

Anesthetic Considerations for Vascular Access Placement in Patients with End-Stage Renal Disease

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Abstract

According to the National Institute of Diabetes and Digestive and Kidney Diseases Health Information Center, the overall prevalence of chronic kidney disease is approximately 14 percent in the general population of the United States [1]. This prevalence has remained relatively stable since 2004 [1] with approximately 468,000 Americans on dialysis as of 2015. [2] With diabetes and hypertension being the most common primary causes of End-Stage Renal Disease (ESRD), patients undergoing procedures for arteriovenous access tend to present with multiple co-morbidities. For this specific patient population, these comorbidities may have specific anesthetic implications. This article focuses on the anesthetic considerations throughout the entire perioperative period with special emphasis on the role of regional anesthesia.

Introduction

When managing End-Stage Renal Disease (ESRD) patients undergoing vascular access placement, a complete perioperative care including preoperative medical optimization, intraoperative anesthetic techniques, and postoperative management is necessary to ensure patient safety and enhance individual experience of care. During the preoperative period, the patients must be medically optimized with a system-based approach, ensuring all the comorbidities are addressed and treated prior to surgery. Once deemed an appropriate surgical candidate, the type of anesthesia should be determined with the anesthesiologist, surgeon and patient. More and more, regional anesthesia has become a great option for these patients.

Methods

A literature review of the original research studies, review articles, and editorials present on PubMed since 1990 was conducted. The authors included peer-reviewed articles that they deemed relevant to current practice. Additional articles were identified after review of the references of selected articles.

Preoperative Considerations

Patients presenting for vascular access placement, such as arteriovenous fistula surgery, often present with multiple co-morbidities. To identify and treat the existing diseases in these ESRD patients, Rang et al. suggested a system-based approach for the preoperative evaluation [3]. Common diseases associated with ESRD are listed by different systems in Table 1. Chronic Renal Disease (CRD) is strongly associated with Coronary Artery Disease (CAD). Therefore, all CRD patients with the positive history of cardiovascular disease should receive a baseline Electrocardiogram (ECG) [4]. Preoperative evaluation of the patient with Hypertension (HTN) should assess if there is an adequate control of blood pressure and whether there is the presence of end-organ damage. Uncontrolled HTN may warrant consult for effective antihypertensive treatment prior to surgery. If newly onset or unstable angina is presented, the patient needs to be referred for cardiac evaluation and optimization prior to surgery [5,6]. Patients with history of impaired cardiac contractility or heart failure may benefit from ventricular function evaluation. For patients with shortness of breath and/or poor to unknown preoperative functional capacity, a preoperative chest x-ray in addition to the cardiac evaluation may be warranted. Adequate diabetes management and anemia treatment are also important as hyperglycemia and anemia are both related to increased morbidity and mortality rate in the perioperative setting. [7-9]

The timing of the patient's routine Intermittent Hemodialysis (IHD) is important. Having IHD on the same day of the vascular access placement may place the patient at risk for dialysis disequilibrium syndrome. Since the rate of urea removal during IHD is a crucial factor in the development of this syndrome, patients undergoing dialysis on the same day of the procedure should not have dialysis at increased blood flow rates in an effort to avoid delay of the procedure [10]. At

the time of the procedure, hemodialysis patients are recommended to be as close to dry weight as possible [11]. If the procedure causes the cancellation or delay of the patient’s routine IHD, hypervolemia is a particular concern. Since anemia is a common comorbidity in ESRD patients, they may be more likely to require intraoperative blood products. Transfusion of blood products in ESRD patients not at dry weight preoperatively may present a higher risk for acute congestive heart failure. [12] Procedure should take place within 24 hours following the routine IHD [3,12].

Intraoperative Managements

Anesthetic techniques commonly used for vascular access surgery are Local Anesthetic (LA) infiltration, Regional Anesthesia (RA), and General Anesthesia (GA). Both LA infiltration and RA may be done with Monitored Anesthesia Care (MAC) or without sedation.

