



# **“A comparative study between Bupivacaine volumes on diaphragmatic mobility in Ultrasound guided Supraclavicular Block”**

*Thesis*

*Submitted for Partial Fulfillment of Master Degree in Anesthesia*

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## List of Abbreviations

AAGBI	:	Association of Anaesthetists of Great Britain and Ireland
BP	:	Brachial plexus
C	:	Cervical
CNS	:	Central nervous system
CVS	:	Cardiovascular system
DBP	:	Diastolic blood pressure
DC	:	Direct current
DE	:	Diaphragmatic Excursion
DNA	:	Deoxy Ribo-Nucleic Acid
GABA	:	Gamma amino butyric acid
HR	:	Heart rate
IV	:	Intravenous
LAs	:	Local anesthetics
MEAV50	:	Minimum effective anesthetic volume
MHz	:	Mega Hertz
MSM	:	Middle scalene muscle
Pdi	:	Trans-diaphragmatic Pressure
PNB	:	Peripheral nerve blockade
PNBs	:	Peripheral nerve blocks
PNP	:	Phrenic Nerve Paralysis
PNS	:	Peripheral nerve stimulation
RNA	:	Ribonucleic Acid
SA	:	Subclavian artery
SBP	:	Systolic blood pressure
SCM	:	Sternocleidomastoid
SD	:	Standard deviation
SPO <sub>2</sub>	:	Peripheral oxygen saturation
TLC	:	Total Lung Capacity
US	:	Ultrasound
USG	:	Ultrasound guide

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## INTRODUCTION

Local anesthetic blockade of the brachial plexus is a commonly performed procedure for upper limb surgery. In common with many regional anesthetic techniques, it may confer certain advantages over general anesthesia and is often used in the management of patients with cardiorespiratory disease. However, it is not without risk and it has been demonstrated that interscalene brachial plexus blockade is associated with a 100% incidence of ipsilateral hemidiaphragmatic paralysis (*Erickson et al., 2009*). This is due to the proximity of the phrenic nerve to the brachial plexus in the neck and may be avoided by using the axillary approach. Unfortunately, anesthesia for all types of upper extremity surgical procedures cannot be reliably achieved with an axillary block (*Lee et al., 2009*).

The supraclavicular approach anesthetizes the brachial plexus as the three divisions pass over the first rib lateral to the subclavian artery and usually provides a more complete block of the forearm. It has been suggested that this approach is the most effective technique for blocking the brachial plexus (*Renes et al., 2009*).

Several small studies have shown that ipsilateral phrenic nerve paralysis can occur with supraclavicular block, presumably due to retrograde spread of local anesthetic within

the brachial plexus sheath, although applying proximal digital pressure to the site of injection is not effective in reducing the spread.

The symptoms of phrenic nerve paralysis range from none to relatively severe, usually depending on the presence of pre-existing pulmonary dysfunction (*Gielen et al., 2009*).

Ultrasound guidance is a reliable and safe technique in peripheral nerve blocks. Several benefits obtained using the ultrasound including accuracy, faster onset and decreasing the dose of local anesthetic drugs. Ultrasound guided needle placement decreases the risk of complications and increases the accuracy of the block (*Hopkins, 2007*).

Ultrasound guided supraclavicular brachial plexus block allows better visualization of underlying structures, movement of needle and direct spread of local anesthetic and thereby making procedure safe and effective as compared to nerve stimulator-guided technique (*Duncan et al., 2013*).

Complications of supraclavicular block include pneumothorax, vascular puncture, intravascular injection, Horner's syndrome, recurrent laryngeal nerve blockade, nerve injury, and phrenic nerve blockade with transient hemidiaphragmatic paresis (*Bhatia et al., 2010; Perlas et al., 2009*).

