Ultrasound-Guided Interscalene Blocks

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Anaesthesiologists routinely use peripheral nerve blocks as an alternative or an adjunct to general anesthesia in addition to postoperative analgesia for a wide variety of procedures. More recently, emergency physicians have also begun using regional techniques in lieu of procedural sedation for a wide variety of extremity procedures such as reduction of shoulder dislocation. The goal of a peripheral nerve block is to apply a local anesthetic directly onto a peripheral nerve or nerve plexus to completely anesthetize the surgical site.

Historically, anaesthesiologists have performed peripheral nerve blocks using the paresthesia technique, in which the needle is inserted at a point determined by standard anatomic landmarks and then advanced until the patient feels paresthesia in the relevant sensory distribution. In the 1970s and 1980s, anaesthesiologists began using a nerve stimulator to improve needle localization. Essentially, a nerve stimulator is a device that sends current through the block needle to elicit contraction of relevant muscle groups when in close proximity to the nerve of interest. These techniques are effective and are still in use, although they have many drawbacks. Over the past decade, ultrasound has gained popularity for peripheral nerve blockade because it allows the anaesthesiologist to directly visualize the nerves of interest, the needle tip itself, and the spread of the local anesthetic in the desired location. In addition, the ultrasound image reliably depicts other structures such as blood vessels and lungs that the anaesthesiologist wants to avoid. For these reasons, ultrasound guidance has increasingly become the standard technique for regional anesthesia.

Brachial plexus blockade has long been used for upper extremity surgery, and there are several standard techniques. The interscalene block is especially useful for shoulder surgery. In this article, we will describe the technique of an ultrasound-guided interscalene block and then discuss its advantages over the traditional landmark technique.

Description of the Procedure

The brachial plexus is derived from the C4-T1 spinal nerve roots. The nerve roots exit the vertebral foramina and pass anterolaterally and inferiorly to lie between the anterior and middle scalene muscles. Beyond that point, the nerve roots coalesce to form the superior, middle, and inferior trunks, which then go on to further divide and coalesce sequentially into divisions, cords, and then finally the individual peripheral nerves of the upper extremity.
The interscalene block targets the C4, C5, and C6 nerve roots where they lie between the anterior and middle scalene muscles near the level of the cricoid cartilage. Because the block is typically performed cephalad to the exit points of the C7 and T1 nerve roots, the interscalene block typically requires supplementation with an ulnar nerve block to be useful for forearm or hand surgery. For shoulder surgery, however, it is extremely reliable as a sole block.1

Before performing the block, the patient requires an intravenous line and standard American Society of Anesthesiologists monitors, including blood pressure, electrocardiography, and continuous pulse oximetry. Emergency resuscitation equipment, including airway devices, advanced cardiac life support drugs, and intravenous fat emulsions for local anesthetic toxicity, must be immediately available. Oxygen is administered by nasal cannula. Sedation is optional because the procedure is usually short with minimal discomfort, although in our experience, most patients are quite anxious and do well with mild sedation (we typically use low doses of midazolam and fentanyl).

The patient is then positioned supine with the head turned away from the side to be injected, and the site is marked. Some patients require a roll under the shoulder to enhance neck extension. The operator dons a cap, mask, and sterile gloves and the patient’s neck is prepared widely with chlorhexidine. The ultrasound probe is placed in a sterile probe sheath. We use a LOGIQ e ultrasound machine with a 12L-RS linear array, 42 × 7-mm, 5- to 13-MHz transducer (GE Healthcare, Milwaukee, WI). For most interscalene blocks, we set the ultrasound machine for 10 MHz with a 3-cm depth.

After a procedure time-out, the ultrasound probe is placed over the patient’s neck, oriented roughly in the axial plane (Figure 1). By convention, we position the probe with the direction indicator medially on the neck. The probe is positioned over the sternocleidomastoid at the level of the cricoid cartilage. After identifying the jugular vein and carotid artery in the short axis, the operator slides the probe laterally/posteriorly until the brachial plexus nerve roots are visualized. At this level, the nerve roots of the brachial plexus will appear as 2 to 4 round hypoechoic circles lying between the anterior and middle scalene muscles (Figure 2). Occasionally, the brachial plexus can be difficult to find using this method. Another useful approach is to visualize the subclavian artery just above the clavicle. The brachial plexus lies in a cluster around the artery at this level and is very easy to identify. The operator then slides the ultrasound probe cephalad, tracking the brachial plexus until the interscalene target is identified. The nerve roots should be positioned toward the medial edge of the screen (away from the needle insertion point) to maximize needle visualization during the block. The great vessels should not be in view during the block. If both vessels are in view, the transducer is likely too medial.

Once an optimal view of the nerve roots is established and color Doppler imaging confirms the absence of blood vessels in the trajectory of the needle, the operator prepares for the block. The ideal needle insertion point is roughly 1 cm lateral to the lateral edge of the ultrasound probe (Figure 3). The skin is anesthetized with 1 to 2 mL of lidocaine, 1%. While holding the ultrasound transducer with the non-dominant hand, the operator then inserts a 22-gauge × 50-mm nerve block needle “in plane” with the ultrasound probe, allowing visualization of the entire needle (Figure 4). The needle can also be inserted “out of plane,” although we think that the in-plane technique is more effective and safer because needle tip visualization is easier. The operator advances the needle slowly, taking care to avoid any vascular structures and keeping the needle tip in view at all times. Once the needle tip is adjacent to the brachial plexus, an assistant will aspirate (checking for intravascular needle placement) and then inject 1 mL of a local anesthetic. The optimal needle location can be shown by visualizing the spread of the local anesthetic as a hypoechoic area around the nerve roots (Figure 5). If adequate spread is not seen, then the needle tip has probably not penetrated through the fascial plane that separates the middle scalene and the brachial plexus sheath. If that is the case, the needle will need to be advanced slightly. Once the ideal local anesthetic spread is visualized, the assistant injects a local anesthetic (we use 12 to 25 mL of bupivacaine, 0.5%, with epinephrine, 1:400,000), taking care to aspirate intermittently to ensure that the needle tip remains extravascular (Video 1). The needle is then removed.

