

Ultrasound-guided supraclavicular block

Arthur Atchabahian, MD

Department of Anesthesiology, St. Vincent Medical Center, New York, NY

Acknowledgments and History

I am heavily indebted to Vincent Chan who first described in great detail this specific technique, although in his initial paper (1), both ultrasound and nerve stimulation were used, which I no longer routinely do. Although la Grange et al. (2), as early as 1978, advocated the use of a Doppler probe to locate the axillary artery and facilitate plexus location, Kapral et al. (3) first described the actual ultrasound imaging of the plexus in the supraclavicular position and the needle insertion under ultrasound guidance. *The Journal of NYSORA*; 13: 20-26.

US GUIDED SUPRACLAVICULAR BLOCK

ANATOMY

The supraclavicular block is performed at the level of divisions, where the brachial plexus passes with the subclavian artery between the clavicle and the first rib, after passing between anterior and middle scalene muscles (Figure 1). Paresthesia or neurostimulation techniques aimed at contacting the plexus just above the clavicle. However, the proximity of the pleura, leading to a high risk of pneumothorax, explains that this block was rarely performed before the onset of ultrasound-guided regional anesthesia. Ultrasound guidance allows visualization of the nerves, the subclavian artery and vein, the first rib and the pleura, and the risk of pneumothorax in experienced hands is thus extremely low.

The number of nerves seen at the level the block is performed is highly variable and can range from two to a dozen. Typically, the more superficial nerves innervate the proximal upper extremity (shoulder, upper arm), while the

deeper nerves, closer to the first rib, innervate the distal aspect (elbow, forearm, hand).

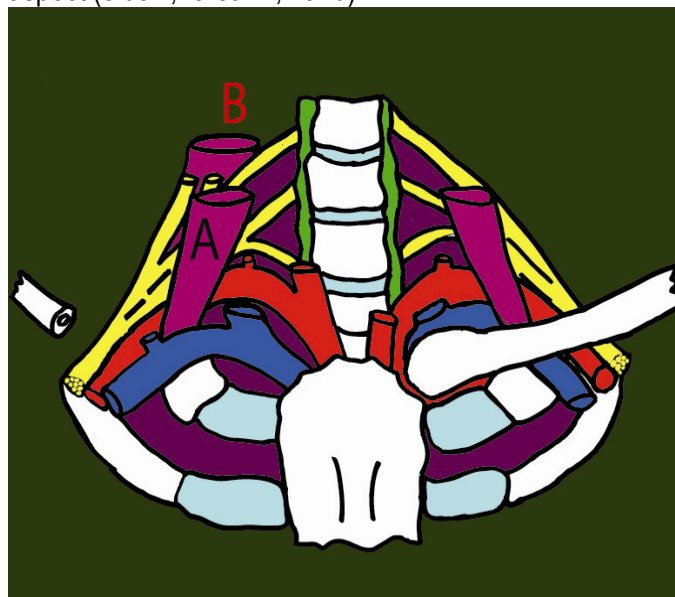


Figure 1: Anatomy of the supraclavicular area. The clavicle has been resected on the subject's right side. The brachial plexus and the subclavian artery pass between anterior (A) and middle (B) scalene muscles, then between clavicle and first rib. The subclavian vein is anterior to the anterior scalene muscle, and then medial to the artery as it passes between clavicle and rib.

Indications

This block is adequate for any surgery on the upper extremity. Most practitioners will use it for surgery below the mid-humerus level. Axillary nerve blockade is almost constant, but above the mid-humerus level, an interscalene block would be more appropriate. Others will use the supraclavicular block for shoulder surgery, and if a large enough volume is used, it is probably indistinguishable from the interscalene block, both in its coverage and in its side effects (phrenic nerve blockade, Horner's syndrome, etc.). If a low volume (e.g. 20 mL) is used, the other limitation of the supraclavicular block is that, contrary to the interscalene block, it will not diffuse to the lower roots of the cervical plexus, and thus will not block the upper aspect of the shoulder, which can be an issue in case of a mini-open rotator cuff repair.

