ULTRASOUND GUIDED INTERSCALENE BRACHIAL PLEXUS BLOCK

ANAESTHESIA TUTORIAL OF THE WEEK 233

25th JULY 2011

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QUESTIONS

Before starting the tutorial, try and answer the following questions with a true or false response. Answers with some explanations are found at the end of the article.

1. Interscalene block is suitable for the following surgeries
    a) Shoulder arthroplasty
    b) Hand surgery
    c) Acromio-clavicular joint surgery
    d) Sterno-clavicular joint surgery
    e) Proximal humerus surgery

2. Some of the side-effects/complications of interscalene block are
    a) Hemidiaphragmatic palsy
    b) Mydriasis
    c) Nasal stuffiness
    d) Epidural injection
    e) Ptosis

3. Regarding ultrasound guided interscalene block
    a) The plexus may be approached with an in-plane or out-of-plane needling technique
    b) The ideal ultrasound probe frequency is 5-10 MHz
    c) Out-of-plane technique is preferred for insertion of continuous catheter techniques
    d) Shallow angle to the skin aids in needle visualisation
    e) On testing, loss of motor component is the most reliable indicator of block success

INTRODUCTION

Interscalene block can provide anaesthesia and/or analgesia for operations on the distal clavicle, shoulder and proximal arm. Ultrasound guided interscalene block target the roots and proximal trunks of the brachial plexus as they are sandwiched between the anterior and the middle scalene muscle. There is currently insufficient evidence that ultrasound guided blocks improve success rate or decrease complication rate. However, there is evidence that the use of ultrasound decreases the onset time, improves sensory block and decreases the number of needle passes when compared with blocks performed using a nerve stimulator technique. Ultrasound can act as a useful learning tool because the procedure becomes objective: the needle, the nerves and the spread of local anaesthetic injectate can be visualised in real-time.

ANATOMY

- The brachial plexus consists of anterior rami of the spinal nerves from C5 to T1.
- These anterior rami pass through their respective intervetebral foramina and converge laterally and caudally to form the trunks of the brachial plexus. C5 and C6 unite to become the superior trunk, C7 forms the middle trunk and C8 and T1 converge to form the inferior trunk.
- The trunks are enclosed within an interscalene fascial sheath as they pass between the anterior and the middle scalene muscles.
- The trunks may be crossed by the external jugular vein and the transverse cervical and the suprascapular arteries (both branches of the thyrocervical trunk).
- The phrenic nerve passes between these muscles and then runs ventrally to the anterior scalene muscle, in its fascia ventrally and medially. A diaphragmatic twitch during interscalene block performed with a nerve stimulator indicates placement of the needle anterior to the plexus.
- The recurrent laryngeal nerve lies more medially, but still close to the plexus, especially on the right side.
- Medially to the anterior scalene muscle runs the cervical sympathetic chain.
- Medially and dorsally lies the vertebral artery and central nervous structures, exposing to a risk of injection into vertebral artery or epidural or intrathecal anaesthesia
- Caudally, the plexus overhangs the pleura and the subclavian vessels

