided blocks will ever replace neurostimulation techniques is debatable especially when regional anaesthesia is performed by specialists in the field.

Key words : Ultrasound guidance ; peripheral nerve blocks ; epidural blocks.

In recent years, the practice of regional anaesthesia has been forever changed by the introduction of ultrasonography into everyday practice. The ability of ultrasound (US) to visualise nerves as well as structures (vessels, pleura) to be avoided, has resulted in increased confidence for anaesthesiologists performing regional anaesthetic techniques. US guided nerve blocks provide real-time imaging of needle position and facilitate nerve location even when anatomical variations from traditional landmarks are present. The techniques traditionally used for regional anaesthesia procedure guidance included either subjective perceptions of arterial pulses or fascial “pops” or more objective aims as trans arterial approaches or nerve stimulation. The ability to now visualise directly the spread of local anaesthetic solution and its relationship with the nerve allows for immediate adjustments to needle position and/or local anaesthetic volume and spread resulting theoretically in improved block performance through faster onset, reduced local anaesthetic volumes and higher success rates (1, 2, 3). The recent literature reflects the exponential evolution of ultrasound guided regional blocks from descriptive studies demonstrating its feasibility to prospective RCT comparing ultrasounds to other classical techniques of guidance. Regional anaesthetic techniques such as the supra-clavicular block, or sub-gluteal sciatic nerve approach that were considered

high risk or challenging, may now be undertaken with the knowledge that needle position relative to other structures is known.

HOW : ULTRASOUND GUIDANCE – THE BASICS

Ultrasonographic waves can be generated by, and converted back into electrical energy by applying an alternating current to a material with piezoelectric properties, that is to say, the ability to vibrate depending on a specific frequency and to transform the energy generated into US waves from electrical current or vice versa. The physical characteristics of sound waves are described below : Wavelength : the distance travelled in one cycle in the direction of the energy propagated (units = mm), Period : the time duration of one cycle (units = seconds), Frequency : the number of cycles per second (units = Hz), Amplitude : the square root of the wave energy, Velocity : the distance travelled by the wave per unit time (units = m/s). Each medium has a unique acoustic impedance. Where two mediums interface, the difference in the acoustic impedance between both results in some waves being reflected. The greater the degree of reflection, the higher the intensity of the sound signal and this is represented a brighter ultrasonographic image also known as greater echogenicity. Hyperechoic structures appear white on screen, hypoechoic structures are dark or black. Nerves, tendons and fascia are hyperechoic, although neural structures

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often have hypoechoic areas resulting in an honeycomb appearance. Arteries and veins are anechoic or “empty” and are seen as black on ultrasound. The use of Doppler or colour flow to demonstrate pulsatile flow and the compressibility of the vessels helps to distinguish arterial and venous vessels. Muscles are both hyperechoic and hypoechoic, fat is hypoechoic and bone is very hyperechoic—often seen as a signal “drop-out”. Finally local anaesthetic is seen as hypoechoic. It is important that the US waves both leave and return to the probe in the same plane. If waves travel from the probe in one direction and are reflected in a different plane an artifact known as anisotropy will occur and a hyperechoic structure will appear hypoechoic. The recent US machines are both effective and portable. Different probes are required depending on the frequencies needed (a usual choice is a 5-8 MHz and a 10-14 MHz probe). The ultrasonographic image of a nerve will depend on its particular anatomical structure (4). Myelinated axons are rich in fat and therefore are hypoechoic, non-myelinated nerves are surrounded by Schwann cells only and appear less dark. The image also depends on the number of fascicles in each neural structure. Therefore the final image seen on screen will depend on the number and type of nerves running in the neural bundle - nerves more distal to the nerve roots tend to appear hyperechoic structures with hypoechoic islands on transverse view or as varying hyperechoic/hypoechoic strands on longitudinal view. Nerves can be distinguished from muscles and tendons by their lack of anisotropy. Local anaesthetic surrounding the nerve is dark hence the term “doughnut sign”.

