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ULTRASOUND GUIDED SUPRACLAVICULAR BLOCK

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The supraclavicular block can provide rapid onset, dense anesthesia of the arm with a single injection.[1] Several different techniques have been described, but despite modifications to the original method by Kulenkampff the major disadvantage of these 'blind' approaches remains the small but significant risk of pneumothorax.[2-5] Whilst this risk has been reported to be zero in expert hands, other series quote an incidence of pneumothorax as high as 6.1%.[6,7] Further complications of supraclavicular block include subclavian artery puncture, and spread of local anesthetic to cause paresis of the stellate ganglion, the phrenic nerve and recurrent laryngeal nerve. *The Journal of NYSORA; 12: 6-10*

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INTRODUCTION

Ultrasound continues to grow in popularity as a method of nerve localization and, for the supraclavicular block, has the advantage of allowing real time visualization of the plexus, pleura and vessels along with the needle and local anesthetic spread.[8] Several authors have described an ultrasound guided supraclavicular approach to the brachial plexus, beginning with La Grange and colleagues who in 1978 utilized Doppler ultrasound to indirectly facilitate needle positioning.[9] Technology subsequently improved and in 1994 Kapral *et al* were the first to report direct needle, plexus and local anesthetic visualization. Using a 7.5MHz probe, orientated 3cm sagittally above the midpoint of the clavicle, their success rate was 95%.[10] Chan and colleagues published their technique almost 10 years later.[11,12] In the intervening period descriptions of ultrasound guided catheter insertion into the supraclavicular brachial plexus sheath also emerged.[13]

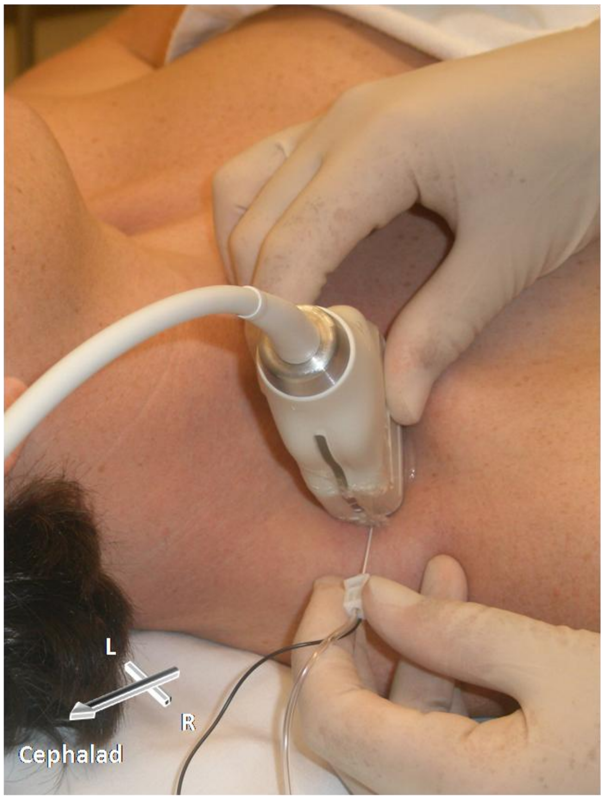


Figure 1. Coronal oblique orientation of probe in right supraclavicular fossa. Needle alignment is in-plane, with a lateral to medial approach.

