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Comparative study between intravenous versus perineural dexamethasone in prolonging the analgesic effect of supraclavicular plexus nerve block in hand surgeries

Thesis

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Moustafa Mahmoud abdelsattar

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List of Abbreviations

Abb.	Full term
5-HT	5-Hydroxy tyramine (serotonin)
AXI	Axillary nerve
BP	Brachial plexus
CNS	Central nervous system
COX	Cyclooxygenase
DBP	Diastolic blood pressure
DC	Direct current
GABA	Gamma amino butyric acid
HR	Heart rate
Hz	Hertz
LAs	Local anesthetics
LC	Locus ceruleus
MAOI	Monoamine oxidase inhibitors
MC	Musculocutaneous nerve
MEAV	Minimum effective anesthetic volume
MED	Median nerve
MSM	Middle scalene muscle
NO	Nitric oxide
NSAIDs	Non-steroidal anti-inflammatory drugs
PAG	Peri-aqueductal grey area
PNB	Peripheral nerve blockade
PNS	Peripheral nerve stimulation
RAD	Radial nerve
SA	Subclavian artery
SBP	Systolic blood pressure
SD	Standard deviation
SG	Substantia gelatinosa
ULN	Ulnar nerve
US	Ultrasound

List of Symbols

Sym.	Full term
λ	Wave length
F	Frequency
C	Velocity
Σ	Sum
n	Number of observations
$\overline{X}_d$	Mean's difference between preand post
SEd	Standard error of the difference between pre and post

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INTRODUCTION

Brachial plexus block is a popular and widely employed regional nerve block technique for peri-operative anesthesia and analgesia for surgery of the upper extremity. Supraclavicular approach is the easiest and most consistent method for surgery below the shoulder joint. Regional nerve block minimizes the stress response to surgery and allows using minimal anesthetic drugs which is always beneficial for the patients with various cardio-respiratory co-morbidities ***(Shrestha et al., 2007).***

Ultrasound guidance is a reliable and safe technique in peripheral nerve blocks. It also plays a crucial and an increasing role in medicine nowadays due its low cost, the absence of ionizing radiation and its high temporal resolution ***(Jerrold et al., 2010).***

Local anesthetics alone for supraclavicular brachial plexus block provide good operative conditions, but they have short duration of postoperative analgesia. Therefore, various adjuvants such as opioids, clonidine, neostigmine and midazolam were added to local anesthetics in brachial plexus block to achieve quick, dense and prolonged block ***(Gowala et al., 2009).***

Bupivacaine is a widely used local anesthetic which is related chemically and pharmacologically to the amide local

anesthetics available. Using 0.5% bupivacaine in supraclavicular brachial plexus block, the onset time may be up to 20 min with surgical anaesthesia taking up to 40 min. The duration of block ranges from 4-12h with residual anaesthesia still being present at 24h ***(Berde and Strichartz, 2015).***

Perineural dexamethasone was first explored clinically more than12yr ago, followed by a myriad of clinical trials. Recently, a meta-analysis concluded that perineural dexamethasone, compared with placebo, prolonged the duration of analgesia by >8h, when combined with long-acting local anesthetics, suggesting that patients could benefit from a pain-free postoperative night. The mechanism of action for this prolongation of block is not fully understood, but suggested possibilities include decreased nociceptive C-fiber activity via a direct effect on glucocorticoid receptors ***(Johansson et al., 1990)***, a direct effect on inhibitory potassium channels, a local vasoconstrictive effect or systemic anti-inflammatory effect.

However, perineural route of dexamethasone administration remains off label. An alternative choice of intravenous dexamethasone has likewise been explored, which at moderate doses offers the potential for a systemic anti-inflammatory effect ***(De Olivera et al., 2011).***

AIM OF THE WORK

The aim of this work is to study the effect of dexamethasone as an adjuvant to bupivacaine either intravenous or perineural in ultrasound guided supraclavicular brachial plexus block in hand surgeries regarding the onset of the block, the duration of the block, the effect on postoperative analgesic requirements as well as anticipated complications.