HOW : ULTRASOUND GUIDANCE- THE BLOCK PERFORMANCE

It has long been demonstrated that there is poor correlation between nerve stimulation results and paresthesia as well as there is no constant correlation between nerve stimulation minimal intensity and needle tip position close to or into a nerve. Ultrasound guidance theoretically provides direct visual confirmation of needle-nerve contact. PERLAS *et al.* (5) reported that after needle-nerve contact with ultrasound view in axillary blocks, only 38% of patients reported paresthesiae and 75% had a motor response at a threshold current less than 0.5 mA. Similarly BEACH *et al.* (6) reported in patients scheduled for ultrasound guided supraclavicular blocks that only 87% had a motor response despite a constant contact with nerve-plexus struc-

tures. Sinha *et al.* (7) highlighted that there was no correlation between the minimal current threshold and the likelihood of block success and that only the appropriate spread of LA visualized on ultrasound signified the success. The position of all identifiable structures - nerves, arteries etc., is first determined. Changes to the depth, frequency, gain or the use of Doppler/colour flow may be necessary. Once the operator agrees with the resultant image, the needle is introduced. There are two options for needle introduction - the needle can be inserted either longitudinally or axially to the probe (on plane). Longitudinal insertion has the advantage that the full length of the needle is visible but the distance to the target is further. With axial (transverse) insertion (out of plane) only the tip or shaft transverse view of the needle can be seen (dot) which may be more difficult to visualise, but the distance to the target is less. Ultrasonographic-guided regional anesthetic techniques and probe characteristics and position for the procedure are listed in table 1. As well as direct visualization of the needle, surrogate markers such as the movement of surrounding structures or the injection of small bubbles of air or amounts of local anaesthetic, may assist in needle tip position identification. The type of needle also plays a role (8) – needles specially designed for US guided procedures are now commercially available. Successful blockade of a nerve is not only dependant on needle tip position but also on the diffusion of local anaesthetic to and around the nerve. This is where the major advantage of US over neurostimulation guided blocks is found. By visualizing the spread of local anaesthetic in real time, some adjustments can be made to needle position to enable correct spread of local anaesthetic.

HOW : ULTRASOUND GUIDANCE- THE PERIPHERAL NERVE BLOCK CATHETERS

The results concerning the interest of USG for CPNB are sparse. There's no prospective randomized study to date directly comparing ultrasound guidance versus peripheral nerve stimulation for CPC placement. Theoretically, ultrasound has the potential to confirm catheter tip location (direct visualization of the catheter tip or indirectly by visualizing local anesthetic spread). SLATER and colleague (9) and DHIR *et al.* (10) claimed that infraclavicular block catheters inserted using ultrasound can be of value in increasing the success rate of such a procedure. However ultrasonography for peripheral catheter placement can be a challenging

Table 1

Ultrasonographic-guided regional anesthetic techniques and probe characteristics and position for the procedure

Type of regional block	Ultrasonographic probe	Technique
Interscalene block	Linear : 10-12 Hz	– Transverse view, puncture along the short axis, needle reposition necessary to block the C8 and T1 roots – Long axis view preferable for catheter insertion
Supraclavicular block	Linear : 10-12 Hz	– Transverse view, in plane technique, needle reposition for the posterior fascicle
Infraclavicular block	Linear : 8-10 Hz	– Transverse view, puncture along the short axis
Axillary block	Linear : 10-12 Hz	– Transverse view, puncture along the short axis, multi-injection technique – Long axis view preferable for catheter insertion
Distal nerve blocks	Linear : 10-12 Hz	– Transverse view, puncture along the short axis, single nerve injection technique
Parasacral SN block	Curved array probe 5-8 Hz	– Transverse and long axis view laterally from the needle entry point, puncture along the long axis
Subgluteal SN block	Linear 8-10 Hz or Curved array probe 5-8 Hz	– Transverse view, puncture along the short axis – Long axis view preferable for catheter insertion
Mid femoral SN block	Linear 8-10 Hz or Curved array probe 5-8 Hz	– Transverse view, puncture along the short axis
Politeal SN block	Linear : 10-12 Hz	– Transverse view, in-line technique from lateral side or puncture along the short axis for the posterior approach – Long axis view preferable for catheter insertion
Femoral nerve block	Linear : 10-12 Hz	– Transverse view, puncture along the short axis – Long axis view preferable for catheter insertion
Obturator nerve block	Linear : 8-10 Hz	– Transverse view, needle position in the intermuscular fascial planes
Saphenous nerve block	Linear : 10-12 Hz	– Transverse view, puncture along the short axis
LCNT block	Linear : 10-12 Hz	– Transverse view, puncture along the short axis
Psoas Compartment block	Curved array probe 5-8 Hz	– Transverse view (90° angle to the vertebral column), in-line technique, visualization of the psoas muscle, lumbar plexus between the middle and posterior third of the psoas muscle
TAP block	Linear : 8-10 Hz	– Transverse view, needle position in the intermuscular fascial planes
Neuraxial epidural block	Linear 6-10 Hz or Curved array probe 5-8 Hz	– Longitudinal view from paramedian, puncture from median – Visualization of the epidural space depth