Figure 1. Starting orientation of the ultrasound probe.
Discussion

Before the introduction of ultrasound guidance, anesthesiologists performed regional blocks using classic landmark techniques with or without nerve stimulation. For a landmark-based interscalene block, the needle insertion point is at the interscalene groove just posterolateral to the sternocleidomastoid muscle at the level of the cricoid cartilage. The needle is inserted at a 45° caudal and slightly posterior angle and advanced until either paresthesia or appropriate nerve stimulation is achieved in the C4, C5, or C6 distribution. At that point, the anesthesiologist aspirates the needle to make sure the needle tip is not intravascular and then injects the local anesthetic.1

Although typically effective, the landmark-based technique is problematic in that it is a “blind” procedure. Because of anatomic variation and occasional difficulty palpating the interscalene groove, the landmark technique is subject to failure or the need for multiple needle passes.

Furthermore, there are many vulnerable anatomic structures in close proximity to the brachial plexus, including the carotid artery, jugular vein, vertebral artery, phrenic and laryngeal nerves, dura mater, and dome of the pleura. Thus, a slightly errant needle can result in serious complications, including nerve injury, intravascular injection with subsequent local anesthetic toxicity, total spinal anesthesia, and pneumothorax.3,5 In theory, ultrasound guidance mitigates these problems because the anesthesiologist can directly visualize the anatomy as well as the needle. The question remains, however, of whether there is literature to support the superiority of ultrasound guidance versus traditional techniques for an interscalene block.
There is substantial evidence that ultrasound guidance increases the efficacy and decreases the performance time of interscalene blocks. In a randomized study, Kapral et al. showed that ultrasound guidance was 99% successful in achieving surgical anesthesia compared with 91% for landmark/nerve stimulation. Furthermore, Liu et al. reported a reduced number of block attempts as well as improved motor blockade in ultrasound-guided interscalene blocks versus landmark/nerve stimulation blocks. Antonakakis et al. reviewed 19 randomized controlled trials of ultrasound versus landmark/nerve stimulation blocks. Antenakakis et al. stated that ultrasound guidance versus traditional techniques (assorted nerve blocks, not only interscalene) and found that 11 of the studies showed a significant improvement in performance times using ultrasound, and 5 studies showed no statistical difference. Furthermore, from a review of 17 randomized controlled trials, the authors concluded that the use of ultrasound for regional blocks decreases the overall block onset time by 2 to 12 minutes compared with traditional techniques.

The evidence for improved safety has been less conclusive. Several randomized controlled trials have shown that ultrasound guidance results in fewer unintended paresthesias, which suggests that because of direct visualization, needle-related nerve injury might be less common. However, Liu et al. failed to show any reduction in long-term neurologic sequelae with the use of ultrasound for interscalene blocks. Furthermore, a prospective study of more than 7000 patients undergoing all types of nerve blocks showed no long-term difference in the incidence of neurologic injury. Several randomized controlled trials also showed a decreased incidence of vascular puncture using ultrasound guidance versus traditional techniques. However, to our knowledge, no study has shown a significant reduction in the incidence of local anesthetic toxicity. Investigators have shown that ultrasound guidance allows for a substantial reduction in the volume of injectate required for a successful block, which results in a lower incidence of phrenic nerve palsy and diaphragmatic paresis. In theory, the lower local anesthetic volume might also reduce the incidence or severity of other complications, such as stellate ganglion blocks, recurrent laryngeal nerve blocks, spinal and epidural anesthesia, and the toxic sequelae following inadvertent intravascular injection. It is possible that given the rarity of most of these complications, the studies thus far have been underpowered to detect any difference.

In a broader sense, the use of ultrasound may find its greatest benefit in that it expands the use of regional anesthesia for shoulder surgery, which has been shown to have many clinical benefits, including less pain, earlier ambulation, earlier discharge from the recovery area, fewer subsequent hospital admissions, and greater patient satisfaction. Antonakakis and Sites pointed out that the use of ultrasound has resulted in an enormous increase in the application of regional anesthesia, probably because of the ease of use and anesthesiologists’ perception of improved safety. They argued that, ultimately, ultrasound guidance for nerve blocks benefits patients simply because more patients are getting regional anesthesia for surgery. Similarly, ultrasound guidance has expanded the application of regional anesthesia to other specialties such as emergency medicine as well as other settings such as combat trauma hospitals and rehabilitation centers.

In conclusion, ultrasound guidance has emerged as a standard technique for performing interscalene blocks as well as a number of other regional anesthetic blocks. Ultrasound guidance for interscalene blocks may be superior in terms of efficacy and safety compared with the traditional landmark technique because it allows direct visualization of the nerve targets, other adjacent anatomic structures, and the needle itself. There is substantial evidence to support the efficacy of ultrasound guidance for interscalene blocks (as well as other nerve blocks), although improved safety has not been clearly shown compared with the landmark technique, probably because of the rarity of serious complications. In practice, ultrasound has dramatically increased the use of regional anesthesia, which offers many important clinical benefits to patients recovering from surgery.

References