The major advantage of the supraclavicular approach is that the nerves are very tightly packed, so that the onset is fast and the blockade deep, leading to this technique being nicknamed "the spinal of the arm". That is especially an advantage compared to the infraclavicular block, where the cords lie circumferentially around the artery, making proper blockade of the posterior cord sometimes difficult (4).

The downside, of course, is the proximity of the pleura, but with ultrasound guidance, the pleura can be visualized, and as long as proper technique is used, i.e. if the needle, and especially the needle tip, is visualized at all times, pneumothorax should not occur. Upon locating the pleura, one realizes, however, how dangerous this block is when performed "blindly" with the nerve stimulator, be it by the classic or the "plumb-bob" technique. Moreover, at least one study demonstrated a better block quality with the ultrasound-guided vs. nerve-stimulator-guided technique (5).

Equipment

- Ultrasound machine, with an appropriate (8-12 MHz, straight or curved-array) probe and a lot of ultrasound gel. My usual practice is to stand behind the patient's head, with the machine on the side to be blocked, and to orient the probe so as to have the side probe ridge/dot on the

same side as the symbol on the screen (Figure 2). This allows me to have the same orientation for the picture on the screen as for the slice of tissue under the probe. Radiologists use a convention whereby the side with the ridge/symbol is the patient's right side. Respecting this can be useful when pictures are recorded to be reviewed at a later time. Many practitioners, however, prefer to stand by the patient's side with the ultrasound machine on the opposite side.



Figure 2: Position to perform the block. I stand behind the patient's head, with the ultrasound machine on the side being blocked. The head of the bed is slightly raised to allow the shoulder to drop somewhat. I have the patient's head turned to the opposite side, resting directly on the table without a pillow. I will softly rest the hand holding the probe against the patient's jaw, and insert the needle from the lateral side. However, many practitioners prefer to stand on the patient's side and place the ultrasound machine on the opposite side.

- Needle. I routinely use the stimulating insulated needles, although they are not especially echogenic. This allows using neurostimulation in case of doubt about the nature of a round structure that looks like a nerve. Several companies commercialize needles treated to enhance their echogenicity, but in my opinion, the improvement is rather minimal.

- Local anesthetic. Twenty mL is enough! A large volume increases the risk of phrenic nerve blockade, which is theoretically low with the supraclavicular approach. Ropivacaine is nowadays the local anesthetic of choice, but it

has a somewhat shorter duration than bupivacaine. When a long-acting block is desired, (e.g. internal fixation with plates and screws, wrist arthrodesis, proximal carpal row resection), I will use a continuous block with insertion of a catheter. When a short-acting, i.e. 4-6 hours, block is desired, e.g. for a Dupuytren's contracture release, I will use 1.5% mepivacaine or 2% lidocaine.

Landmarks

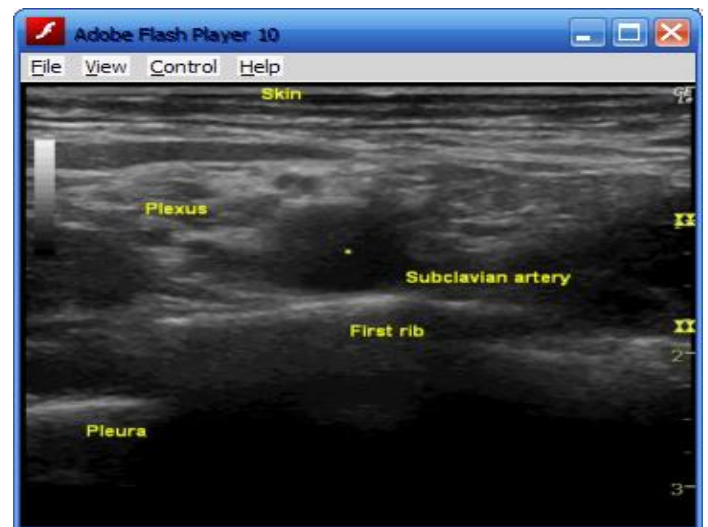
There is no landmark proper, besides the clavicle, which in most patients is easily felt. The subclavian pulse might be palpated above the clavicle, but that is not indispensable. The ultrasound probe is positioned in the supraclavicular fossa, pointing caudad, and moved laterally and medially, as well as in a rocking fashion, in order to locate the subclavian artery (Figure 3).