Local anesthetic infiltration

LA infiltration technique is simple to administered, but it associated with higher risks of local edema [13,14] and vassal spasms [14,15]. For procedures lasting longer than the local anesthetic effect, repeated LA injections or additional sedative medications may be required.

Regional anesthesia

Vascular accesses in patients with ESRD are commonly placed in the upper extremities. RA of the upper extremity requires blockade of the brachial plexus at different levels (supraclavicular, infraclavicular, or axillary) depending on the site of surgery. This technique has the potential advantages of avoidance of airway manipulation, decreased drug side effects seen in GA and MAC, intraoperative hemodynamic stability, better postoperative analgesia and faster recovery [16-

19]. Evidences have showed that RA reduces vasospasm and causes vasodilation to maintain a higher blood flow during the perioperative period [20,21]. Risks associated with RA include neuropathy from mechanical trauma to the nerves, neuronal ischemia and neurotoxicity from direct intraneuronal injection of LA, hematoma, infection, and technical difficulty and local anesthetic toxicity from injection of LA into the vessel.

One of the challenges with RA using anatomical landmarks is the presence of anatomic variation [22]. Traditional techniques for nerve localization (i.e., paresthesia and nerve stimulation) rely upon anatomical assumption based on the surface landmarks. In patients with abnormal anatomy or obesity, it is difficult to identify surface landmarks or predict the depth of the desired nerve. During nerve stimulation, the produced motor response cannot exclude the possibility of incorrect needle placement and block failure [19]. Motor twitches are lost after LA is given, especially with superficial blocks. With the use of ultrasound (US), direct visualization of the nerves, ligaments, and vessels provides clear images of the needle location and the spread of injected local anesthesia [19,23]. Another potential benefit of the US-guided RA is a reduction in the incidence of systemic local anesthetic toxicity by injecting the LA in close proximity to the nerve, thereby minimizing the effective dose required [24]. Several randomized trials reported fewer needle passes, faster block performance, and faster onset of the block with US use compared to the conventional blind technique [25].

General anesthesia

GA may be required for patients with difficult anatomy, contraindications to RA, or after RA is attempted and failed. It can enhance blood flow as a result of the vasodilatory effect of anesthetics, but this effect is limited to the intraoperative period [13]. GA can lead to increased stress response, hemodynamic instability, potential drug interaction, [14,15,26] residual muscle relaxant, respiratory depression during postoperative period, and poor postoperative pain control. However, with careful management, the risk of these possible complications is low [3].

Steps of Regional Anesthesia Considerations

Determination of regional anesthesia appropriateness

1. Determine if the patient is a candidate for regional anesthesia. Obtain consent and determine patient’s cooperation with procedure. Also evaluate anticoagulation status and follow the Anesthesiology Society of Regional Anesthesia (ASRA) guidelines [27].

2. Determine which block is optimal for the patient and procedure. Surgical anesthesia options for vascular access include the supraclavicular, infraclavicular, and axillary block.

The supraclavicular block is performed where the brachial plexus passes with the subclavian artery between the clavicle and the first rib, after passing between the anterior and middle scalene muscles. Local anesthetic solution is deposited over the trunks of the brachial plexus above the formation of musculocutaneous and axillary nerves [28]. The supraclavicular block is preferred in our practice because the brachial plexus is tightly packed at this level allowing for a dense block. Also, this block provides adequate anesthesia of the entire arm and allows for surgical site flexibility. The major downside is its close

Table 1: Common Co morbidities Associated with ESRD Patients [1].

Cardiovascular disease
• Hypertension
• Coronary artery disease
• Congestive Heart Failure
• Cardiomyopathy
• Pericarditis
• Pericardial effusion
• Cerebrovascular disease
• Pulmonary hypertension
• Atrial fibrillation
Pulmonary disease
• Pulmonary edema
• Uremic pleuritis
Diabetes
Anemia
Coagulation abnormality
• Platelet dysfunction
Electrolyte abnormality
Fluid balance abnormality
Gastrointestinal disease
• Delayed gastric emptying
• Stress ulceration
Peripheral and autonomic neuropathy

proximity to the pleura, hence ultrasound use is highly recommended with this technique, with or without nerve stimulation. Due to the superficial location of the brachial plexus at this level, high frequency system (10-15 MHz) can generate an excellent visualization of all structures in this area. Nerve stimulation is not routinely used at our institution, sparing the patient from painful muscle contractions unless there is difficulty with the image. Phrenic nerve blockade is likely (upwards of 50% incidence) with this approach and close observation should be performed especially in patients with compromised respiratory function or a different approach should be used in this patient population.