There are few outcome studies regarding ultrasound guided supraclavicular brachial plexus blockade. In the study by Kapral *et al*, ultrasound guided supraclavicular block was compared to ultrasound guided axillary block. No difference in surgical anesthesia was found between the two groups of 20 patients (95% in each group) although the musculocutaneous nerve was only blocked in 75% of the axillary group compared to 100% in the supraclavicular group. Arcand and colleagues compared ultrasound guided supraclavicular to ultrasound guided infraclavicular block and demonstrated that surgical anesthesia was similar in both groups although the radial nerve required more frequent supplementation in the infraclavicular group.[14] In another randomized controlled trial, Williams *et al* demonstrated that ultrasound combined with nerve stimulation reduced the time required to perform the procedure compared to using nerve stimulation alone.[15] A retrospective review of over 1000 ultrasound guided supraclavicular blocks at Toronto Western Hospital revealed a success rate of 94.7% (no need for further supplementation or general anesthesia) and importantly no pneumothoraces (Dr Anahi Perlas, personal communication, article in press). Whilst there is no definitive evidence as yet that ultrasound is superior to other methods of nerve localization for the supraclavicular block, there are now case reports appearing where ultrasound scanning has detected abnormal anatomy that would otherwise not have been evident using 'blind'approaches.[16,17] By alerting the anaesthesiologist to either choose another approach or simply avoid regional anesthesia altogether ultrasound may in this manner improve the safety of supraclavicular brachial plexus blockade. Despite these benefits, ultrasound may conversely create a false sense of security and care must be taken, particularly when learning. If the needle tip is not adequately visualized errors can still occur during ultrasound guided nerve blocks.[18-20]

Ultrasound guided supraclavicular block is the mainstay of our regional anesthesia practice for upper limb surgical procedures at or below the elbow. The remainder of this article describes our technique. The indications, contraindications, choice of local anesthetic and complications of the supraclavicular block in general have been described elsewhere.[1]

Positioning

The patient is positioned supine with the arm place by the side. The head is positioned, without a headrest, facing 45° to the contralateral side to be blocked.

Equipment

A high frequency (10-15Mhz), linear probe should be selected. A 22 gauge, 50mm stimulating needle is chosen. This allows nerve stimulation if desired, though most practitioners in our group do not stimulate. Our preferred local anesthetic is 50:50 2% lidocaine and 0.5% bupivicaine with adrenaline 1:400000. The skin is cleaned with an appropriate solution such as 2% chlorhexidine in 70% isopropyl alcohol solution. Drugs for sedation such as midazolam and fentanyl should also be available. As with all nerve blocks, standard monitoring should be applied and intravenous access secured.

Scanning Technique, Nerve Localization and Needle Placement[11]

The probe is placed in the supraclavicular fossa in a coronal oblique plane (Figure 1). The pulsating, hypoechoic supraclavicular artery is identified, lying above the hyperechoic first rib. While maintaining the view of the artery, the probe is then angled until both the first rib and the pleura are also seen simultaneously, seeking to visualize a 'step' between these two structures (Figure 2).

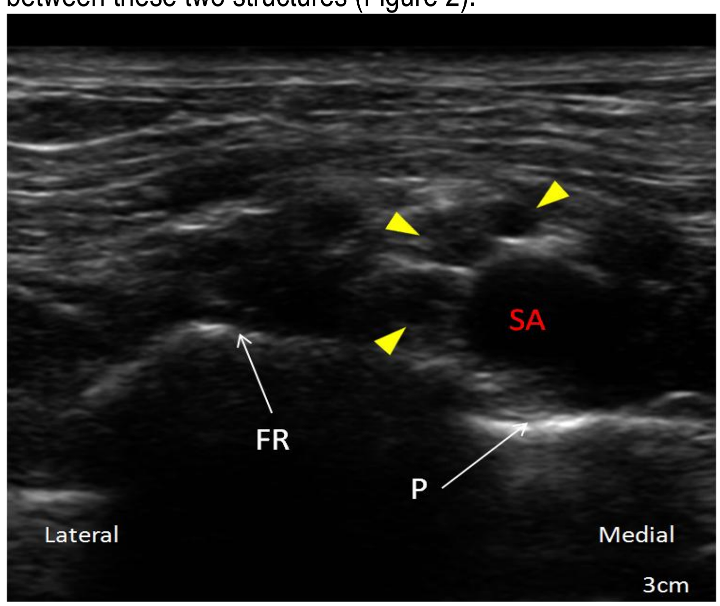
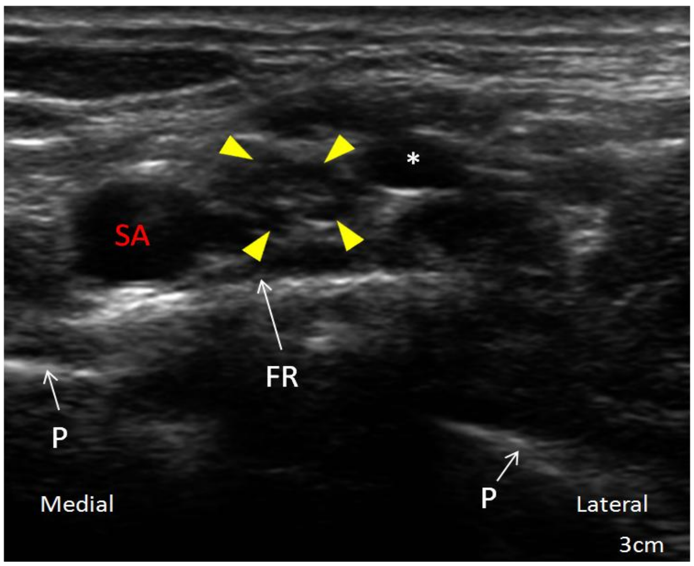


