BRACHIAL PLEXUS BLOCK-COMPARISON OF DIFFERENT TECHNIQUES

SUMMARY: Regional blocks for the upper limb are widely used and their outcome depends a lot on the proper selection of the right approach, depending on the type of surgery planned. This requires a good knowledge of the anatomy of the brachial plexus and the important relations with the adjacent structures to anticipate the complications and the risk involved and that determines the choice of technique depending on the patient’s general condition. With the advent of the nerve stimulator, dependence on the patient’s subjective sensation has been overtaken, by the anaesthesiologist's interpretation of the Evoked Motor Response. There is a lot of literature on the same and our experience added on to the knowledge gives a good input for our students. The following article is my perception of the different techniques for upper limb blocks.

INTRODUCTION:

The upper limb surgeries can be divided into four parts: 1) shoulder 2) elbow 3) forearm 4) wrist and hand surgeries. The approach to the plexus is determined by the region to be operated upon.

Shoulder region is innervated by C3-6, but for operations on the shoulder joint T1-2 also need to be blocked. This can be achieved by the interscalene approach and by additionally blocking the second intercostals nerve in the posterior axillary line.

Elbow surgeries require blockade of C5-8, T1-2 and the supraclavicular or the infraclavicular approach is the best.

Forearm being supplied by the musculocutaneous nerve, median nerve and the ulnar nerves i.e. C8-T1, an infraclavicular or axillary approach along with block of the intercostobrachial for the tourniquet pain gives good results.

Wrist and hand surgeries are challenging as this region has a rich nerve supply. Base of the thumb is supplied by the median nerve from the anterolateral aspect, radial nerve from the posterolateral aspect and the musculocutaneous nerve from the superolateral aspect hence the supraclavicular and infraclavicular approaches are better. For the ulnar aspect of the wrist and hand the axillary approach is better.

ANATOMY OF THE BRACHIAL PLEXUS:

Brachial plexus comprises of the ventral primary rami of the nerve roots of C5-T1, with an occasional contribution from C4 and T2. The ventral rami form the roots of the plexus and
they combine to form the trunks. C5-6 form the upper trunk, C7 the middle trunk, C8-T1 the lower trunk

These trunks then are divided into an anterior and a posterior division each. The anterior divisions of the upper and middle trunk form the lateral cord (C5-7), the anterior division of the lower trunk forms the medial cord and the posterior divisions unite to form the posterior cord.

**BRANCHES OF THE BRACHIAL PLEXUS:**
1. **SUPRACLAVICULAR BRANCHES:**

   **(A) FROM THE ROOTS:** -
   
   i) connection to cervical sympathetic trunk  
   ii) branches to the scalenei and the longus colli  
   iii) branches to the rhomboids  
   iv) long thoracic nerve (N to serratus ant)  
   v) dorsal scapular nerve  
   vi) branch to phrenic nerve

   **(B) FROM THE TRUNKS:** -
   
   i) N to subclavius  
   ii) suprascapular nerves

2. **INFRACULAR BRANCHES:** -

   - from the medial cord: ulnar nerve; medial pectoral n; media cut n of arm; med cut n of forearm, branch to median n
   - from the lateral cord: lateral pectoral n; musculocutaneous n, branch to median n
   - from the posterior cord: axillary n, radial n, upper and lower subscapular n and thoracodorsal n

**RELATIONS OF BRACHIAL PLEXUS:**

In the neck: The roots arise posterior to the vertebral artery and descend in the posterior triangle. The interscalene space is bounded by the scalenus ant anteriorly and scalenus medius posteriorly, the vertebral bodies the subarachnoid and epidural space medially, and the transverse process of C7 to a line joining the mid clavicular point to the first rib inferiorly.

Medially to the plexus lies the vertebral triangle bounded by the lateral border of longus colli and longus cervicis medially, the medial border of scalenous laterally and the subclavian A inferiorly, the vertebral A runs through the middle of this triangle. The internal jugular v, common carotid a and the vagus n lie ant to the vertebral triangle.

