Ain Shams University
Faculty of Medicine
Department of Anesthesiology,
Intensive Care and Pain Management

Ketamine with Local Anesthetics Versus Local Anesthetics Alone in Supraclavicular Brachial Plexus Block in Upper Limb Surgeries

Submitted for Partial Fulfillment of Master Degree in Anesthesia
By

Belal Nabil Mahfouz Khalil
M.B.,B.Ch (Ain Shams University)

Supervised By

Prof. Dr. Mohsen Abdelghany Bassiony
Professor of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University

Ass. Prof. Dr. Neven Gerges Fahmy
Assistant Professor of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University

Dr. Mohammed Mahmoud Maarouf
Lecturer of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University

Faculty of Medicine,
Ain Shams University
2017

Acknowledgement

*First of all, all gratitude is due to **Allah** almighty for blessing this work, until it has reached its end, as a part of his generous help throughout my life.*

*Really, I can hardly find the words to express my gratitude to **Prof. Dr. Mohsen Abdelghany Bassiony,** Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for her supervision, continuous help, encouragement throughout this work and tremendous effort she has done in the meticulous revision of the whole work. It is a great honor to work under her guidance and supervision.*

*I cannot forget the great help of **Assistant Prof. Dr. Neven Gerges Fahmy**, Assistant Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University for her invaluable efforts, tireless guidance and for her patience and support to get this work into light.*

*I would like to express special thanks to **Dr. Mohammed Mahmoud Maarouf,** Lecturer in Anesthesia, Intensive Care and Pain Management, Faculty in Medicine, Ain Shams University for his faithful supervision, precious help and continuous support throughout this work.*

Last but not least, I dedicate this work to my future wife , my family and friends, whom without their sincere emotional support pushing me forwards, this work would not have ever been completed.

Belal Nabil Mahfouz

Contents

List of Abbreviations

5-HT	:	5-Hydroxy tyramine (serotonin)
ANOVA	:	Analysis of variance
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
MHRA	:	The Medicines and Healthcare Products Regulatory Agency
MSM	:	Middle scalene muscle
NO	:	Nitric oxide
NSAIDs	:	Non-steroidal anti-inflammatory drugs
PAG	:	Peri-aqueductal grey area
PCA	:	Patient-controlled analgesia
PNB	:	Peripheral nerve blockade
PNS	:	Peripheral nerve stimulation

List of Abbreviations (Cont.)

RAD	:	Radial nerve
SA	:	Subclavian artery
SBP	:	Systolic blood pressure
SD	:	Standard deviation
SG	:	Substantia gelatinosa
ULN	:	Ulnar nerve
US	:	Ultrasound

List of symbols

λ	:	Wave length
F	:	Frequency
C	:	Velocity
Σ	:	Sum
n	:	Number of observations
$\bar{X}_d$	:	Mean's difference between pre and post
SE_d	:	Standard error of the difference between pre and post

List of Tables

List of Figures

List of Figures

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).***

N-Methyl D-Aspartate (NMDA) receptors play an important role in neuronal plasticity leading to central sensitization and in the intensity of perceived postoperative pain. Ketamine is an NMDA antagonist with analgesic properties which modulates central sensitization of nociceptive stimulation ***(Biyani et al., 2013).***

Aim of Work:

The aim of this work is to study the effect of ketamine as an adjuvant to bupivacaine in supraclavicular brachial plexus block

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).***

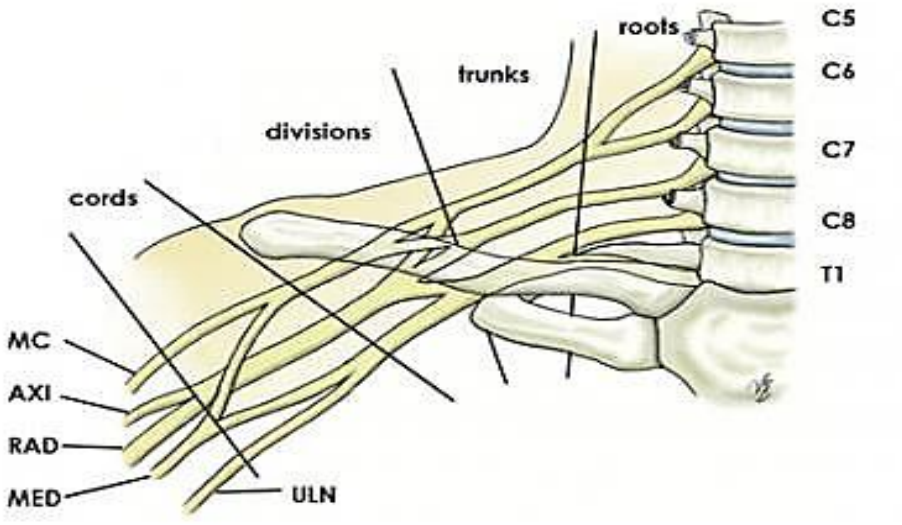

Figure (1): Brachial plexus with terminal branches labeled: MC is musculocutaneous nerve, AXI is axillary nerve, RAD is radial nerve, MED is median nerve, and ULN is ulnar nerve (***Andres & Sala, 2001)***.