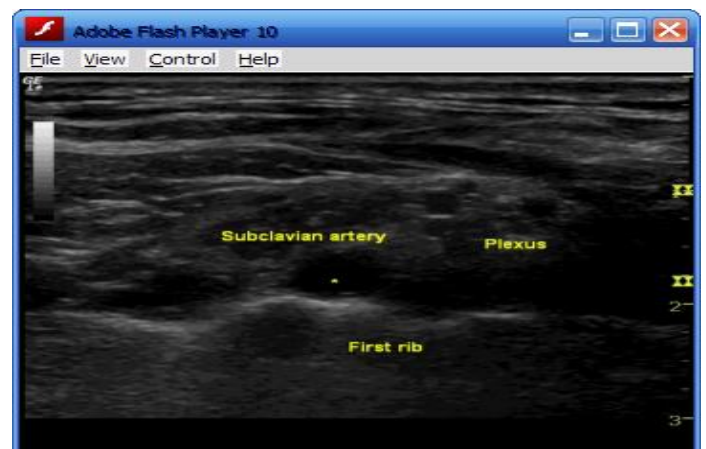
Figure 3: Position of probe and needle. The probe is positioned just above the clavicle. It can be moved laterally or medially, and rocked back and forth until a good quality picture is obtained. The needle is inserted from the lateral side of the probe, as the plexus lies lateral to the subclavian artery. It has to be exactly in the long axis of the probe. This is especially important for this block, in which the needle can easily cause a pneumothorax if it is not fully visible at all times. On this picture, the operator is standing at the patient's side rather than at the head.

Technique

Once the subclavian artery is visualized, the area lateral and superficial to it is explored until the plexus is seen, with a characteristic "honeycomb" appearance. Multiple nerves can be seen, or as few as two, depending on the level and the patient (Videos 1 and 2). A caudad-cephalad rocking motion is then used to find the plane where the nerves are best seen.



Video 1: Left subclavian artery and nerves of the brachial plexus. The subclavian artery is seen beating at the center of the field. Underlying it is the first rib, with a bright cortical bone and a posterior shadow. The pleura are seen on each side of the rib, somewhat deeper, and moving with the patient's respiration. The nerves of the brachial plexus can be seen lateral and a little superficial to the artery. The distribution is variable, with as little as two or as many as 10 nerves seen. **(Click image to play video)**



Video 2: Right supraclavicular block anatomy. Similar to video 1, but on the right side. Again, the subclavian artery is seen beating, with the plexus lateral and superficial to it. The first rib, with its posterior shadow, underlies the artery. **(Click image to play video)**

Color Doppler can be used to confirm the vascular nature of the vessels, especially when the anatomy is somewhat distorted (Video 3). The subclavian vein is typically medial and superficial to the artery.



Video 3: Left supraclavicular block anatomy using color Doppler. Same position as Video 1. The color Doppler is turned on, showing flow in the subclavian artery. In cases when the anatomy is somewhat distorted, the color Doppler can be useful to identify vascular structures. Remember that the flow is toward and away from the probe, so that if the probe is perpendicular to the blood flow, no signal will be seen. One has to incline the probe to obtain an adequate flow signal. (Click image to play video)

By deepening the field, the pleura can be seen, with the characteristic aspect of the lung parenchyma displayed as multiple parallel lines. The patient can be asked to take a deep breath, showing sliding of the parietal and parenchymal pleural layers, as well as a change in the appearance of the lung.

The first rib can be visualized as well, with a bright hyperchoic cortical rim and a posterior shadow. It might be safer to choose a plane where the rib lies immediately deep to the neurovascular bundle, in order to have the needle hit the rib rather than the pleura in case it goes too deep.

I almost always use a lateral to medial approach in order to avoid the vein. The risk of collapsing the vein by pressing with the probe, leading to unrecognized intravascular injection, should be kept in mind; the telltale sign is the absence of local anesthetic spread despite

injection, which should prompt to immediately stopping the injection and reassessing the needle position.