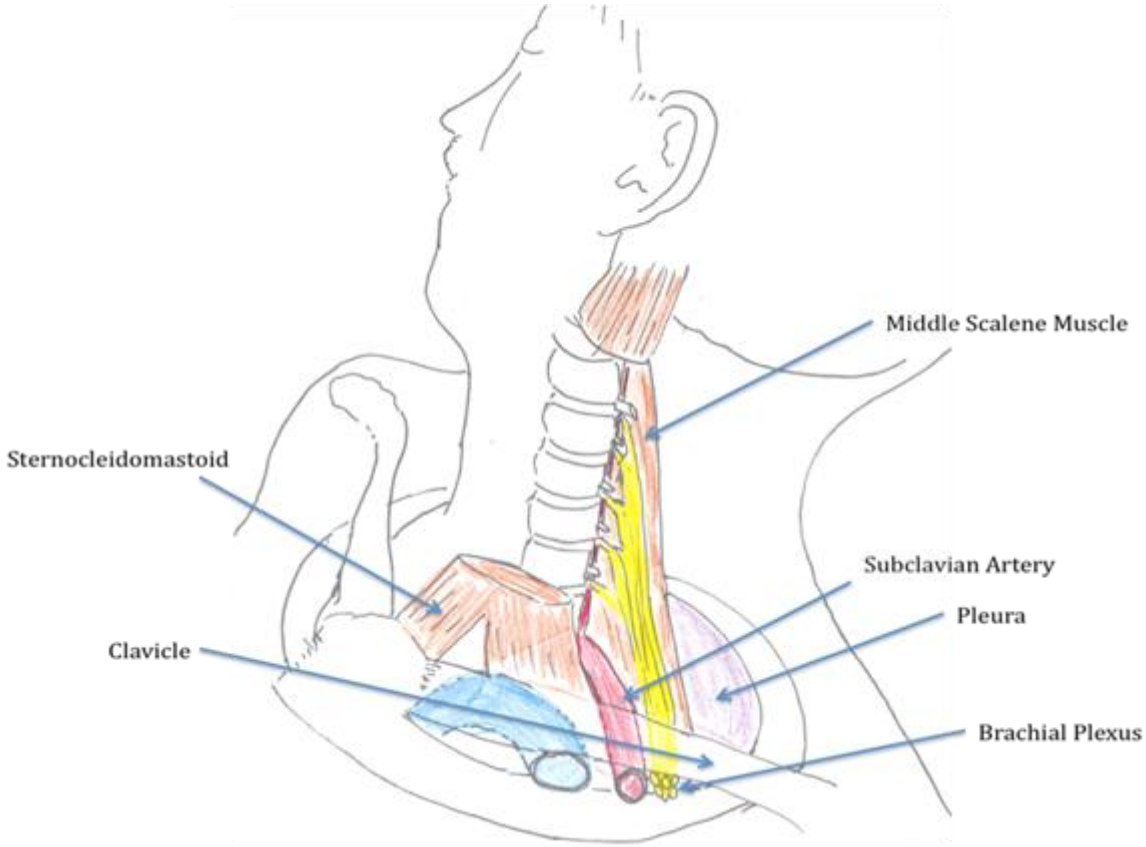

Figure-1: Anatomy of the Interscalene Brachial Plexus

INDICATIONS

Interscalene block can be used for surgeries on the shoulder, lateral clavicle, acromioclavicular joint and proximal humerus.

CONTRAINDICATIONS

Absolute contraindications to interscalene blockade are patient refusal and severe local infection

A successful interscalene block also usually results in blockade of the ipsilateral phrenic nerve and thus ipsilateral diaphragmatic paresis. It is important therefore never to block both sides at the same time. Caution should be exercised in the following circumstances and in general they constitute relative contraindications for an interscalene block:

- Contralateral phrenic palsy
- Contralateral pneumothorax
- Contralateral pneumectomy
- Severe COPD

Ultrasound guided block may be judiciously performed in coagulopathic patients as the vascular anatomy can be identified and avoided.

PATIENT POSITIONING

The patient lays supine, head slightly elevated and turned away from the side to be blocked. The arm should be uncovered so biceps, triceps and deltoid muscles can be seen. The patient can be given mild sedation/analgesia but should be able to maintain verbal contact so he/she can tell you about any pain they might experience during injection.

The patient can also be placed in a semi-lateral position for ultrasound guided blocks. This can also make needle and probe alignment easier.

EQUIPMENT AND DRUGS

Fully prepare the equipment and patient, including consent. Ensure intravenous access, monitoring and full resuscitation facilities. For a more detailed explanation on preparation see ATOTW 134 "Peripheral nerve blocks - Getting started". Appropriate aseptic precautions should be taken.

A linear ultrasound probe (Frequency 10-15 MHz) is used with the depth setting of 2-4 cm. A 50mm length insulated nerve stimulator needle is used to perform the block. Peripheral nerve stimulation (PNS) is desirable as an additional way of confirming nerve location but not essential. If PNS used, initial settings should be 0.5 mA for current , frequency of 2Hz and pulse width of 0.1 msec. Higher currents may result in muscle contractions which cause the arm to move and make it difficult to maintain a stable ultrasound image.

If a PNS is used, the usual precautions of a threshold potential > 0.3mA, immediate twitch ablation on injection and painless easy injection should be observed. ***It is not a requirement to seek out specific nerve stimulator twitches if the relevant anatomy is clearly identified.***

The local anaesthetic drug and its concentration used depend upon the requirement of the block in terms of surgical anaesthesia or analgesia, onset time, duration and motor sparing effects. L-Bupivacaine (0.25-0.5%) and Ropivacaine (0.2-0.75%) are commonly used in the UK. Traditionally, the volume required was 20-40 ml for nerve stimulator or paraesthesia guided blockade. However, the advent of ultrasound allows lower volumes (10-15ml) to be used effectively.