Chapter 1

ANATOMY OF THE BRACHIAL PLEXUS

Brachial plexus is a complex network of nerves supplying the whole upper limb, including its motor and sensory supply, arising from the neck and passing through the axilla to the upper limb. It is composed of 5 roots, 3 trunks, 6 divisions, 3 cords, and terminal branches **(Figure 1)** ***(Andres and Sala, 2001).***

1- Roots:

The ventral rami of spinal nerves from C5 to T1 are referred to as the roots of the brachial plexus. The typical spinal nerve root results from the union of the ventral nerve rootlets originating in the anterior horn cells of the spinal cord and the dorsal nerve rootlets ***(Andres and Sala, 2001).***

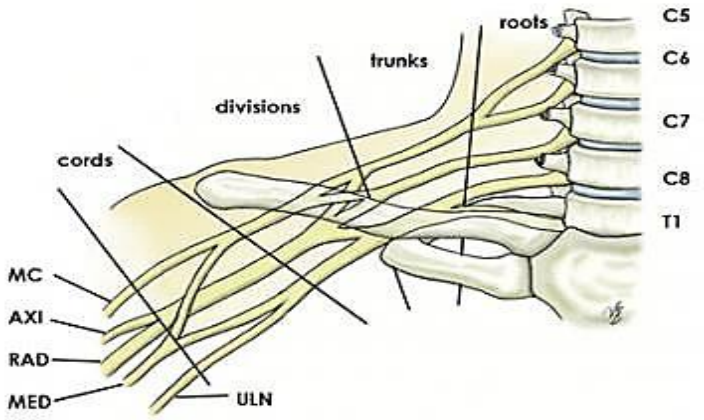

Figure (1): Brachial plexus with terminal branches labeled: MC is musculocutaneous nerve, AXI is axillary nerve, RAD is radial nerve, MED is median nerve, and ULN is ulnar nerve (***Andres & Sala, 2001)***.

The roots then get exit through the transverse processes of the cervical vertebrae just posterior to the vertebral artery, which runs in a cephalic direction through the transverse foraminae. Each transverse process consists of a posterior and anterior tubercle, which meet laterally to form the costotransverse bar (**Figure 2).** The transverse foramenlies medial to the costotransverse bar and between the posterior and anterior tubercles. The spinal nerves that form the brachial plexus run in an inferior and anterior direction within the sulci which is formed by these structures ***(Gloss et al., 2006).***

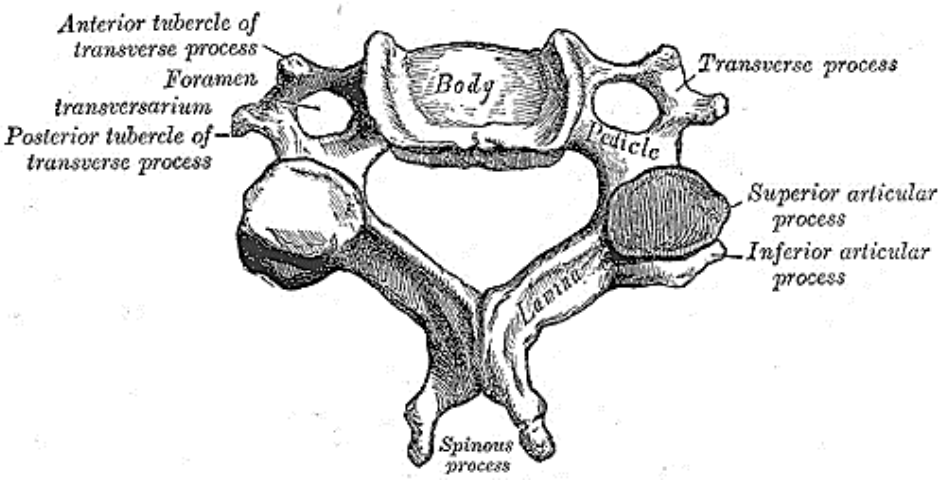

Figure (2): Typical cervical vertebra ***(Gloss et al., 2006).***

2- Trunks:

Shortly after emerging from the intervertebral foraminae, the 5 roots (C5-T1) unite to form 3 trunks. One on top of the

other, as they traverse the triangular interscalene space formed between the anterior and the middle scalene muscles. This space becomes wider in the anteroposterior plane as the muscles approach their insertion on the first rib. Although the roots of the plexus are long, the trunks areas short (approximately 1cm) as they are wide, which shortly give rise to a total of six divisions (three anterior and three posterior), as they reach the clavicle ***(Franco and Vieira, 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, carrying the entire sensory, motor and sympathetic innervation of the upper extremity, with the exception of a small area in the axilla and upper middle arm, which is innervated by the intercosto-brachial nerve, a branch of the 2nd intercostal nerve. 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).***

The ventral rami of C5 and C6 unite to form the upper (superior) trunk, from which the suprascapular nerve and the nerve to the subclavius arise. The suprascapular nerve carries sensory fibers to the shoulder joint and provides motor innervation to the supraspinatus and infraspinatus muscles. The ventral ramus of C7 continues as the middle trunk. The ventral rami of C8 and T1 unite to form the lower (inferior)trunk (**Figure 3)** ***(Fazan et al., 2001)***.