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Supraclavicular Approach vs Retroclavicular Approach as A Brachial Plexus Block: Review article

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ABSTRACT

Background: Five roots, three trunks, six divisions (three anterior and three posterior), three cords, and five branches make up the brachial plexus. Supraclavicular, infraclavicular (ICB), or axillary brachial plexus blocks are often used in regional anaesthesia for distal upper limb operations. The well-known and straightforward retroclavicular route for brachial plexus anaesthesia is used. One of the methods for numbing the brachial plexus is the retroclavicular block. In this method, the needle was placed above the clavicle's midpoint. It is a great option for hand and elbow surgery.

Objective: This review article compared the needle visualisation, success rate, and timing of the beginning of the sensory and motor block in supraclavicular and retroclavicular brachial plexus blocks.

Methods: Supraclavicular approach, Retroclavicular approach and Brachial plexus block were searched for in PubMed, Google and Google Scholar. Only the most current or comprehensive study was included after the authors thoroughly filtered references from the pertinent literature, which comprised all the recognised studies and reviews.

Conclusion: Supraclavicular approach has better needle visualization than retroclavicular approach and better success rate but has shorter duration of both sensory and motor block.

Keywords: Supraclavicular approach, Retroclavicular approach, Brachial plexus block.

INTRODUCTION

For upper limb surgery, regional anaesthesia (RA) has significant benefits over general anaesthesia (GA). It lessens postoperative pain, which reduces the demand for opioids and makes it appropriate for patients with co-morbid conditions that exclude the use of general anaesthesia **(1)**.

Supraclavicular, infraclavicular (ICB), or axillary brachial plexus blocks are often used in regional anaesthesia for distal upper limb operations. The retroclavicular (RCB) brachial plexus block is a brand-new, ultrasound-guided method of brachial plexus surgery **(2)**.

Shorter treatment times, improved needle visualisation, less patient discomfort, and higher patient satisfaction are said to be advantages of the retro-clavicular block over the conventional approach to the infraclavicular region.

The brachial plexus anaesthesia technique known as the ICB method is straightforward to carry out [(3)].

The steep angle that the needle creates with the ultrasonic probe, which makes needle visibility difficult, is a natural drawback of this procedure. The RCB technique delivers a nearly perpendicular needle ultrasonic (US) beam angle due to its variable needle entrance point [(4)], but nevertheless pursues the same objective as the ICB. Theoretically, the block performance criterion can be improved by this little but crucial difference [(5)].

Brachial plexus block anatomy variations (Figure 1):

Five roots, three trunks, six divisions (three anterior and three posterior), three cords, and five branches make up the brachial plexus. There are multiple "pre-terminals" or "collateral" branches, including the subscapular nerve, the thoracodorsal nerve, and the long thoracic nerve, in addition to five "terminal" branches **(6)**.

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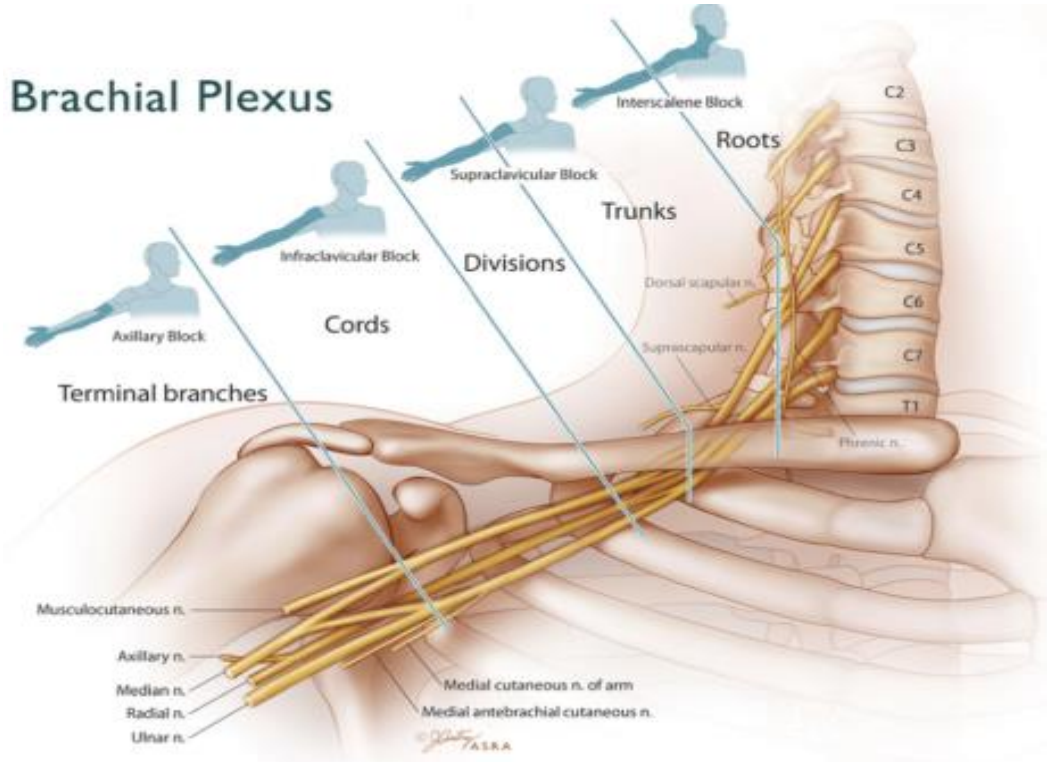