Clonidine (1mcg/kg) is sometimes used as an adjunct as it can prolong the duration of the block.

SCANNING TECHNIQUE

The operator stands on the side of the patient to be blocked. The US machine should be at a comfortable ergonomic position on the opposite side of the patient.

Distal to proximal or 'Traceback' approach

The supraclavicular fossa is scanned first to identify the subclavian artery as it passes over the first rib. This may be achieved by placing the probe against the clavicle and scanning in a caudad direction. The vascular anatomy may be confirmed using the colour Doppler mode. The brachial plexus is easily identified in this region. It resembles a "bunch of grapes" usually lying supero-lateral to the artery. The nerves in this position appear hypo-echoic (black) surrounded by more echogenic (white) connective tissue. The plexus can be followed medially and cephalad along it course by keeping the nerves in the centre of the screen till the roots/trunks are seen as hypoechoic round or oval structures in the interscalene groove.

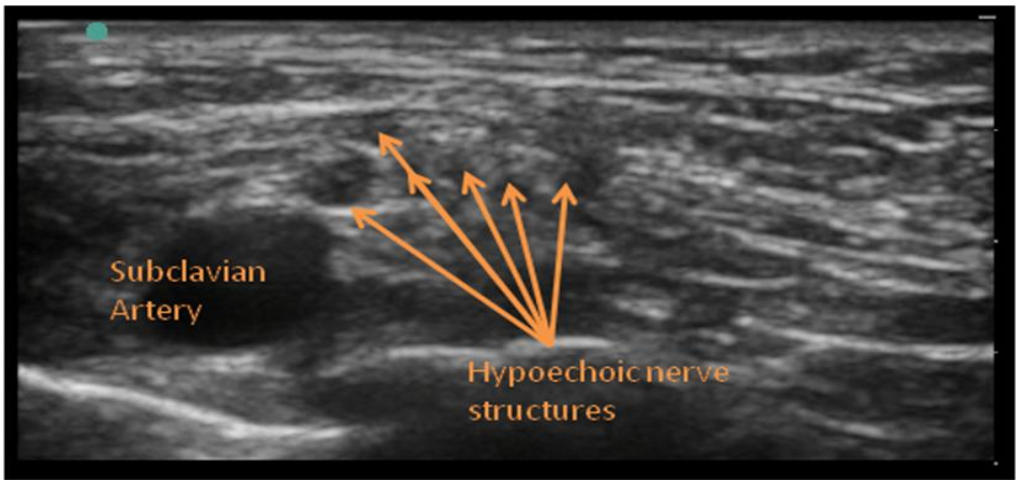

Figure 2: Ultrasound Image of the Brachial Plexus in Supraclavicular Region

Figure 3: Probe position for in-plane approach

Medial to lateral approach

The probe is initially placed near the midline at the level of cricoid cartilage and scanned laterally to identify the carotid artery and internal jugular vein. The sternocleidomastoid muscle overlies these structures. By moving the probe laterally, the anterior scalene muscle is seen below the lateral edge of the sternocleidomastoid. A groove containing the hypo-echoic nerve structures can usually be identified but may require fine adjustments of the probe in a rotational or tilting motion.