technique. Methods to indirectly assess perineural catheter tip location are piezoelectric vibration of the catheter tip, injection of agitated microbubbles, which appears as a hyperechoic injectate within the anechoic LA fluid, or use of color flow Doppler, where the injectate appears as a mix of colors superimposed on the grayscale background. The other possibility is to use the long axis view possibility to follow the insertion of the catheter (11). Only two large prospective observational studies (3, 12), in ambulatory patients, demonstrated the effectiveness of USG as the primary modality (with or without needle nerve stimulation) to place peripheral nerve catheters. Both studies reported that 98% of catheters provided optimal postoperative analgesia with a low incidence of minor side-effects (complications rate was 0.4%). The 1st attempt catheter success rate was 96%.

WHY : ULTRASOUND GUIDANCE FOR NERVE BLOCKS-PROVED ADVANTAGES

Upper Limb

Interscalene block

The landmark for this superficial block (the interscalene groove) can be difficult to locate, especially in obese patients. US allows for easy identification of the anterior and middle scalene muscles as well as the carotid vessels and depth of the cervical vertebrae. Whether US results in improvements to neuro-stimulation techniques for this block has yet to be studied. SINHA *et al.* (7) performed ultrasound guided interscalene blocks in which they inserted the needle between the presumed C5 and C6 roots. They reported that only 42% of the patients had a motor response at or less than 0.5 mA. The success

rate of the sensory blockade after an injection of 30 ml of 0.5% bupivacaine was similar in the <0.5 mA group (96%) and the >0.5 mA group (91%). These results suggest that an appropriate needle-nerve/root contact is necessary for an optimal sensory blockade and that the spread of local anaesthetics solution is the key element for success. Kapral and colleagues (13) recently reported that the use of ultrasound to guide needle placement and monitor the spread of local anesthetic improves the success rate of interscalene brachial plexus block. RIASI *et al.* (14) demonstrated that the use of ultrasound guidance for interscalene blocks allowed to decrease volumes of local anesthetics (5 ml) and was associated with fewer respiratory and other complications with no change in postoperative analgesia compared with the standard-volume technique.

Supraclavicular block

The close proximity of the pleura and apex of the lung means that traditional techniques carry a risk of pneumothorax. Direct visualization of these structures may make this a safer block to performed. The trunks of the brachial plexus surround the artery. US guided supraclavicular block results in greater radial blockade than US guided infraclavicular block and faster onset than neurostimulation technique. KAPRAL *et al.* and WILLIAMS *et al.* (15, 16) reported that the use of ultrasound guidance allowed faster onset and procedure, higher quality of block and minimization of risk in comparison with nerve stimulation or paresthesia techniques (17).

Infraclavicular block

The ability to locate and avoid vessels is a major benefit of US guidance for this block as it carries an incidence of vascular puncture of up to 30%. Visualization and the knowledge of the depth to the pleura also provides a measure of security. Based on US imaging, modification of the landmarks for vertical infraclavicular block is necessary. A medial approach results in better imaging, less procedure time, faster onset, less vascular puncture and greater blockade than a lateral approach (18-21). DINGEMANS *et al.* (22) claimed that ultrasound guided infraclavicular block is more rapidly performed and yields a higher success rate when visualization of posterolateral spread of local anesthetic around the axillary artery is used as the end point for injection. SAUTER and colleagues (23) did not demonstrate difference in success rate

between nerve stimulation or ultrasound guidance but concluded that local anesthetic injection cranio-posterior to the artery appears feasible and recommended.

Axillary brachial plexus block

Successful axillary block requires a multi-stimulation technique necessitating location of at least three nerves (musculocutaneous, median and radial). This may be facilitated by US and prevent arterial puncture. Two studies (24, 25) have demonstrated improved success rates and faster onset with US guided axillary block but comparisons have been made with the trans-arterial technique and a triple stimulation technique with only a 62% success rate (most studies indicated a 94-98% rate). CASATI and colleagues (26) recently reported that multiple injection axillary block with ultrasound guidance provided similar success rates and comparable incidence of complication as compared with nerve stimulation guidance. Only onset of sensory blockade was shorter in the ultrasound guided group.