The infraclavicular block is performed where the brachial plexus is below the level of the clavicle and in proximity to the coracoid process. Local anesthetic solution is deposited over the cords of the brachial plexus which lie circumferentially around the artery at this level. This block is sufficient for distal arm surgery at the elbow, forearm and hand and can be performed with ultrasound or nerve stimulation technique. Due to deep location of the brachial plexus at this level, lower frequency system (5-12 MHz) is recommended for better tissue penetration in overweight individuals [19]. Ultrasound images of this approach are inferior to those of other approaches because the high frequencies are absorbed by the pectoralis muscles [29]. Maneuvers to decrease the depth of the target may be attempted with varying success. It is difficult to perform this approach in obese patients due to extreme depth of the plexus at this level and difficulty with visualization. This block can be very uncomfortable for some patients because the needle must penetrate through the thick muscles (pectoralis major and minor), requiring more sedation which places patients at risk for respiratory depression. Also, supplementation of LA by the surgeon, additional sedation or conversion to general endotracheal anesthesia may be necessary if high surgical approach (upper arm) is required. We reserve this block for situations when there is a relative contraindication to supraclavicular block (e.g., subclavian artery pathology or arteriovenous communication around the trunks which makes it difficult to pass the needle without puncturing the vessels; severe chronic obstructive pulmonary disease).

The axillary block is performed where the brachial plexus is at the level of the terminal branches which include the median, ulnar, radial and musculocutaneous nerves. This block is sufficient for distal arm surgery and requires a separate block of the musculocutaneous nerve, which leaves the brachial plexus sheath proximally. This block can be performed with ultrasound or nerve stimulation technique or via a transarterial approach. All techniques rely on the relationship of the nerves to the axillary artery. Due to the superficial location of the brachial plexus at this level, high frequency system (10-15 MHz) can generate an excellent visualization of all structures in this area. However, significant variation exists regarding the position of the nerves relative to the axillary artery [30]. Multiple injections are superior to single injection for axillary approach. Median and radial nerves are easily seen and appears to be more important for a successful block [30,31]. Retzl and colleagues observed that the position of the nerves relative to the axillary artery at this level changes significantly with application of varying pressures [32].

3. Determine which local anesthetic to use. Selecting a LA should be based on specific goals. The intermediate-acting agents lidocaine and mepivacaine can be used when faster onset is necessary but they have short analgesic duration (90-180 minutes). When prolonged

analgesia is desirable, ropivacaine and bupivacaine should be used (4-18 hours). Ropivacaine is most widely used because it has less cardiac toxicity and less propensity for motor blockade than bupivacaine. The choice of concentration should be based on whether the block is intended for surgical anesthesia or analgesia. For example, 0.5% ropivacaine can provide excellent analgesia, but does not consistently provide for surgical anesthesia [20]. For surgical anesthesia, sensory and motor block onset and duration were no different with 0.75% ropivacaine compared to 0.5% bupivacaine [30,33,34]. Local anesthetic mixtures are usually avoided at our institution. While they provide faster block onset than long-acting agents alone, the duration and potency of the block with the mixtures is less predictable and extend the duration typically seen with intermediate- or short-acting agents. We also tend not to use the adjuvants (clonidine, epinephrine, opioids) due to nature of vascular access surgery. The provider should also be familiar with local anesthetic toxicity, its recognition, and prompt treatment. The provider should have knowledge of where emergency medications, including lipid emulsion, are located.