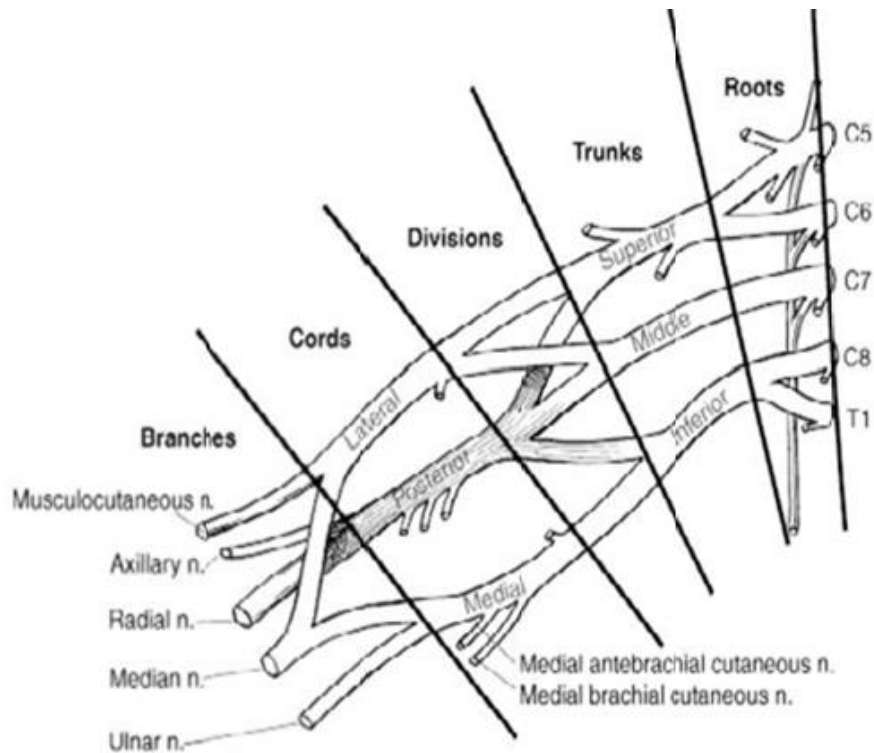
## AIM OF THE WORK

To compare the effect of two different volumes of bupivacaine (20 ml and 25 ml) on diaphragmatic mobility within 15 and 30 minutes from ultrasound guided supraclavicular brachial plexus block in upper limb orthopedic surgeries.

## REVIEW OF LITERATURE

### 1. Anatomy of the Brachial Plexus:

The brachial plexus is derived from the anterior primary rami of the fifth, sixth, seventh, and eighth cervical nerves and the first thoracic nerve (**Figure 1**), with variable contributions from the fourth cervical and second thoracic nerves just after leaving their intervertebral foramina. Along its course, brachial plexus is divided to: roots, trunks, divisions, cords and terminates as peripheral nerves (*Miller et al., 2010*).



**Figure (1):** Roots, trunks, divisions, cords and branches of the brachial plexus (*Strichartz & Berde, 2005*).

## ***1.1 Divisions of the brachial plexus***

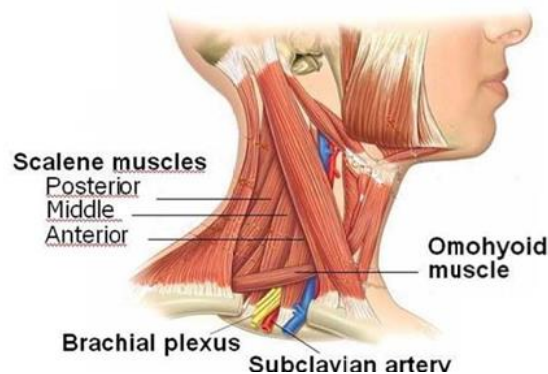
### ***1.1.1 Roots:***

After leaving their intervertebral foramina, these nerve roots course anterolaterally and inferiorly between the prevertebral fascia which divides to invest both the anterior and middle scalene muscles, that arise from the anterior and posterior tubercles of the cervical vertebra, respectively. The anterior scalene muscle passes caudally and laterally to insert into the scalene tubercle of the first rib; the middle scalene muscle inserts on the first rib posterior to the subclavian artery which passes between these two scalene muscles along the subclavian groove as shown in **Figure (2)** (*Panchal & Ahmed, 2002*).