Blocks at the elbow or forearm

The use of US makes peripheral blocks at these levels more feasible especially because of the lack of landmarks in the forearm or at the elbow for the radial nerve. The use of US may make these blocks more accessible in the non-operating room setting (27, 28).

Lower Limb

Psoas compartment block

The psoas compartment or posterior lumbar plexus block is the only effective "3-in-1" block with neural blockade of the lateral femoral cutaneous, femoral and obturator nerves. However concerns regarding the depth of the block and the possibility of bilateral anaesthesia have limited its use. Initially it was believed that US may reduce these problems but at present poor visual resolution means US has a limited role and is used mainly to determine psoas muscle depth and renal position (29).

Femoral block

US guided femoral block results in greater success rates (95% vs 85%), faster onset time and reduce local anaesthetic volumes compared to neurostimulation (30). CASATI *et al.* (31) reported that

ultrasound guidance provided a 42% reduction in the minimum effective local anaesthetic volume of ropivacaine 0.5% required to block the femoral nerve as compared with the nerve stimulation guidance. US guidance is also useful in cases where a femoral vascular graft is present (32).

Obturator nerve blocks

The obturator nerve can be sonographically visualized by scanning along the known course of the nerve; the anterior division characteristically converges toward the posterior division along the lateral border of the adductor brevis muscle to form the common obturator nerve more proximally. SOONG and colleagues (33) described in a descriptive study in 20 volunteers that 25% of common, 85% of anterior, and 87.5% (35/40) of posterior obturator nerves were sonographically identified. The nerve and its anterior and posterior divisions are flat nerves. HELAYEL *et al.* (34) reported that in 91% of cases, the obturator nerve was correctly identified on first attempt as a hyperechoic flat with internal hypoechoic dots in between the adductor longus muscle and adductor brevis muscle for the anterior branch and the adductor brevis and magnus muscles for the posterior branch. The local anaesthetics injection should be done into the fascias separating these muscles.

Sciatic nerve blocks

Using US, the sciatic nerve can be traced from the subgluteal region to the popliteal fossa, allowing for neural blockade at any level. DOMINGO-TRIADO and colleagues (35) studied the value of ultrasound guidance for the lateral midfemoral approach for the sciatic nerve. The nerve stimulation endpoint was less than 0.5 mA. Ultrasound guidance did not decrease block failure incidence but reduced the number of attempts required to nerve location and the percentage of patient with partial sensory block (3 vs 29%). Interestingly, BARRINGTON *et al.* (36) recently reported that ultrasound guidance of the sciatic nerve block at the midhigh level can be achieved, however 37.5% of patients required nerve stimulation to confirm the sonographic appearance. US also facilitates the location of the division of the sciatic nerve into its two components (tibial and common peroneal nerves) (37). As blockade of both components is necessary for complete sciatic nerve blockade, direct visualization of local anaesthetic spread may improve block performance (38). Locating the popliteal artery medial to the nerves or using a

trace-back method cephalad from the popliteal fossa, are useful clinical tips. PERLAS *et al.* (39) reported that ultrasound guidance resulted in higher success (89.2% vs. 60.6%), faster onset, and progression of sensorimotor block compared to nerve stimulation while the procedure time was similar. On the other hand, the use of combined nerve stimulation-ultrasound guidance can optimize the result of the block (40).

The interests of ultrasound guidance in terms of actual literature readings are reported in table 2 and in Koscielniak-Nielsen recent review (41).

Neuraxial blocks

US may be used for epidural, spinal and paravertebral blocks, but in the adult patient interference from bony artefacts may complicate block performance. The signal drop-out from bone however can be used to determine the position of the spinal interspaces and the depth to the vertebral bodies (42, 43). The longitudinal view is best for determining interspaces and depth to dura mater whereas the transverse view allows for imaging of the ligamentum flavum and dura mater, which are both hyperechoic structures. US guided lumbar epidural or combined epidural-spinal anaesthesia results in fewer puncture attempts, reduced spinal needle manipulations, improved obstetric analgesia, fewer side effects and greater maternal satisfaction than a "blind" technique (44). The paramedian window improves imaging of the ligamentum flavum, dura mater and cauda equina but whether this translates into better outcomes compared to a median window approach has not been studied (44). A case series on US use in four obstetric patients has been reported. Loss of continuity in the doppler layer signal of the dura mater indicated the defect and a reduced volume of cerebrospinal fluid was noted. Following US guided epidural block, the expansion of the epidural space by blood was seen and the doppler signal layer changes were no longer present indicating closure of the defect. For the paravertebral block US provides accurate information on the depth from the skin to the paravertebral space (45).

