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"All Lazy Students Dissected Brachial Plexus"-An Important Mnemonic to Avoid Interscalene Block Failure

(Running Head: "All Lazy Students Dissected Brachial Plexus"-Mnemonic to Avoid Interscalene Block Failure)

Dr. Kartik Sonawane[1*], Dr. Hrudini Dixit[2], Dr. J. Balavenkatasubramanian[3]

[1]Junior Consultant, Dept. of Anesthesiology, Ganga Medical Centre & Hospitals, Pvt. Ltd., Coimbatore, Tamil Nadu, India
[2]Fellow in Regional Anesthesia, Dept. of Anesthesiology, Ganga Medical Centre & Hospitals, Pvt. Ltd., Coimbatore, Tamil Nadu, India
[3]Senior Consultant, Dept. of Anesthesiology, Ganga Medical Centre & Hospitals, Pvt. Ltd., Coimbatore, Tamil Nadu, India

[*]**Address correspondence to:** Dr. Kartik Sonawane, Junior Consultant, Department of Anesthesiology, Ganga Medical Centre & Hospitals, Pvt. Ltd. Coimbatore, Tamil Nadu, India. Email: drkartiksonawane@gmail.com

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Abstract

The complete or partial failure of any particular regional anesthesia (RA) technique is not uncommon. It depends on many confounding factors, among which the anatomical relationship of the target nerves with the surrounding structures is very important. Sometimes, stimulation of neighboring nerves mimics a similar response as expected from the target nerves. For this reason, the knowledge of the location of such neural elements and ideal motor responses of actual target nerves while using nerve stimulator guidance is essential. While performing interscalene block, stimulation of four important nerves lying in the vicinity can produce a false motor response, causing shoulder movement. "All Lazy Students Dissected Brachial Plexus" mnemonic will help identify those neural elements and differentiate their motor responses from the ideal response.

Keywords*: Brachial plexus block, Block failure, False motor response, Peripheral nerve stimulator, PNS-guided bocks, regional analgesia.*

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Brachial plexus block (BPB) is the most commonly performed regional anesthesia (RA) technique worldwide. Due to the advent of ultrasound, the accuracy and safety of the RA technique have been significantly increased. Also, lots of modifications in the conventional techniques have been described stepping towards the precision RA. The peripheral nerve stimulator (PNS) guided nerve blocks are still practiced where ultrasound facilities are unavailable. However, identifying the target nerves using PNS alone is technically challenging and time-consuming, leading to incomplete anesthesia or adverse neurovascular injury due to improper localization. Therefore, PNS usage is becoming limited to the dual-guidance technique to confirm the target nerve when the imaging by the ultrasound is suboptimal.

The anatomical knowledge is the backbone of any RA technique, both for ultrasound-guided and PNS-guided blocks. Identifying the target nerves under direct vision using ultrasound or confirmation of target nerves by looking for appropriate motor responses using PNS requires specific training, learning, and experience. To identify or confirm target nerves, their anatomical relationships with neighboring structures play an important role in deciding the success of blocks. Sometimes, false identification or confirmation may lead to block failure or undesired side effects.

The stimulation of the brachial plexus, which lies between the anterior scalenus muscle (ASM) and middle scalenus muscle (MSM), is associated with movement at the shoulder, elbow, or wrist joint depending on the muscle contractions as per the location of the stimulating needle tip. The ideal accepted response depends on the location of the surgery and the type of required anesthesia coverage. For interscalene block, while stimulating roots or trunks, the contraction of the deltoid or biceps is accepted, which results in significant shoulder movements [1]. However,

shoulder movement is also possible due to the contraction of the muscles acting on the joint but not innervated by the desired target nerves (roots or trunks). Stimulation of such undesired nerves can be possible due to their proximity to the target nerves, and acceptance of such false motor responses may lead to block failure. So, understanding the location and course of these nerves is very important. These nerves include the dorsal scapular nerve, suprascapular nerve, nerve to levator scapulae, and accessory spinal nerve. These nerves lie between the MSM and posterior scalenus muscle (PSM), as depicted in Figure 1.