4. Have all necessary equipment available. Standard monitors including EKG, pulse oximeter, and noninvasive blood pressure are required. In order to ensure patient comfort and facilitate the block performance, use adequate sedation and analgesia. This requires supplemental oxygen, emergency airway equipment, and intravenous access. Standard equipment for the block will include antiseptic preparatory equipment, 25 gauge needle for local skin infiltration, B-bevel stimulating needle (5 to 10 cm, depending on the type of the block and patient habitus), two 20 ml syringes, 3 way stopcock, ultrasound system (should be portable, with high definition) and a choice of probes to allow imaging of both superficial (high frequency) and deep (lower frequency) nerves , large tegaderm , ultrasound gel, and nerve stimulator if necessary (Figure 1A). If the anesthesiologist is certain of the nerve's identity on ultrasound, stimulation with a peripheral nerve stimulator is not necessary.

5. Draw appropriate volume of desired LA solution, usually 20 to 40 ml (depending on block) into 20 ml syringes. Connect the syringes to 3-way stopcock along with the stimulating needle (Figure 1B). Flush the needle to prevent air from distorting ultrasound image when performing the block. Draw 2-3 ml of plain lidocaine 1-2% into a syringe with the 25 gauge needle for local infiltration.

Place the ultrasound machine on the contralateral side of the patient. The operator should stand on the ipsilateral side of the extremity to be blocked. All transducers have an orientation marker that should be positioned at the upper-left corner of the screen, so skin surface will be uppermost. Choose the appropriate transducer: high-frequency (up to 15 MHz) for superficial blocks, allowing better resolution and lower-frequency transducer for deeper blocks allowing better penetration. Place the sterile tegaderm over the transducer and apply the ultrasound gel. If using the nerve stimulator, connect the stimulating needle to the stimulator. Place an electrode on any available part of the patient's extremity; this will be the ground that the nerve stimulator will also be attached.

Administration of the regional anesthesia

For successful US-guided nerve block, the performer should 1) identify the target nerve structure and get appropriate image, 2) track the in-plane needle advancement in real time, 3) assess the LA spread around the target nerve.



Figure 1A: Standard regional anesthesia setup.



Figure 2: Needle and probe positioning for supraclavicular block.

Ultrasound-guided supraclavicular block

Patient position: supine with head slightly turned to contralateral side of block and arm down at side.

Transducer: High frequency 38 mm transducer is usually adequate. A smaller footprint (25 mm) may be considered in the supraclavicular region when space is limited.

Needle size: 50 mm, 22 gauge blunt stimulating needle.

Local Anesthetic: 20 to 30 ml of 1.5% mepivacaine or 0.5%-0.75% ropivacaine or 0.5% bupivacaine.

Technique

1. With patient’s monitors placed and oxygen and sedation administered, prepare the skin of the block area with antiseptic solution, either povidone iodine or chlorhexidine. Wear either sterile gloves or clean gloves.

2. Place the transducer parallel and abutting to the clavicle in the supraclavicular region (Figure 2). Key ultrasound structures to identify are: the subclavian artery, first rib, pleura, and the hypoechoic nerves of the brachial plexus (Figure 3). The transducer should be held

with a slight vertical tilt aiming into the chest to obtain the transverse images of the subclavian artery and optimal images of plexus. Locate the subclavian artery by moving the probe laterally and medially, as well as toggle the probe from caudad to cephalad. Color Doppler may also be used if in doubt about the vascular nature of a structure. The brachial plexus is usually located lateral and superficial to the artery, with a characteristic “honeycomb” appearance. Two distinct appearances of the brachial plexus may be seen at the supraclavicular level. It can be seen as a grape-like cluster of 5 to 6 hypoechoic circle, which probably represent the divisions of the brachial plexus (Figure 3) or as three hypoechoic structures, which represent the trunks of the brachial plexus (Figure 4) Rock the probe to find the plane where the nerves can best be visualized. Increasing the depth on the ultrasound will allow visualization of the pleura and first rib, if it is not already seen. With the first rib in view directly beneath the brachial plexus, a backstop prevents inadvertent lung entry. The artery should be visualized at all times while performing the block.

3. After establishing the ideal image, the skin on the lateral side of the probe is anesthetized with local anesthetic using a 25 gauge needle creating a skin wheal.