WHY : ULTRASOUND IN PAEDIATRIC REGIONAL ANAESTHESIA

Ultrasonography for regional anaesthesia in paediatric patients is very rewarding as image resolution is particularly good even for deeper blocks such as the psoas compartment block or neuraxial techniques (46, 47). Visualization of the neural

Table 2

Review of studies for each particular peripheral nerve block claiming benefits for the use of ultrasound guidance

Block type	Study	Number of patients	Interest of US guidance
Interscalene Block	Sinha S. K., Abrams J. H., Weller R. S., <i>Ultrasound-guided interscalene needle placement produces successful anesthesia regardless of motor stimulation above or below 0.5 mA</i> , ANESTH. ANALG., 105 (3), 848-52, 2007.	61	– The spread of local anaesthetics solution is the key element for success
	Kapral S., Greher M., Huber G., Willschke H., Kettner S., Kdolsky R., Marhofer P., <i>Ultrasound-guided interscalene approach for regional anesthesia of the brachial plexus blockade</i> , REG. ANESTH. PAIN MED., 33 (3), 253-8, 2008.	160	– Success rate improved
Supraclavicular Block	Kapral S., Krafft P., Eisenberger K., Fitzgerald R., Gosch M., Weinstabl C., <i>Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus</i> , ANESTH. ANALG., 78 , 507-13, 1994.	40	Faster onset, improved block, minimization of risk.
	Williams S. R., Chouinard P., Arcand G., Harris P., Ruel M., Boudreault D., Girard F., <i>Ultrasound guidance speeds execution and improves the quality of supraclavicular block</i> , ANESTH. ANALG., 95 , 1518-23, 2003.	80	Decrease time procedure and improved block
Infraclavicular Block	Ootaki C., Hayashi H., Amano M., <i>Ultrasound guided infraclavicular brachial plexus block : an alternative technique to anatomical landmark-guided approaches</i> , REG. ANESTH. PAIN MED., 25 , 600-604, 2000.	60	95% success rate. Direct visualization.
	Sandhu N. S., Capan L. M., <i>Ultrasound-guided infraclavicular brachial plexus block</i> , Br. J. ANAESTH., 89 , 254-9, 2002.	126	High success rate. Short onset time. Low complication rate.
	Sandhu N. S., Manne J. S., Medabalmi P. K., Capan L. M., <i>Sonographically guided infraclavicular brachial plexus block in adults : a retrospective analysis of 1146 cases</i> , J. ULTRASOUND MED., 25 , 1555-61, 2006.	1146	High success rate. Low complication rate.
	Dingemans E., Williams S. R., Arcand G., Chouinard P., Harris P., Ruel M., Girard F., <i>Neurostimulation in ultrasound-guided infraclavicular block : A prospective randomized trial</i> , ANESTH. ANALG., 104 , 1275-80, 2007.	72	More rapidly performed. Higher success rate if posterior spread of LA
	Sauter A. R., Dodgson M. S., Stubhaug A., Halstensen A. M., Klaastad Ø., <i>Electrical nerve stimulation or ultrasound guidance for lateral sagittal infraclavicular blocks : a randomized, controlled, observer-blinded, comparative study</i> , ANESTH. ANALG., 106 (6), 1910-5, 2008.	80	High success rate if inferoposterior spread of LA
Axillary Block	Sites B. D., Beach M. L., Spence B. C., Wiley C. W., Shiffrin J., Hartman G. S., Gallagher J. D., <i>Ultrasound guidance improves the success rate of perivascular axillary plexus block</i> , ACTA ANAESTHESIOL. SCAND., 50 , 678-84, 2006.	50	Improved success rate. Faster procedural time.
	Chan V. W., Perlas A., McCartney C. J., Brull R., Xu D., Abbas D., <i>Ultrasound improves success rate of axillary brachial plexus block</i> , CAN. J. OF ANAESTH., 54 , 3176-182, 2007.	188	Higher success rates. Addition of nerve stimulation did not increase success
	Casati A., Danelli G., Baciardo M., Corradi M., Leone S., Di Cianni S., Fanelli G., <i>A prospective randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block</i> , ANESTHESIOLOGY, 106 , 992-96, 2007.	60	Similar results for success. Sensory block onset time decreased with ultrasound.
Distal nerve blocks	McCartney C. J., Xu D., Constantinescu C., Abbas S., Chan V. W., <i>Ultrasound examination of peripheral nerves in the forearm</i> , REG. ANESTH. PAIN MED., 32 (5), 434-9, 2007.	11	Nerves consistently located