Figure (1): Brachial plexus block anatomy variations [(7)].

Infraclavicular area anatomy:

The infraclavicular fossa is bounded anteriorly by the pectoralis minor and major muscles, medially by the ribs, superiorly by the clavicle and coracoid process, and laterally by the humerus. The scapula is located in this area posterior to the brachial plexus. The second portion of the axillary artery is surrounded by cords that make up the brachial plexus at this site [(8)].

Physiology of nerve impulse conduction

Ionic disequilibrium causes the resting membrane potential (RMP) of neuronal membrane. Na^+ and K^+ pass across the membrane at different rates [(9)].

An impulse is produced by an increase in the conductance of Na^+ and a decrease in the RMP. More voltage-gated Na channels (NaV) open at threshold, and RMP increases to positive levels [(9)].

In addition to being the site of action for medications with local anesthetic (LA) effects, sodium channels (Na V) are essential for impulse transmission [(10)].

The results:

The quantity of medication that reaches the nerve is influenced by two things.

- **Relative mass:** This refers to the weight of the nerve in comparison with the weight of the tissues around the volume of the LA agent administered [(11)].
- **Perineurium:** The medication diffuses via the perineurium at a significantly slower pace than it enters the systemic circulation [(12)].

Perception of conducted impulses and effective blocks: The percentage of conducted impulses inhibited increases with the length of the nerve exposed to the LA. Traditional myelinated tiny fibres are most susceptible to LAs, whereas unmyelinated C fibres, which mediate dull visceral pain, are resistant to LAs. Differential blockade is the capacity of the LA to inhibit sensory impulses while preserving motor and proprioception [(13)].

Use of dependent blockade-tonic and phasic blockade

- **Tonic block:** According to infrequent stimuli, all LAs reduce Na current (I Na) because they bind to Na channels that are at rest or closed. The tonic block is this [(14)].
- **Phasic block:** 'Neutral' medicines like benzocaine have less of this phasic block. With volatile drugs, phasic blocks are also seen [(14)].
- **Hille-modulated receptor theory and hydrophilic pathway:** To explain phasic blockage and tonic blockade. It was postulated that state changes that occur during membrane depolarization affect the LA receptor site [(14)].
- **Guarded receptor hypothesis:** Although the LA binds to a receptor with constant affinity, channel gates control access to it [(15)].
- **Volume and concentration for nerve blocks:** It is well known that decreasing the density of the block results in improved drug diffusion when the volume of LA agents is increased [(16)].
- **MEV and MEAC:** The term MEV stands for the minimal effective volume required to eliminate

all sensory modalities. Depending on the injection location, this changes [17].

Effect of ultrasound-guidance on MEV:

The minimal amount for a brachial plexus block, according to studies, is around 32 ml, regardless of the method employed [18]. However, ultrasonic-guided (USG) procedures have successfully utilised volumes as low as 1.8 and 2 ml per nerve [18].

Pharmacological aspects of nerve block

Blockers of sodium (Na^+) channels are LAAs. They can be utilised as anti-dysrhythmics by influencing the Na^+ ion mobility and the action potential of cardiac tissue, local anaesthetic drugs for topical, regional, and neuraxial nerve conduction blockage, and anti-epileptics [19]. By the kind of link between the benzene ring and the tertiary amide, they may be separated into two groups: amides and esters [19].