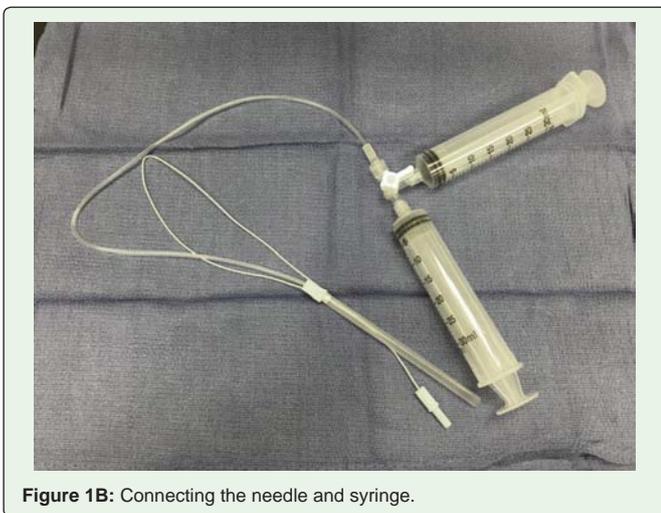


Figure 1B: Connecting the needle and syringe.



Figure 3: Sonoanatomy of the supraclavicular block with divisions of the brachial plexus. A: Subclavian artery; D: Divisions; R: Rib; P: Pleura

4. Apply the needle using the in-plane approach from the lateral aspect of the transducer. Advance the needle at a very shallow angle to allow for needle visualization on ultrasound. It is essential that the needle tip be imaged at all times to avoid pneumothorax. Place the needle entry point away from the transducer to improve the needle visualization. When the needle image appears on the screen, direct the tip of the needle toward the nerve bundle. A pop may be felt when entering the nerve sheath. It is best to first inject at the site immediately adjacent to the artery and inferior to the lower trunk (corner pocket) (Figure 5). This causes the plexus to rise and float in the fluid, ensuring anesthesia of the inferior trunk. If there is inadequate spread of LA with the initial injection, move the needle to the more superior nerve structures. It has been suggested that using multiple injections around the plexus has the potential to increase the success rate to 100% [28]. Always aspirate prior to every 5 ml injection and observe the spread of LA. Stop injection if patient complains of pain, paresthesia going down to the extremity or resistance is met upon injection. In this situation, withdraw slightly, aspirate, and reattempt injection. Once in the correct position, inject anywhere between 5-10 ml of local anesthetic in one given location.

Ultrasound-guided infraclavicular block

Patient position: supine with head slightly turned contralateral side. Arm is abducted 90 degrees, externally rotated and flexed at the elbow. This maneuver rotates the clavicle posteriorly while also moving the plexus into a more superficial position.

Transducer: High frequency 38 mm transducer may not be adequate due to deeper location of the brachial plexus at this level in overweight patients. Lower frequency transducer (5 to 12 MHz) may be required in the infraclavicular region to image cords of the brachial plexus that are deep (5 cm or more). A smaller footprint (25 mm) may also be considered because the infraclavicular fossa is small and the larger-footprint probe can hang over the clavicle.

Needle size: 100 mm, 22 gauge blunt stimulating needle.

Local Anesthetic: 20 to 30 ml of 1.5% mepivacaine or 0.5%-0.75% ropivacaine or 0.5% bupivacaine.

Technique

1. With patient's monitors placed and oxygen and sedation administered, prepare the skin of the block area with antiseptic solution, either povidone iodine or chlorhexidine. Wear either sterile gloves or clean gloves.

2. Place the ultrasound probe directly inferior to the clavicle in parasagittal orientation in the infraclavicular fossa (Figure 6). The infraclavicular fossa is a natural depression about 1 cm medial to the coracoid process of the scapula. Key structures to identify are: the pectoralis major muscle, pectoralis minor muscle, axillary artery and vein, and the hyperechoic cords of the brachial plexus which lie lateral, medial and posterior to the artery at 3, 6 and 9 O'clock positions (Figure 7). The transducer may be moved laterally, medially, or toggled to provide the optimal images of the nerves and vessels. To minimize the risk of lung entry, once an image is obtained, rotate the transducer's caudal edge slightly away from the midline. This small detail will still provide an excellent view of the brachial plexus while steering the needle's trajectory into the periphery of the axilla rather than the thorax.