Femoral nerve Block	Marhofer P., Schrogendorfer K., Koinig H., Kapral S., Weinstabl C., Mayer N., <i>Ultrasound-guided interscalene approach for regional anesthesia of the brachial plexus blockade</i> , ANESTH. ANALG., 85 , 854-7, 1997.	40	Faster onset. Higher quality block.
	Marhofer P., Schrogendorfer K., Wallner T., Koinig H., Mayer N., Kapral S., <i>Ultrasound guidance reduces the amount of local anesthetic for 3-in-1 blocks</i> , REG. ANESTH. PAIN MED., 23 , 584-588, 1998.	60	Higher success rate. Shorter onset time. Better quality block. Less volume required.
	Casati A., Baciarello M., Di Cianni S., Danelli G., De Marco G., Leone S., Rossi M., Fanelli G., <i>Effects of ultrasound guidance on the minimum effective anaesthetic volume required to block the femoral nerve</i> , Br. J. ANAESTH., 98 , 823-7, 2007.	60	42% reduction of volume needed for effective block in US group
Obturator nerve block	Soong J., Schafhalter-Zoppoth I., Gray A. T., <i>Sonographic imaging of the obturator nerve for regional block</i> , REG. ANESTH. PAIN MED., 32 (2), 146-51, 2007.	20	25% of common, 85% of anterior, and 87.5% of posterior obturator nerves were sonographically identified
	Helayel P. E., da Conceição D. B., Pavei P., Knaesel J. A., de Oliveira Filho G. R., <i>Ultrasound-guided obturator nerve block : a preliminary report of a case series</i> , REG. ANESTH. PAIN MED., 32 (3), 221-6, 2007.	22	ultrasound-guided obturator-nerve identification and block are technically easy and highly successful
Mid Femoral Sciatic nerve block	Domingo-Triadó V., Selfá S., Martínez F., Sánchez-Contreras D., Reche M., Tecles J., Crespo M. T., Palanca J., Moro B., <i>Ultrasound guidance for lateral midfemoral sciatic nerve : A prospective, comparative, randomized study</i> , ANESTH. ANALG., 104 , 1270-1274, 2007.	61	Addition of ultrasound to nerve stimulation resulted in less attempts and better quality of block.
	Barrington M. J., Lai S. L., Briggs C. A., Ivanusic J. J., Gledhill S. R., <i>Ultrasound-guided midhigh sciatic nerve block-a clinical and anatomical study</i> , REG. ANESTH. PAIN MED., 33 (4), 369-76, 2008.	40	37.5% of patients required nerve stimulation to confirm sciatic nerve sonographic appearance
Popliteal Sciatic nerve Block	Perlas A., Brull R., Chan V. W., McCartney C. J., Nuica A., Abbas S., <i>Ultrasound guidance improves the success of sciatic nerve block at the popliteal fossa</i> , REG. ANESTH. PAIN MED., 33 (3), 259-65, 2008.	74	Ultrasound guidance resulted in higher success, faster onset, and progression of sensorimotor block
	Dufour E., Quennesson P., Van Robais A. L., Ledon F., Laloë P. A., Liu N., Fischler M., <i>Combined ultrasound and neurostimulation guidance for popliteal sciatic nerve block : a prospective, randomized comparison with neurostimulation alone</i> , ANESTH. ANALG., 106 , 1553-8, 2008.	60	Combined ultrasound and neurostimulation guidance increases the success rate of popliteal sciatic nerve block

structures is enhanced compared to adults and this is especially true in the case of babies and infants. The main reason for this is that structures are more superficial and hence a higher frequency probe resulting in better image resolution can be used. US guided ilioinguinal/iliohypogastric, psoas compartment, epidural, caudal (48, 49) and abdominal wall blocks have been described in children (50).

CONCLUSION

The use of US is the first major change in regional anaesthesia practice since the introduction of neurostimulation for nerve location. The ability to now both visualize the nerve and confirm correct local anaesthetic solution placement is a very exciting development and has already demonstrated its efficacy in terms of success rates, speed of onset and reduced local anaesthetic volume for a number of neural blocks. Whether US guided blocks will replace neurostimulation techniques is debatable especially when regional anaesthesia is performed by specialists in the field. However US does offer an increased margin of safety or at least improved confidence for particular blocks or specific patient situations (51).

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