Severity of peripheral nerve injury (PNI):

The relative level of axonal disruption is used to define the severity of PNI. The severity of proximal axonal lesions is higher than that of distal lesions. The Seddon and Sunderland categories are the two anatomical divisions that are most often utilised [20].

Mechanisms of injury: Three major categories may be used to classify the mechanism of PNI associated with the use of PNBs: mechanical and injection damage (traumatic), vascular (ischemic), and chemical (neurotoxicity) [21].

Mechanical and injection injury: Injury can be caused by injection, compression, stretch, or laceration. Conduction blocks and, if present for a long time, localised demyelination of certain axons are possible effects of nerve compression or entrapment [21].

Evidence-based recommendations to reduce the risk of block-related PNI [22]:

- **sVascular injury:** When there is direct vascular injury, an abrupt obstruction of the arteries from which the vasa nervorum are derived, or haemorrhage inside a nerve sheath, damage to the nerve vasculature during nerve blocks can cause local or generalised ischemia [23].
- **Chemical injury:** Results from the injected fluids' or their additives' tissue toxicity. Acute inflammation or persistent fibrosis that indirectly affects the nerve may result from injecting the toxic solution into nearby tissues or directly into the nerve [24].
- **Inflammatory injury:** An essential factor in the post-PNBs neurologic impairment is becoming more well recognised to be the inflammatory processes of PNI. Non-specific inflammatory reactions that target peripheral nerves can happen outside the surgical site or inside the operative limb, where it may be challenging to identify from other PNI causes [25].

Factors contributing to perioperative nerve injury [26]:

- Anatomical: Internal nerve morphology, including the connective tissue that supports fascicles and axons. The location, route, relationships, attachments, and relative mobility of nerves are gross anatomical characteristics.
- Anaesthesia: the kind of anaesthesia used, the insensate limb, the location of the peripheral nerve block (PNB) (proximal PNB is more dangerous than distal PNB), the amount of sedation experienced during the nerve block, mechanical trauma from a needle, catheter, or injectate, direct local anaesthetic toxicity, and neuronal ischemia.
- Surgical Trauma: perioperative positioning, contusion, compression, retraction, traction, and transection tourniquet: pressure and inflation time 81,104 Plaster casts and swelling particular procedures have a distinct risk profile.
- Patients: It is theorised that preoperative neurological impairment raises the likelihood of PNI and lumbar canal stenosis [26].

Anesthetic technique for infraclavicular (ICB) and retro clavicular (RCB)

Patients were positioned supine in a semi-sitting posture with the head rotated 45 degrees to the non-operative side, the ipsilateral arm put adducted by the patient's side, monitoring applied (pulse, ECG, BP), and oxygen mask 5 liters [27].

Supraclavicular brachial plexus block (Figure 2):

One of the methods for numbing the brachial plexus is the supraclavicular block. Nearly all of the sensory, motor, and sympathetic innervation of the upper extremity is carried by just three nerve structures that are constrained to a relatively limited surface area at the level of the brachial plexus trunks, where the block is carried out. As a result, this method usually produces a thick block with a predictable onset. Kulenkampff and Persky published the method in 1928. According to their description, the treatment was carried out either with the patient supine with a cushion between their shoulders or in a sitting posture ("a regular chair will suffice"). At the patient's side, the operator sat on a stool. The needle was placed medially towards the spinous process of T2 or T3 just above the midpoint of the clavicle, where the subclavian artery's pulse could be felt [27].

- **Indications:** Gives the upper extremity below the shoulder analgesia and anaesthesia. It is a great option for hand and elbow surgery.
- **Contraindications:** is not utilised in individuals with compromised breathing or bilaterally due to the possibility of pneumothorax or phrenic nerve block.