3. After establishing the ideal image, the skin on the superior side of the probe is anesthetized with local anesthetic using a 25 gauge needle creating a skin wheal.

4. Insert the needle from either the inferior or superior side of the transducer using in-plane approach. As the needle is introduced, the transducer is adjusted to obtain a view of the tip during its progress. It is essential to maintain imaging of the tip of the needle at all times to avoid vascular or pleural puncture. The needle is then advanced under continuous observation towards each of the cords. Local anesthetic of 8 to 10 ml is then deposited next to the each cord. It is easy to guide the needle to the lateral cord first, using the nerve stimulation if desired for confirmation with stimulation of the median or musculocutaneous nerves. It is imperative to place the needle between the axillary artery and the posterior cord of the brachial plexus to ensure adequate anesthesia of the posterior cord. Often, injection at this 6 O'clock point relative to the artery will concurrently encourage spread of local anesthetic to the medial cord which lies between the axillary artery and vein. If spread to the medial



Figure 4: Sonoanatomy of the supraclavicular block with trunk of the brachial plexus.

A: Artery; S: Superior trunk; M: Middle trunk; I: Inferior trunk

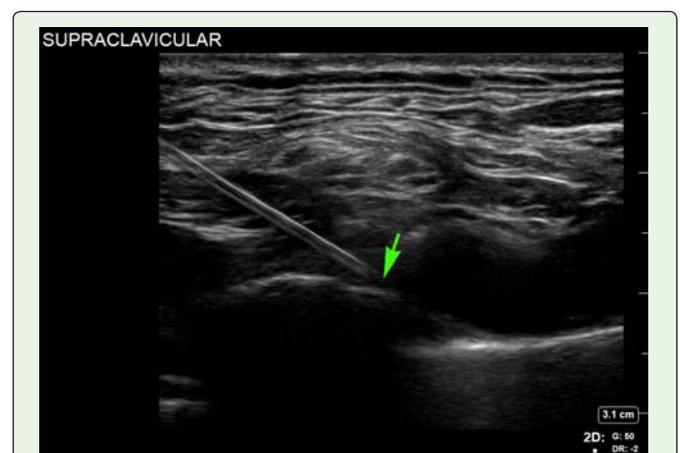


Figure 5: Needle directed towards the corner pocket during performance of supraclavicular block.

cord is not sufficient, the needle can be advanced to facilitate wider spread. Direct needling of the medial cord is usually not necessary nor recommended due to its precarious position. With each needle positioning, the anesthesiologist may utilize peripheral nerve stimulation to confirm the target. Nerve stimulation is helpful in this block because the cords are deeper than the more proximal brachial plexus and harder to visualize.

Ultrasound-guided axillary block

Patient position: supine with head slightly turned to contralateral side. Arm is abducted, externally rotated and flexed at the elbow.

Transducer: High frequency 38 mm transducer

Needle size: 50 mm, 22 gauge blunt stimulating needle.

Local anesthetic: 25 to 30 ml of 1.5% mepivacaine or 0.5%-0.75% ropivacaine or 0.5% bupivacaine.

Technique

1. with patient’s monitors placed and oxygen and sedation administered, prepare the skin of the block area with antiseptic solution, either povidone iodine or chlorhexidine. Wear either sterile gloves or clean gloves.