In the supraclavicular region: The trunks lie above and lateral to the subclavian artery. The following are superficial structures - skin, deep fascia, platysma inferior belly of omohyoid, external jugular v and transverse cervical artery. Inferomedially lie the recurrent laryngeal nerve and the stellate ganglion. Anterior relations are the subclavian vein and the subclavius muscle. Below the plexus lies the pleura and the lung parenchyma.

In the axilla the three cords lie medially, laterally and posteriorly respectively.

Brachial plexus sheath: The deep cervical fascia investing the nuchal muscles forms a sheath around the plexus extending from the origin of the plexus to the branches of the cords. This limits the spread of the drug and gives rise to an incomplete block. Similarly there is a transverse septum at the level of the coracoid process, which limits the spread of drug from the interscalene to the axillary space.
Relationships of the brachial plexus.

1. Vertebral artery 11. Middle trunk
2. Middle scalene muscle 12. Lower trunk
4. Sheath limiting the 14. Musculocutaneous nerve
    interscalene space 15. Radial nerve
6. Clavicle 17. Axillary vein
7. Apical pleura 18. Axillary sheath
8. First rib 19. Ulnar nerve
10. Upper trunk

The relations of the brachial plexus in the root of the neck.
1. **Medial Pectoral Nerve:** After leaving the medial cord it pierces the scalenus medius and supplies the Pectoralis minor.

2. **Ulnar Nerve:** It lies medial to the axillary artery till the insertion of the corachobrachialis muscle and then pierces the medial intermuscular septum and lies on the medial head of the triceps between the olecranon and the medial epicondyle. It enters the forearm between the heads of flexor carpi ulnaris and lies between this muscle and the flexor digitorum profundus. It reaches the wrist and lies lateral to the flexor carpi ulnaris and pisiform and medial to the ulnar artery and supplies the muscles of the hypothenar area - flexor, opponens and abductor digitominimi and the abductor pollicis and all the interossei and the 3rd and 4th lumbricals. and skin of medial 1½ fingers.
3 Lateral Pectoral Nerve supplies the pectoral major after piercing the clavipectoral fascia

4 Median Nerve Lies lateral to the axillary artery till the insertion of the corachobrachial is then it crosses it and lies medial to it. It lies between the biceps and the brachialis lying medial to the bicipital aponeurosis and then enters the forearm between the heads of the pronator teres. In the forearm it lies in between the flexor digitorum profundus and superficialis and at the wrist lies medial to the flexor digitorum radialis and lateral to the palmaris longus and superficialis. It supplies the lateral 3 1/2 fingers and the 1 & 2 lumbricals.
Musculocutaneous Nerve Pierces the coracobrachialis and lies between the biceps and brachialis and enters the forearm between the biceps and brachioradialis and then continues as the lateral cutaneous n of forearm.
6 Radial Nerve Lies posterior to the axillary artery and between the long and medial head of the triceps and then lies in the groove and courses laterally and descends between the brachialis and brachioradialis then divides into the superficial and deep branches. It supplies the posterior aspect of the lateral 3½ fingers.

The distribution of the radial nerve.

7 Axillary Nerve Turns backwards through the quadrangular space and supplies the deltoid and teres minor.

8 Thoracodorsal N supplies the serratus anterior.

9 Upper and Lower subscapular nerves supplies the subcapularis muscle.

Procedure for different blocks:
A. **Interscalene Approach:**

Position of patient: supine with head turned to the opposite side and the arm placed by the side

**Landmarks:** chaassagnac’s tubercle at the level of the cricoid cartilage in the space between the scaleneus ant and medius at the lateral border of the sternocleidomastoid

**Technique:** A 5cm 22G needle is inserted at this point at 60 degrees to the skin and 30 degrees to the vertical axis and advanced medially, caudally and forwards till the Evoked motor response is elicited at 0.4-0.7mAe contraction of the deltoid, biceps, triceps, lateral pectoral and flexion of the elbow. Then the drug is injected and the patient made to lie with a 45 degree head up tilt to allow the drug to travel downwards. A successful block usually leads to cervical sympathetic block and Horner’s syndrome with pupillary dilatation and the arm having vasodilatation.