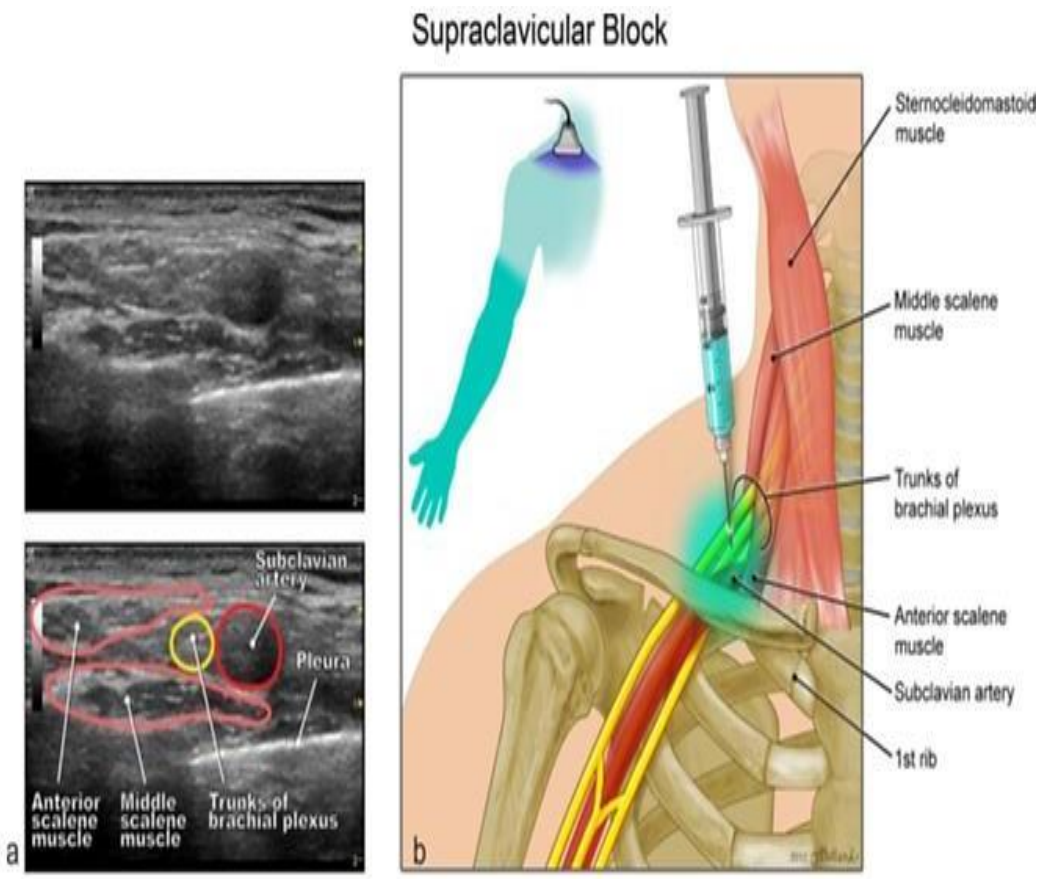

Figure (2): Supraclavicular Brachial Plexus Block [28].

Retroclavicular approach of brachial plexus block (Figure 3): The probe is positioned medial to the coracoid process, below, and perpendicular to the clavicle in a paramedian sagittal plane to obtain a short-axis view of the cords of the brachial plexus and the axillary arteries. The supraclavicular fossa, which is located about 1 cm posterior to the clavicle, is then punctured with a needle that is positioned in plane and exact parallel to the ultrasound transducer. After passing through the first blind zone caused by the acoustic shadow of the clavicle, which is about 2 cm long, the needle tip is always visible until it is positioned posterior to the axillary artery. The RCB technique is simple and effective, but it still has advantages over the horizontal approach in the following cases: patients with a deep deltopectoral groove where a prominent humerus prevents needling, patients with altered anatomy where the brachial plexus is located more laterally than usual position, and patients who have recently sustained an injury where abduction of the upper limb will not be comfortable for the patient [29].

Figure (3): Retro-clavicular nerve block technique [29].

The role of Supraclavicular block and Retroclavicular block in brachial plexus

Blanco *et al.* [30] reported that RCB had better needle visualization score than ICB block. **Grape *et al.* [3]** discovered that the supraclavicular group experienced less needling time than the retro clavicular group. **Grape *et al.* [3]** and **Georgiadis [31]** observed no significant difference in sensory and motor loss between both blocks. The success rate and lower procedure time were comparable between both block techniques as reported by **Grape *et al.* [3].**

Hence, for the brachial plexus's ultrasound-guided surgical approach, both supraclavicular and RCB approaches were comparable regarding success rate with reduced incidence of complications with superiority to supraclavicular regarding better needle visualization score and shorted needling time.

CONCLUSION

Supraclavicular approach has better needle visualization than retroclavicular approach and better success rate but has shorter duration of both sensory and motor block.

- **Sponsoring financially:** Nil.
- **Competing interests:** Nil.

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