Figure 7: Sonoanatomy of the infraclavicular block. A: Axillary artery; V: Axillary vein; L: Lateral cord; P: Posterior cord; I: Medial cord

2. Place the ultrasound probe in the axilla at the crease formed by the pectoralis major and biceps muscles; perpendicular to the axillary artery (Figure 9). Key structures to identify are: axillary artery and vein, and the hyperechoic terminal nerves of the brachial plexus: median, ulnar and radial which lie superior, inferior and posterior to the artery. You may use color Doppler to identify the vascular structure in this region. The artery should be noncompressible and pulsating, and the vein should be compressible and have continuous steady flow. Veins may vary in number, with one, two or even more being present. It is important to note their position because even mild pressure with the transducer can obliterate the lumen on the ultrasound image. The median nerve tends to appear consistently at 12 O’clock position with the ulnar nerve between the between 2 and 5 O’clock positions and radial nerve between 4 and 9 O’clock positions (Figure 10). Nevertheless, the location of these three nerves relative to the axillary artery can be highly variable [32]. To image the musculocutaneous nerve, move the transducer slightly superior towards the biceps muscle from the axilla. The nerve may be viewed either in the plane between the choracobrachialis muscle and the biceps muscle or in the body of the choracobrachialis muscle (Figure 11). The nerve is hyperechoic, brighter than the surrounding muscle.



Figure 6: Needle and probe positioning for infraclavicular block.



Figure 8: Needle visualization during performance of infraclavicular block.



Figure 9: Needle and probe positioning for axillary block.

3. After establishing the ideal image, the skin is anesthetized with local anesthetic using a 25 gauge needle creating a skin wheal.

4. Initially, Insert the needle from the superior side of the transducer using in-plane approach towards the median nerve. Local anesthetic is incrementally injected (6-8 ml) until a halo appears around the nerve. Then direct the needle to the ulnar nerve to the inferior edge of the artery and LA is injected as described above. Next, the needle is redirected more posterior, and guided to the radial nerve, followed by incremental injection of 6-8 ml of LA (Figure 12). It may be difficult to anesthetize all nerves from one needle insertion because of the circumferential location of nerve around the artery. One may block the median nerve from a cephalad approach and the ulnar and radial nerves by introducing the needle inferior to the probe. To block the musculocutaneous nerve move the transducer towards the biceps muscle, place the needle in-plane superior to the probe, and inject 6-8 ml of LA until a halo is seen around the nerve. Nerve stimulation may be helpful in identifying nerves away from the artery and in variable orientation.



Figure 10: Sonoanatomy of axillary block.
A: Axillary artery; V: Axillary vein; M: Median nerve; R: Radial nerve; U: Ulnar nerve; B: Biceps; CB: Coracobrachialis



Figure 11: Sonoanatomy of musculocutaneous nerve block.

Intercostobrachial nerve field block

For procedures requiring the use of a tourniquet, block of the intercostobrachial nerve will provide anesthesia of the upper medial arm which is not completely anesthetized by brachial plexus block. This supplemental block is necessary when general or deep sedation is not employed.

Patient position: supine with head slightly turned to contralateral side. Arm is abducted 90 degrees, externally rotated and flexed at the elbow.

Needle size: 1.5 inch 25 gauge needle.

Local anesthetic: 5-10 ml of 1.5% mepivacaine, 0.5%-0.75% ropivacaine or 0.5% bupivacaine.

Technique

1. With patient's monitors placed and oxygen and sedation administered, prepare the skin of the block area with antiseptic solution, either povidone iodine or chlorhexidine. Wear either sterile or aseptic gloves.



Figure 12: Needle visualization during axillary block.

2. Create a subcutaneous skin wheal along the crease formed in the axilla between the pec and biceps muscles (Figure 12). Skin wheal should traverse the entire medial width of the axillary fossa.

Post-procedure patient instructions

1. Residual block: Expect the limb to remain numb for 8 to 14 hours. Don't use the blocked arm until sensation has completely resolved. Protect the anesthetized arm as long as there is residual block. Residual numbness is not uncommon.

2. Postoperative pain: Don't wait until the block has completely resolved to take pain medications.

3. Warning symptoms that require medical attention: Contact your healthcare providers if you experience swelling or bleeding at the block site, muscle weakness lasting more than 24 hours, numbness lasting more than 2 to 3 weeks, or signs of infection at the block site.

Conclusion

In summary, perioperative consideration for patients undergoing vascular access include preoperative optimization, airway management, anesthetic options (Local, RA or GA), and fluid and electrolyte management during the case.

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