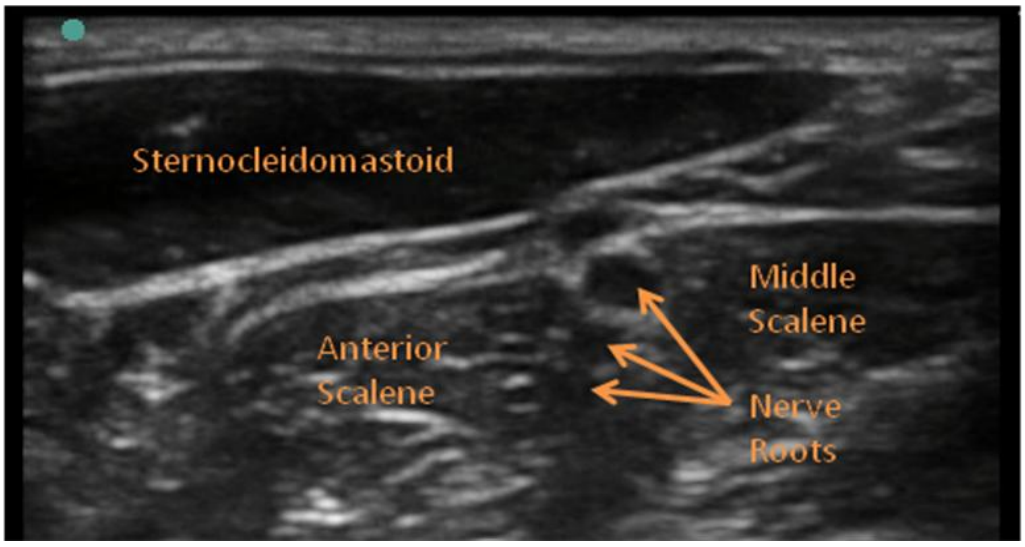

Figure 4: Ultrasound **i**mage of the brachial plexus in the interscalene groove

NEEDLE INSERTION TECHNIQUE

1. In-plane approach

The needle is brought in the same plane as the probe so that the whole length of the needle can be visualised. Conventionally the needle is brought in a lateral to medial direction. This method is used for single shot blocks and is considered by some to be safer as the entire length of the needle is seen if done correctly. Make sure that the needle is advanced only when the whole shaft of the needle and the tip can be seen. The needle is visualised more easily when it is inserted at a shallow angle to the skin so that greater numbers of ultrasound waves are reflected back to the probe leading to a brighter image. (Refer to ATOTW 199 & 218 for more detail about the physics of ultrasound.) This may mean that the point of skin entry is some distance away from the edge of the probe.

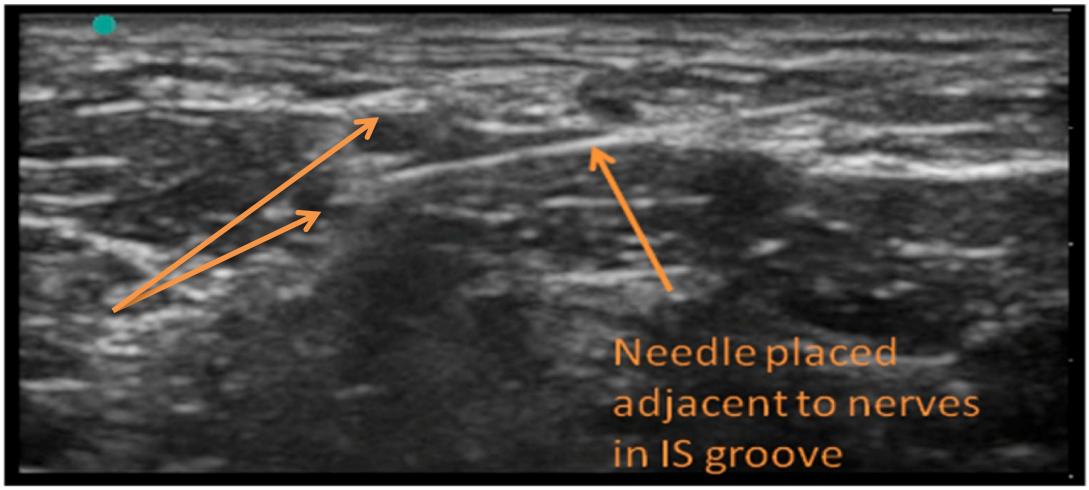

Figure 5: Ultrasound image of In-plane needle lying next to nerve structures in interscalene groove

2. **Out-of-plane approach** The needle is inserted cranial to the probe similar to techniques for internal jugular cannulation. The needle may be seen as a bright dot on the screen as it crosses the ultrasound beam. It may initially be difficult to be sure which part of the needle you are seeing as the "dot" may represent a cross-section of the shaft and not the needle tip. By tilting the probe, the tip is identified as the point where further tilting leads to the bright dot no longer being visualised on-screen. The movement of the surrounding tissues in response to rapid small movements of the needle may also aid its identification. This method is preferred by the authors only for catheter insertion.