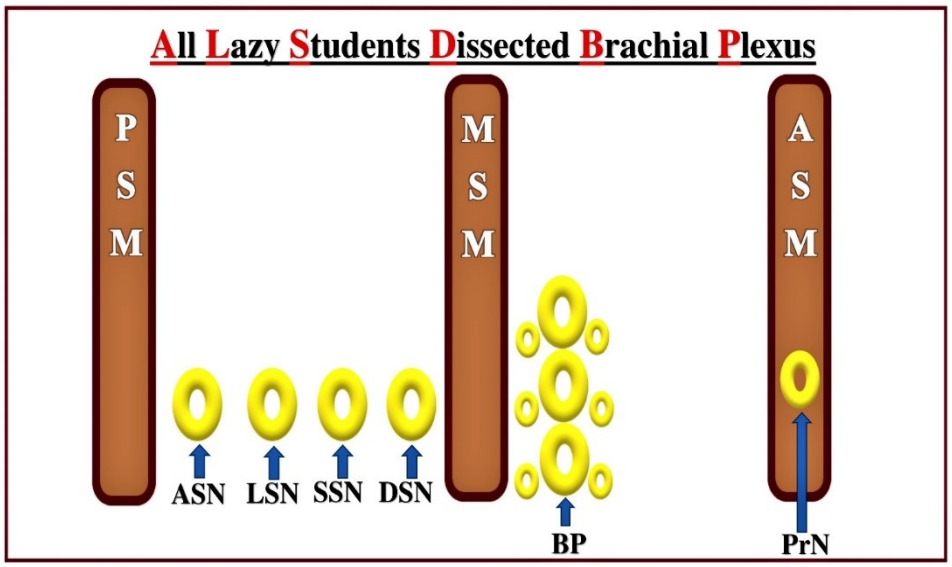

Figure 1: Schematic representation of the nerves lying in the vicinity of the posterior triangle of the neck
(**ASN**: Accessory spinal nerve, **LSN**: Levator scapulae nerve, **SSN**: Suprascapular nerve. **DSN**: Dorsal scapular nerve, **BP**: Brachial plexus, **PrN**: Phrenic nerve, **ASM**: Anterior scalenus muscle, **MSM**: Middle Scalenus muscle, **PSM**: Posterior scalenus muscle)

After emerging from the C5 nerve root, the dorsal scapular nerve (DSN) pierces the middle scalenus muscle and continues deep to the levator scapulae and rhomboid muscles [2]. Stimulation of the DSN causes contraction of the rhomboids (which pulls the scapula medially) and levator scapulae (which elevates the scapula). Thus, scapular movement following DSN stimulation mimics stimulation of deltoid or biceps due to associated shoulder movement.

After emerging from the upper trunk, the suprascapular nerve (SSN) passes across the posterior triangle of the neck parallel to the inferior belly of the omohyoid and deep to the trapezius muscles [3]. It enters the supraspinatus fossa by passing through the suprascapular notch under the superior transverse scapular ligament. Then it curves around the lateral border of the spine of the scapula passing through the spinoglenoid notch to reach the infraspinatus fossa. Stimulation of the SSN leads to the contraction of the supraspinatus muscle (causing abduction of the arm at the shoulder joint) and infraspinatus muscle (causing external rotation of the shoulder joint). Both muscles contractions also lead to significant shoulder movement.

The nerve to levator scapulae (NLS) is the branch of the cervical plexus arising directly from the C3-C5 roots [4]. Stimulation of the NLS causes contraction of the levator scapulae muscle, leading to elevation and downward rotation of the scapula and lateral flexion of the neck. Thus, all these scapular movements will mimic the movement of the shoulder.