Figure 2. Right supraclavicular brachial plexus (yellow arrows). Note supraclavicular artery (SA) lying on first rib (white arrows). P=pleura. Compare with Figure 8 for post anesthetic injection.

The rib generates a bony shadow whilst the lung is a specular reflector and therefore a grainy image is seen below the hyperechoic edge of the pleura. The hypoechoic nerve structures (trunks or divisions) are usually visualized postero-lateral to the artery. Some small, hypoechoic vessels (suprascapular artery and transverse cervical artery) may also be present in this location. Colour doppler can be used to distinguish between vascular and nerve structures (Figures 3 and 4).



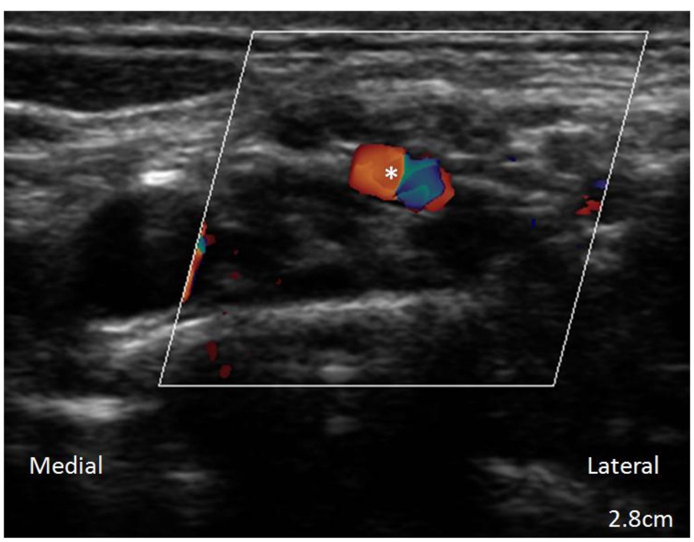


Figure 3,4. Left supraclavicular brachial plexus. Nerves (yellow arrows) cephalo-lateral to subclavian artery (SA). FR=first rib, P=pleura, *=vessel (identified using Doppler – see figure 4)

Once the artery, rib, pleura and plexus are simultaneously in view, the aim is to guide the needle towards the 'corner pocket' between the first rib inferiorly, the supraclavicular artery medially and the nerves superiorly (Figures 5 and 6).[21] This area is where the lower trunk commonly lies. Incomplete block when using the supraclavicular approach is, in our experience, most commonly due to failure to block the lower trunk, which subsequently results in inadequate ulnar nerve anesthesia.