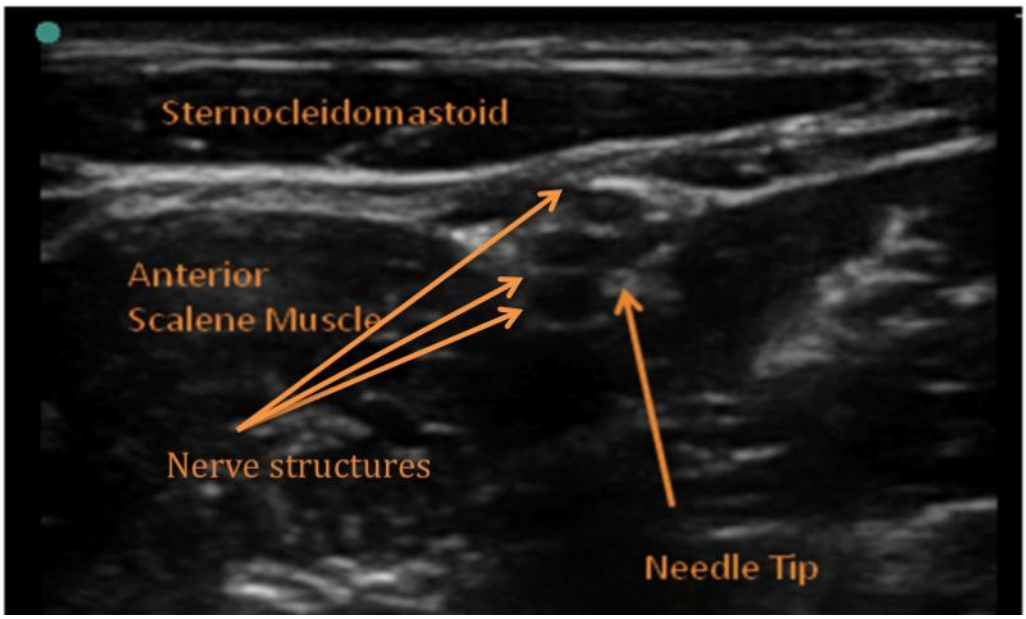

Figure 6: Ultrasound image of cross-section of needle (Out-of-plane approach)

END POINT OF THE INJECTION

A small amount of local anaesthetic is injected to hydro-dissect and open up the fascial plane. This allows clearer visualization of the nerve structures. Local anaesthetic should ideally spread anterior and posterior to the nerve structures and surround the nerves as a doughnut shaped hypoechoic area (see figure 8).

Avoid intramuscular injection which is indicated by an increase in echogenicity (increasing black space) within the muscle bulk. It is usually more difficult to inject into the muscle. Adjust the needle position during injection to optimize local anaesthetic spread if necessary. Scan proximally and distally along the course of the nerves to assess the extent of local anaesthetic spread.

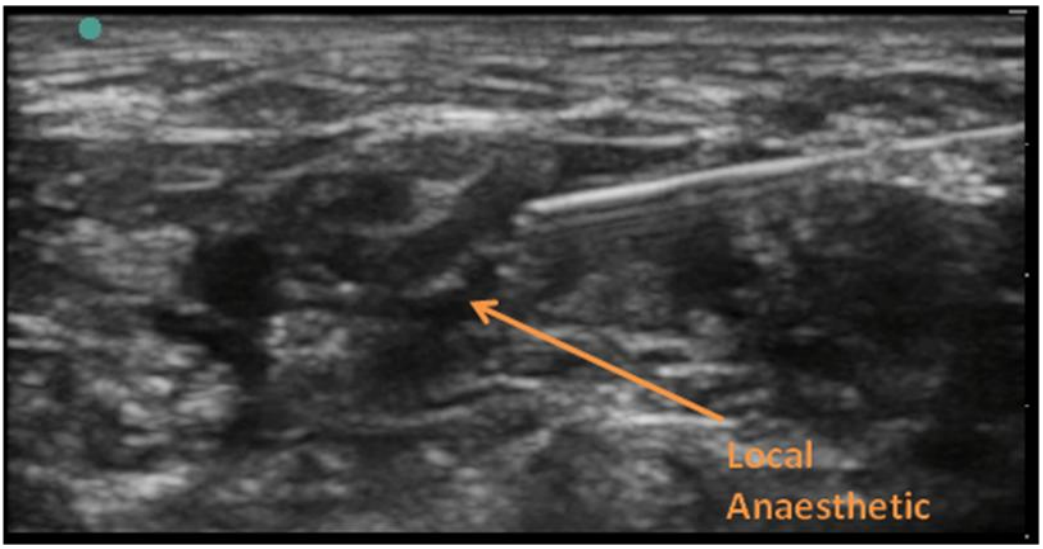

Figure 7: Image of local anaesthetic surrounding nerve structures (hypoechoic area)

CHECKING FOR BLOCK ADEQUACY

It may be possible to demonstrate adequate surgical anaesthesia after 5-10 minutes, however, some blocks may take significantly longer to establish (up to 40 minutes). Three components for the block should be tested.