The skin lateral to the probe is then prepped with povidone iodine or chlorhexidine, and the needle is advanced, first perpendicular to the skin just to penetrate the skin, then at a very shallow angle under the probe. It is paramount to make sure that the needle is advanced exactly under the probe, inside the ultrasound beam, to be seen in its entirety. It is obviously better, initially, for the needle to be too shallow rather than too deep.



Video 4: Penetration of the needle in the “sheath” and injection. The needle is seen being advanced toward the plexus. When it penetrates the “sheath”, a “pop” can often be perceived. After aspiration, a small amount of local anesthetic is injected, confirming the location of the needle is the correct plane. Occasionally, the “popping” will bring the needle tip beyond the plexus sheath, and the needle will have to be slightly withdrawn. (Click image to play video)

When the needle is well seen, direct the tip toward the nerve bundle, while avoiding to “skewer” the nerves. A distinct “pop” is often felt and seen when the “sheath” is entered (Video 4). I usually make 3 or 4 separate injections at various sites in the bundle, tending to start deep, in the “corner pocket” close to the artery, and moving more superficially. The reason for starting deep is that the local anesthetic typically contains air microbubbles and might obscure the view of elements posterior to it once injected. For example, if there are three nerves, I will first inject between the middle and the bottom one, then between the top and the middle one, then above the top one, in order to bathe the

whole nerve, then under the bottom one. It is paramount, however, to ensure that the injection actually happens inside the “sheath”. When I think that I am in the correct position, I will ask my assistant to aspirate, then to inject 1-2 mL of local anesthetic. It then becomes immediately obvious, from the spread of the injected fluid, whether it is going inside or outside the sheath (Videos 5 and 6). Frequent aspiration is part of the technique, although if the needle tip is visualized, it should not be in a blood vessel without the operator’s knowledge.



Video 5: Supraclavicular block: Injection. (US supraclavicular.avi)
 The needle is seen with its tip lying in the midst of the brachial plexus nerves. Local anesthetic is injected following aspiration, and the whole area of the plexus is seen bulging. Typically, the local anesthetic will diffuse away, and the nerves will be seen again after a few seconds. Nerves that do not seem to be adequately “bathed” by the local anesthetic injection can be targeted specifically, and more local anesthetic can be given. **(Click image to play video)**



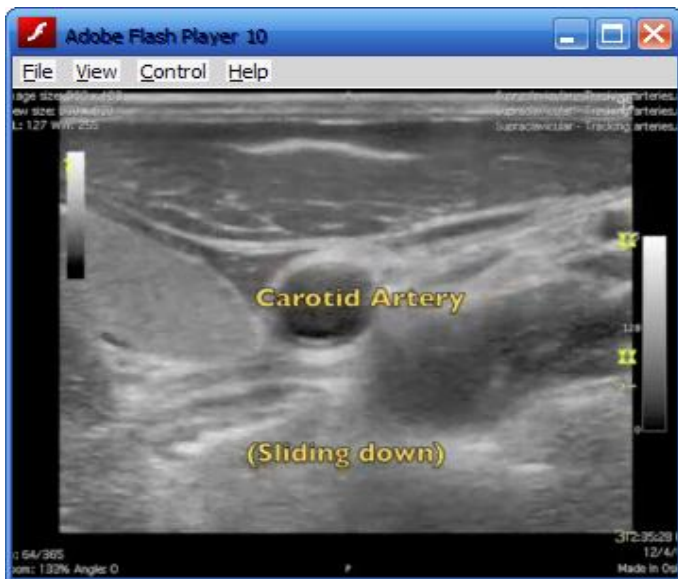
Video 6: Supraclavicular block: Injection in the wrong plane.
 In this case, while the needle appears to have entered the sheath, test injection rapidly demonstrates that the spread of local anesthetic happens in the wrong plane. The needle was subsequently advanced, and repeat injection was seen among the brachial plexus nerves. **(Click image to play video)**