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 foramen lies 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)***

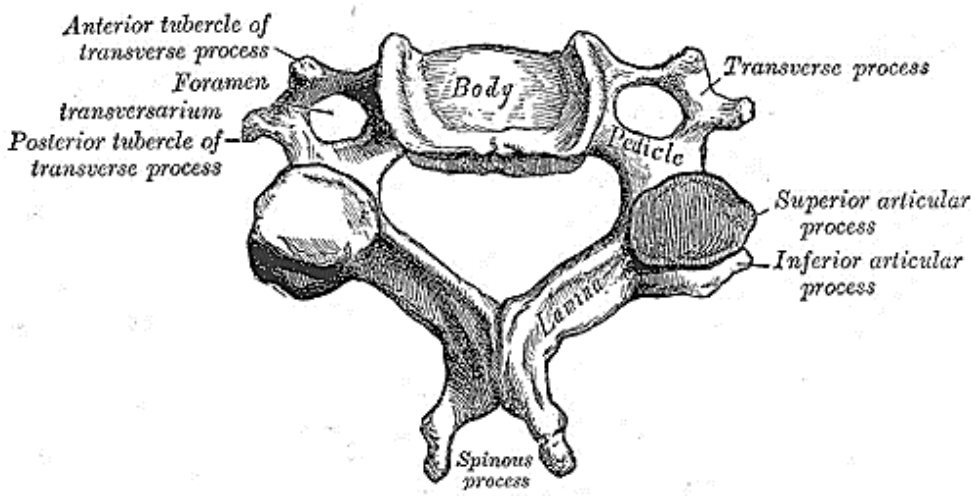

Figure (2): Typical cervical vertebra (***Gloss et al., 2006).***

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 are as 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)***.

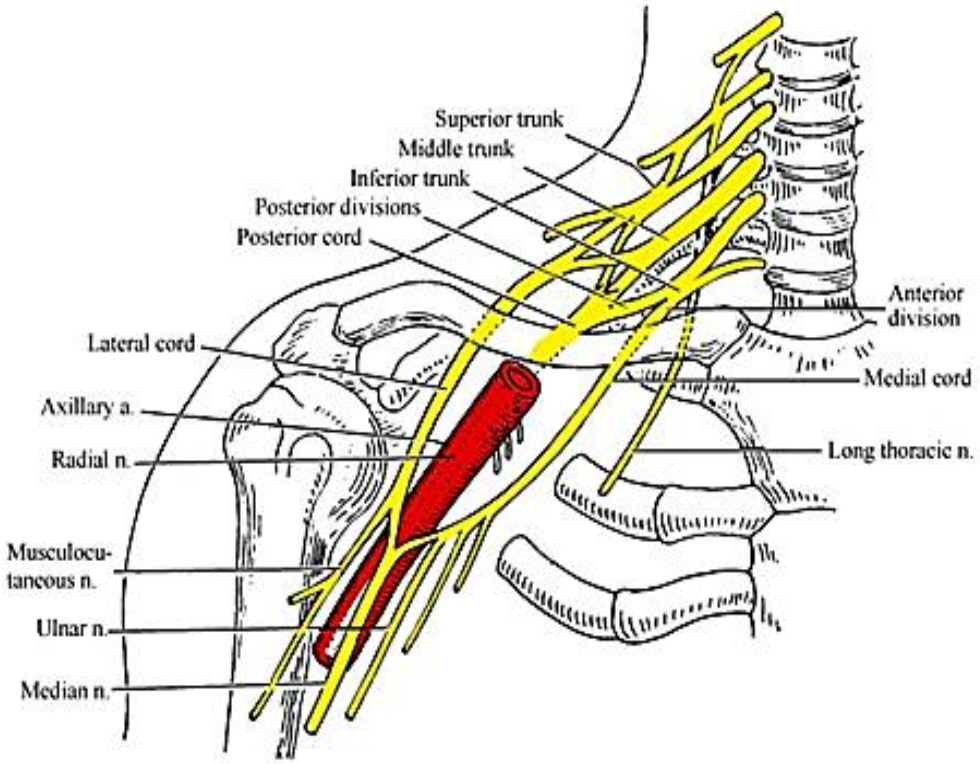

Figure (3): Basic relationships of the brachial plexus to the axillary artery, which is a continuation of the subclavian artery (***Gloss et al., 2006).***

3-Divisions:

Each trunk divides into an anterior division and a posterior division, just above or little behind the clavicle. 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 and Vieira, 2000).***