- Motor- by asking the patient to abduct and flex the arm
- Sensory- by checking loss of cold sensation over the area of surgery
- Proprioception- by demonstrating loss of sense of joint position and motion

CATHETER INSERTION

Continuous interscalene block (CISB) may also be performed for procedures with anticipated ongoing pain. The in-plane or out-of-plane approach may be used for siting CISB.

Injection of 0.5-1ml of local anaesthetic or 5% dextrose solution (if nerve stimulation is being used) through the needle to distend the interscalene groove is recommended to facilitate the ease of catheter advancement.

Local anaesthetic spread can be observed in real time during catheter injection to help confirm correct positioning.

SIDE EFFECTS

The following are classified as side-effects rather than complications because they are likely to be present with any successful ISB and are temporary and resolve with resolution of the block

- Ipsilateral hemidiaphragm paresis is a common sequelae to an interscalene block
- Recurrent laryngeal nerve blockade may occur, leading to hoarseness and swallowing difficulty.
- Horner's syndrome often occurs due to the proximity of the sympathetic cervical chain.

COMPLICATIONS

Respiratory complications

- Pneumothorax.

Neurological complications

- Neuropathy may be a consequence either of intra-neural injection or direct trauma to the nerve by the needle. However, nerve injury is much more frequently due to surgical trauma.
- Injection of local anaesthetics in the vertebral artery or even in the small cervical vessels can lead to neurotoxicity.
- Epidural or spinal injection is a described complication and should be suspected if sensory defect of the contra lateral upper limb occurs.

IMPORTANT POINTS

- Interscalene blockade is useful for surgery around the shoulder and upper arm
- Ultrasound guidance may make the block safer and more reliable
- Complete visualisation of the needle at all times is a prerequisite for the safe performance of this block for the in-plane technique
- If in doubt, use the colour doppler function on the ultrasound machine to aid differentiation of a vascular structure from a nerve
- If the hypoechoic area representing the spread of local anaesthetic from the tip of the needle is not seen during injection, stop injecting and reposition the needle position needs to be readjusted
- For AWAKE arthroscopic procedures of the shoulder, the posterior port insertion site is often not covered by an interscalene block. This will necessitate additional port site local anaesthetic infiltration by the surgeon but is usually well tolerated.

ANSWERS TO QUESTIONS

Question 1.

- a. True
- b. False- C8 & T1 roots are not reliably blocked by interscalene block
- c. True
- d. False- Sternoclavicular joint is innervated by upper cervical nerves
- e. True

Question 2.

- a. True- Due to phrenic nerve block
- b. False- Horners syndrome causes miosis
- c. True- Because of nasal mucousal congestion from cervical sympathetic block
- d. True- If the needle is guided with too much of medial intent, it can reach the epidural space
- e. True- Horners syndrome causes ptosis as well

Question 3.

- a. True
- b. False- Ideal probe frequency for interscalene block is 10-15MHz
- c. True- Because the needle is parallel to the direction of the plexus sheath
- d. True- because more ultrasound waves are reflected back to the probe by the needle
- e. False- You should check for sensory component as well

WEBLINKS

www.usra.ca/sb_interscalene

www.neuraxiom.com/html/**interscalene**_bp.html

http://www.nysora.com/peripheral_nerve_blocks/ultrasound-guided_techniques/3097-us_guided_interscalene_block.html

REFERENCES AND FURTHER READING

Ultrasound Imaging for Regional Anaesthesia- A Practical Guide. 2nd Edition by Vincent W S Chan

Atlas of Ultrasound and Nerve Stimulation Guided Regional Anesthesia. Ban C H Tsui, Ravi Bhargava

Applying ultrasound imaging to interscalene brachial plexus block. Chan VW: Reg Anesth Pain Med 2003; 28: 340-3.

Ultrasonographic guidance improves the success rate of interscalene brachial plexus blockade. Kapral S, Greher M, Huber G, Willschke H, Kettner S, Kdolsky R, Marhofer P. Reg Anesth Pain Med 2008;33:253-8.

Sources of Images:

Dr Joe Carter personal archive