### ***1.1.2 Trunks:***

Between the two scalene muscles as shown in **Figure (2)**, the nerve roots unite to form three trunks, which emerge from the interscalene space to lay cephaloposterior to the subclavian artery as it courses along the upper surface of the first rib (*Wedel, 2000*).

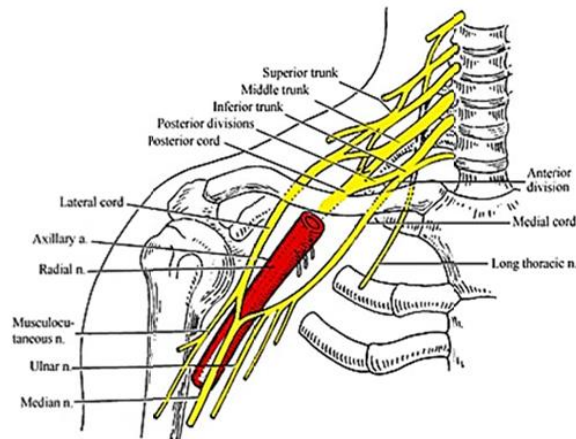
The area of the trunks corresponds to the point where the brachial plexus is confined to its smallest surface area, 3 nerve structures, closely related to each other. This great reduction in surface area allows the plexus to negotiate the narrow passage between the clavicle and the first rib at the apex of the axilla (*Singhal et al., 2007*).



**Figure (2):** Relation of brachial plexus trunks to subclavian artery. Trunks of brachial plexus cephaloposterior to subclavian artery between the anterior and middle scalene muscles (*Manani et al., 2013*).

### ***1.1.3 Divisions:***

At the lateral edge of the first rib, each trunk forms anterior and posterior divisions that pass posterior to the midportion of the clavicle to enter the axilla (**Figure 3**). These separate the innervation of the ventral and dorsal aspect of the upper limb. The anterior divisions usually supply the flexor muscles while the posterior divisions usually supply the extensor muscles (*Franco & Vieira, 2000*).



**Figure (3):** Basic relationships of the brachial plexus to the axillary artery (*Gloss et al., 2006*).

#### ***1.1.4 Cords:***

Within the axilla, divisions form the lateral, posterior and medial cords, named from their relationship with second part of the axillary artery (*Figure 3*). The superior divisions from the superior and middle trunks form the lateral cord, the inferior divisions from all three trunks form the posterior cord, and the anterior division of the inferior trunk continues as the medial cord (*Wedel, 2000*).

#### ***1.1.5 The terminal nerves:***

At the lateral border of the pectoralis minor, the three cords divide into the peripheral nerves of the upper extremity (*Sandhu & Capan, 2003*).

## ***1.2 Branches of the brachial plexus***

### ***1.2.1 Branches from the roots (Figure 4)***

- Phrenic Nerve (C3, 4, 5): chiefly from the C4 nerve root. It crosses the anterior scalene muscle from lateral to medial and extends into the thorax between the subclavian vein and artery (*Nadeau et al., 2013*).
- Dorsal scapular nerve (nerve to rhomboids) (C5).
- The long thoracic nerve (nerve to serratus anterior) (C5, 6, 7).

*(Franco et al., 2004)*

### ***1.2.2 Branches from the trunks (Figure 4)***

- Nerve to subclavius (C5, 6).
- Suprascapular nerve (C5, 6): arises from the upper trunk and gives sensory supply shoulder and acromioclavicular joint.

*(Carlos et al., 2006)*