The accessory spinal nerve (ASN) is the eleventh cranial nerve. After arising from the C1-C5/C6 spinal nerve roots, the spinal component of ASN runs superiorly to enter the cranial cavity through the foramen magnum to meet the cranial portion of the accessory nerve [5]. The extracranial part of the nerve descends along the internal carotid artery to reach the sternocleidomastoid muscle (SCM), then moves across the posterior triangle of the neck to innervate the trapezius muscle (TZM). Stimulation of the ASN causes contraction of SCM, which causes lateral flexion and rotation of the neck; and TZM, which elevates and rotates scapula during abduction of the arm (upper fibers), retracts scapula (middle fibers), and pulls scapula interiorly (lower fibers). Thus, all these scapular movements due to the contraction of both muscles also cause shoulder movements.

Dominant Root	Dominant motor response	Dominant muscle contraction	Innervation
C5	• Abduction of the shoulder	• Deltoid	• Axillary nerve (C5-C6)
C6	• Flexion of the elbow	• Biceps brachii	• Musculocutaneous nerve (C5-C6)
C7	• Extension of the elbow • Extension of the wrist	• Triceps	• Radial nerve (C7-C8)
C8	• Flexion of the wrist	• Flexor carpi ulnaris	• Ulnar nerve (C7-T1)
T1	• Flexion of fingers	• Flexor digitorum superficialis • Flexor digitorum profundus	• Median nerve (C7-T1)

TABLE 1: DOMINANT ROOT CONTRIBUTION OF MUSCLES AND THEIR MOTOR RESPONSE.

The "dominance" of root supply for various muscles explains the possible responses; the observed responses should be used for identifying the roots or trunks [6]. For every motor response of the muscles upon the simulation, the dominance of the particular innervating nerve root plays an important role (Table 1). The stimulation of an upper trunk (C5-C6) can cause abduction of the shoulder joint and flexion of the elbow joint via axillary nerve (with C5 dominance) and musculocutaneous nerve (with C6 dominance), respectively. The stimulation of the middle trunk (C7) can cause extension of the elbow and wrist via radial nerve with C7 dominance. The lower trunk (C8-T1) stimulation leads to wrist and finger flexion via ulnar nerve with C8 dominance and median nerve with T1 dominance.

Due to similar responses, it is very important to look for the contractions of the muscles causing shoulder movement. For a successful interscalene block, the accepted motor response includes muscles anterior to the clavicle whereas, motor responses posterior to the clavicle results in a failed block [1]. False responses causing shoulder movement due to stimulation of nerves lying in the vicinity should be ruled out precisely before injecting local anesthetic for the block. Thus, it is essential to know the relevant anatomy and the interrelationship of the structures like nerves, muscles, or vessels in the vicinity to avoid block failure or unwanted complications.

The first letter of the mnemonic "All Lazy Students Dissected Brachial Plexus" determines the location of the important neural elements in the posterior triangle of the neck (Figure 1). The first letter of the mnemonic represents four important nerves (A: accessory spinal nerve, L: levator scapulae nerve, S: suprascapular nerve, D: dorsal scapular nerve) that lie from the posterior to the anterior side of the neck between the PSM and MSM, one plexus (B: brachial plexus) between MSM and ASM, and one nerve (P: phrenic nerve) that lie in the belly of the AMS. This mnemonic is the easy way to remember all nerves in the vicinity of the target roots/trunks of the interscalene region.

Contributor ship Statement

Dr. Kartik Sonawane[1], Dr.Hrudini Dixit[2], Dr.J.Balavenkatasubramanian[3]

K.S.: Designed manuscript content and mnemonic. Took the lead in manuscript writing and designed required table and figure contents.

H.D.: Proofread and co-wrote the manuscript.

J.B.: Approved idea by KS and provided scientific guidance for manuscript writing. Provided guidance for the content of the manuscript and Co-wrote the paper. Approved final version of the manuscript.

All authors provided critical feedback and helped shape the manuscript.

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