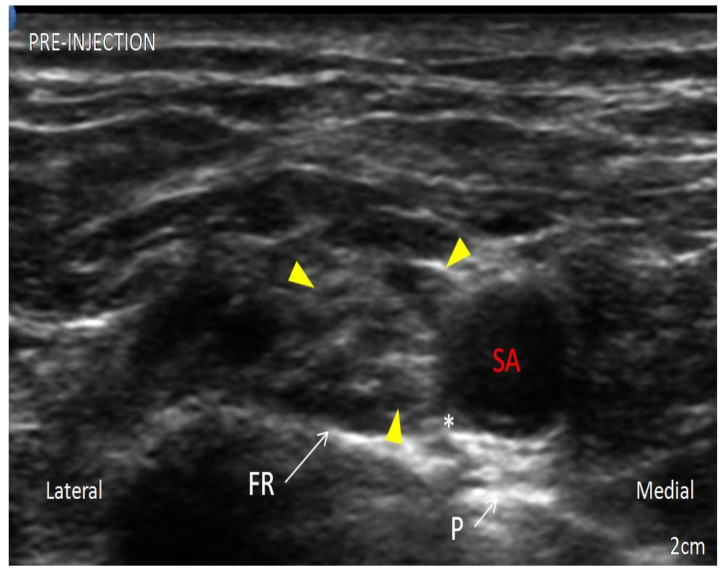


Figure 5. 'Corner pocket' (*), pre anesthetic injection. Plexus=yellow arrows. FR=first rib, SA=subclavian artery, P=pleura. Compare with Figure 6.

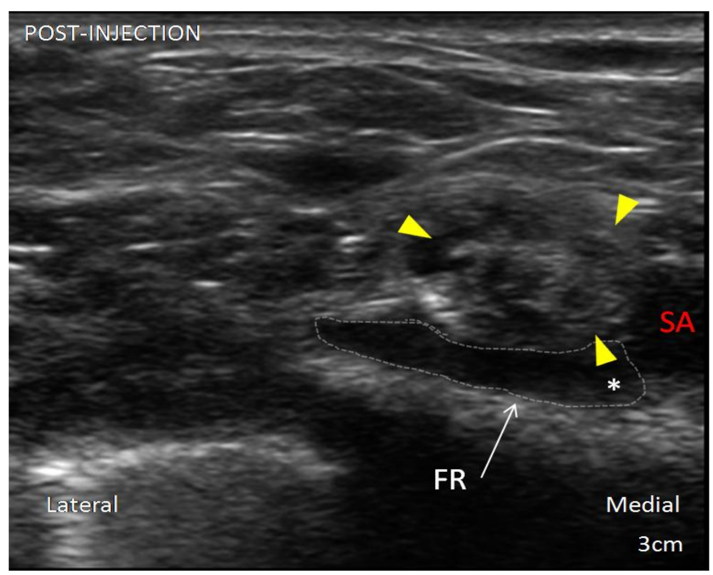


Figure 6. Right supraclavicular brachial plexus (yellow arrows). Local anesthetic (dashed lines) has been deposited in 'corner pocket' (*). Note the nerves now appear to be floating on the anesthetic. FR=first rib, SA=subclavian artery.

There are two differing needle approaches, both of which involve an in-plane technique in order that the needle tip can be better visualized. In the first, the needle is inserted in a lateral to medial direction in the long axis of the transducer (Figure 1). Whilst this method benefits from a generally unobstructed route straight to the 'corner pocket', the major disadvantage (particularly for beginners) is that the needle trajectory is towards the pleura (Figure 7).

The second approach, and that preferred by the senior author of this article, is from medial to lateral. This has the advantage of needle movement away from the lung, with the first rib acting as a 'backstop', and so theoretically is safer if the needle is inadvertently advanced too far. A disadvantage however compared to the lateral to medial approach is that more manipulation of the needle is required because the artery is in the path between the point of needle insertion and the 'corner pocket'. To reach the desired 'corner pocket' with this method the needle shaft can be used to steer the supraclavicular artery out of the way. In both techniques the tip of the needle should be visualized at all times. If the needle tip is not clearly in view, 'hydrolocalisation' using small amounts of 5% dextrose is useful. Local anesthetic rather than 5% dextrose can be injected if neurostimulation is not being used. On depositing local anesthetic in the 'corner pocket' the nerves are often seen to float superiorly (Figure 6).

Local anesthetic spread is observed during injection and the needle repositioned to ensure distribution around all the nerve trunks and divisions within the plexus sheath (Figure 8). No sign of local anesthetic spread may indicate intravascular injection and so care must be taken when this occurs to re-identify the needle tip before further local anesthetic injection. In total between 25 and 40ml is injected, although we have found that as little as 15ml can provide adequate surgical anesthesia for forearm and hand surgery.