Pearls and tricks

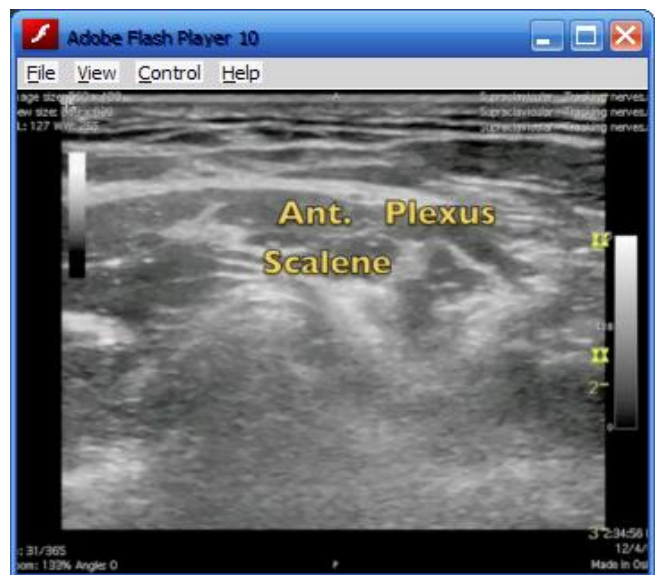
If visualization of the axillary artery is difficult, one can either track the vessel (Video 7) or the nerves (Video 8). The first method consists in placing the probe over the sterno-cleido-mastoid [SCM] muscle, thus obtaining a picture of the internal jugular vein and the common carotid artery. The artery can be followed down (i.e. toward the chest) by sliding the probe. In most patients, it is then possible to see the inception of the subclavian artery, which can then be followed laterally until the desired picture is obtained. The alternate technique consists in identifying the brachial plexus in the interscalene groove, which might take some training. Typically, the probe is again placed over the SCM muscle at about the C6 level, then moved laterally until the anterior and middle scalene muscles are seen. The brachial plexus roots lie between the two, and are better seen by slightly angling the probe caudad, i.e. toward the feet. The nerves can then be followed distally until the desired view of the supraclavicular area with the subclavian artery is obtained.

In case of doubt as to the correct location of the needle tip, neurostimulation can be used to elicit motor responses in the upper extremity and confirm that the structure being contacted is indeed a nerve. Color Doppler can be used as well, in case there is a doubt about the vascular nature of a structure, although typically following it with the probe will be sufficient to confirm whether what is seen is a nerve or a blood vessel.

Typically, as I have confirmed multiple times with neurostimulation, the more superficial nerves innervate the proximal upper extremity, while the deeper nerves innervate the distal aspect. If I am placing a catheter for postoperative analgesia, I will place it in the appropriate area depending on the location of the surgery.



Video 7: Supraclavicular block: Tracking the subclavian artery. On occasion, if difficulty is encountered locating the subclavian artery and the brachial plexus, the carotid artery can be located in the neck, and then tracked down by sliding the probe until the bifurcation is seen. The subclavian artery can then followed in most patients laterally until it is seen in the supraclavicular fossa. **(Click image to play video)**



Video 8: Supraclavicular block: Tracking the nerves of the brachial plexus. As an alternative, the roots can be located in the interscalene area, and then tracked down by sliding the probe until they are seen in the subclavian area. Only the upper roots (C5 through C7) are typically seen in the interscalene area, and it is not uncommon to see the lower portion of the plexus, from C8 and T1, merging with it as one nears the supraclavicular area. **(Click image to play video)**

REFERENCES:

1. Chan VW, Perlas A, Rawson R, Odukoya O. Ultrasound-guided supraclavicular brachial plexus block. *Anesth Analg* 2003; 97:1514-1517
2. la Grange P, Foster PA, Pretorius LK. Application of the Doppler ultrasound bloodflow detector in supraclavicular brachial plexus block. *Br J Anaesth* 1978;50:965-967
3. Kapral S, Krafft P, Eibenberger K, Fitzgerald R, Gosch M, Weinstabl C. Ultrasound-guided supraclavicular approach for regional anesthesia of the brachial plexus. *Anesth Analg* 1994;78:507-513
4. Arcand G, Williams SR, Chouinard P, Boudreault D, Harris P, Ruel M, Girard F. Ultrasound-guided infraclavicular versus supraclavicular block. *Anesth Analg* 2005; 101:886-890
5. Williams SR, Chouinard P, Arcand G, Harris P, Ruel M, Boudreault D, Girard F. Ultrasound guidance speeds execution and improves the quality of supraclavicular block. *Anesth Analg* 2003; 97:1518-1523