**Useful tips:**

1. If phrenic N stimulation leads to diaphragmatic contraction the needle is redirected posteriorly.
2. Dorsal Scapular N stiulation causes contraction of rhomboids and needle needs to be redirected anteriorly.
3. Levator scapulac muscle contraction causes elevation of scapulac and the needle needs to redirected anteriorly.
4. Accessory Nerves stimulation causes contraction of the thapzius and needle needs to be redirected anteriorly.
5. Intercostodrachial N and medial cutaneous Nerve branches may escape and for anterior incision a T_{2} block at exilla or local infiltration along the line of incision.
6. The posterior incision arthroscopy portal may escape and requires local infiltration along theline of incision.
7. The lower branches of the brachial plexus i.e. the ulnar nerve the medial cutaneous nerve of arm and forearm are often incompletely block.
B. Supraclavicular approach: -

Position: Supine with elevation of shoulder with of small rolled towel under the shoulder and the head turned to the opposite side with the arm straight.

Landmark: -
1. Midclavicular pointed midway between sternoclavicular and acromioclavicular joint.
2. Lateral to subclavian Artery, which is displaced medially.
3. Crossed-by line extended from external jugular vain.
4. Lateral border of streno cliediomastoid.

Procedure:
1. Needle is directed medially, cordially and downwards towards the spine of T₄ From this point and an EMR at 0.4-0.7mA of flexion of the wrist and fingers is elicited

Useful tips:
All infraclavicular branches except axillary nerve and supraclavicular branches are blocked

C. AXILLARY APPROACH:

Position: Supine with the arm abducted at 90° and flexed and supinated so that the hand lies close to the head.

Landmark: At the junction of corachobrachialis and pectoralis major a dimple is seen and the axillary artery is palpated and the insulated 5cm needle is inserted at 45° to the skin and an EMR is elicited for each cord separately ---medial cord -ulnar n; adduction of the thumb; lateral cord musculocutaneous n-flexion of the elbow; posterior cord-radial n-extension of the wrist and fingers
**SOLUTIONS:**

Mixture point 5% sensorocain and 2% xylocaine with Adrenaline is used for surgeries lasting more than one hour and for shortage surgeries xylocaine 2% with Adrenaline is used. Total Volume of solution 30 to 35 ml, xylocaine with 3 to 4 mg. / (kg) and sansorocain 1 to 2 mg / (kg) is used. Adding 1500 units of hylase and 50 microgram fantaline improves the affectacy.

**COMPLICATIONS:**

1. **Intravenous Injection:** Always aspirate before injection to rule out this complication if accidental i.v injection it may lead to bradycardia/convulsions/unconsciousness/respiratory arrest and hypotensionand cardiac arrest. Early recognition and treatment with supportive measures. Convulsions are controlled by i.v diazepam or thiopentone.
2. **Sub-arachnoid or epidural injection through inter-scalene approach** may cause cardio-respiratory arrest.
3. **Pneumothorax** through supraclaviculac approach may cause chest pain, difficulty in respiration and treatment is with intercostal drainage if large pneumothorax occurs.
4. **Neuritis** from inter-neural injection.
5. **Infection**
6. **Undesirable Nerve Blocks** - A stelate ganglion block may lead to horner syndrome by inter-scalene block. A phrenic nerve block seen following an interscalene block in 40-60% of patients is not serious complications unless patient has respiratory infection. Recurrent laryngeal nerve block causes hoarseness of the voice and danger of aspiration of the gastric contents. Therefore oral feeding should be withheld until this block wears off completely.