Summary

In summary, although ultrasound guided supraclavicular block has been shown to be a safe alternative to nerve stimulator guided supraclavicular brachial plexus block there is little evidence as yet to support the superiority of ultrasound compared to any other method of nerve localization. Whilst there is anecdotal evidence that safety may be enhanced by ultrasound, as with all regional anesthesia techniques this is in part operator dependant and care must be taken to ensure adequate needle tip visualization at all times in order to avoid complications.

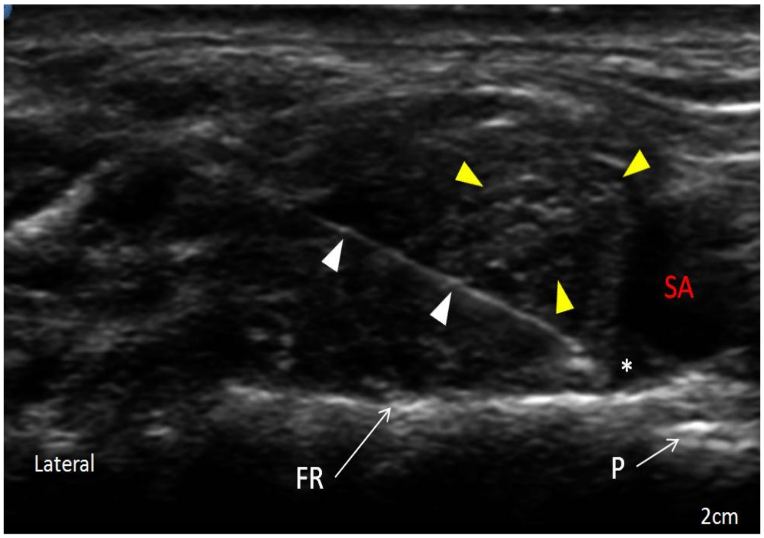


Figure 7. Lateral to medial, in-plane approach of needle (white arrows) advancing towards both pleura (P) and 'corner pocket' (*) of right supraclavicular brachial plexus (yellow arrows). FR=first rib, SA=subclavian artery.

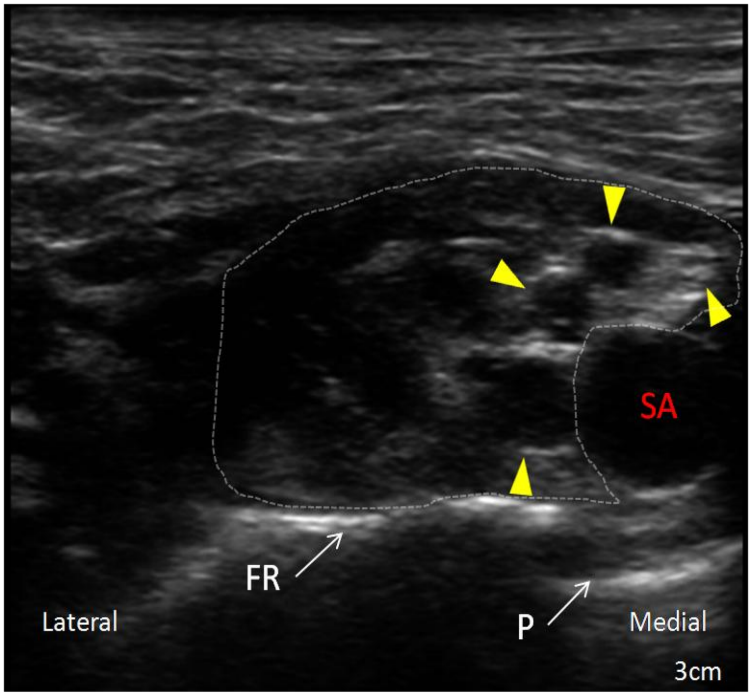


Figure 8. Local anesthetic surrounding nerves shown in Figure 3.

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