

Upper Extremity Blocks Guided By Ultrasound

Jeffrey Swenson, MD

One aspect of regional anesthesia that becomes immediately apparent with the addition of ultrasound guidance is an increased awareness and understanding of anatomy. It is only natural that even the most experienced regional anesthetist will understand normal as well as variant anatomy on a new level after visualizing these structures using high frequency ultrasound. Because this understanding of anatomy is so critical to the ability to perform peripheral nerve blocks safely and successfully, we will discuss each relevant structure in detail.

The Brachial Plexus Above the Clavicle

Although there is much discussion regarding different approaches to the brachial plexus above the clavicle (interscalene, supraclavicular), in reality, all blocks proximal to the first rib are “interscalene” blocks. In fact, the single feature that can make any approach to the brachial plexus above the clavicle successful is to deliver local anesthetic between the scalene muscles and deep to the prevertebral fascia separating these muscles.

The anterior and middle scalene muscles attach to the to the anterior and posterior tubercles of the cervical transverse processes respectively. The cervical nerve roots emerge in a groove between the anterior and posterior tubercles initially and then pass into a conduit made up of the anterior and middle scalene muscles. This conduit is narrow in the upper cervical region and has its widest point at the attachment of the scalene muscles on the first rib. This gives the shape of the interscalene groove that of an inverted “V”.

One aspect of the brachial plexus that is immediately apparent when using ultrasound is the close contact of the prevertebral fascia to the roots of the brachial plexus. When using the traditional approach to the brachial plexus above the clavicle, a needle is advanced through the prevertebral fascia separating the scalene muscles and into the interscalene groove. Using this approach, it is difficult if not impossible to pierce the prevertebral fascia without contacting the upper roots of the brachial plexus. Catheter advancement using this approach may be particularly uncomfortable for the patient. At the University of Utah, a more successful (and comfortable approach for the patient) has been to advance the needle into the middle scalene muscle and then anteriorly and deep to the roots of the brachial plexus into the space between the anterior and middle scalene muscles. This approach can usually be performed without causing a paresthesia and is associated with less resistance to catheter placement.

When using ultrasound to visualize the brachial plexus in the interscalene region it is often difficult to distinguish the scalene muscles and brachial plexus from other soft tissues in the neck. For this reason it is helpful to remember the constant relationship of the subclavian artery and the brachial plexus at the level of the clavicle. If the examiner starts at the clavicle imaging parallel to the clavicle and into the root of the neck, the subclavian artery is readily visible in short axis. Relative to the subclavian artery, the brachial plexus will be consistently in a posterior and superficial position. Keeping the plexus in view, the examiner can then follow the interscalene groove superiorly to the desired level of blockade.

Infraclavicular Brachial Plexus

The brachial plexus, subclavian artery and subclavian vein are readily visible from the mid portion of the clavicle to beyond the coracoid process. With the probe inferior and perpendicular to the long axis of the clavicle, the subclavian artery is the most recognizable structure. Elements of the brachial plexus are positioned medial, lateral and posterior to the artery. The subclavian vein is anterior and inferior to the artery. It can be differentiated from the artery by compressing the probe over these vascular structures. The vein is easily compressible while the artery is pulsatile and not easily compressed. These structures can be followed laterally beyond the coracoid process for injection that does not overlie the thoracic space.

The Brachial Plexus in the Axilla

Blockade of the axillary brachial plexus is usually performed at the level of the lateral border of the pectoralis major muscle. With the transducer perpendicular to the long axis of the arm, the elements of the axillary sheath are seen in short axis. The axillary artery, median, ulnar, and radial nerves are consistently contained within the axillary sheath. The axillary vein and musculocutaneous nerve are not consistently within the axillary sheath. Since the border of the axillary sheath cannot usually be visualized, the axillary artery must serve as a reliable landmark to define the axillary sheath. The biceps and coracobrachialis muscles are located outside the axillary sheath and superior to the axillary artery on U/S view. A large axillary vein is

consistently inferior to the artery, however, it must be noted that a majority of patients will have additional large veins surrounding the axillary artery. As noted earlier, the axillary vein is not consistently within the axillary sheath. The positions of the ulnar, median, and radial nerves are respectively inferior, superior, and posterior to the axillary artery. It should be noted that the classically reported position of these nerves might vary considerably between patients. The musculocutaneous nerve is usually visible outside the axillary sheath in the body of the coracobrachialis muscle or in the fascial plane between the biceps and coracobrachialis muscles.

Distal Approaches to Peripheral Nerves

The ulnar, radial, and median nerves are all readily visible in distal positions of the upper extremity and may be blocked individually using U/S visualization. The radial nerve has a characteristic U/S appearance at the mid-humerus. At this point the radial nerve is located in contact with the posterolateral surface of the humerus between the triceps and the brachialis muscles and traveling with the visibly pulsating profunda artery. The median nerve is easily identified at the elbow in the antecubital fossa on the medial aspect of the brachial artery. The ulnar nerve travels on the ulnar side of the ulnar artery from the wrist to approximately the mid shaft of the forearm where it diverges toward the medial epicondyle.