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Dexmedetomidine versus Fentanyl as an Adjuvant to Bupivacaine in Ultrasound-guided Supraclavicular Brachial Plexus Block

Thesis

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Samuel Habachy Daniel

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	:	Substantiagelatinosa
ULN	:	Ulnar nerve
US	:	Ultrasound

List of symbols

λ	:	Wave length
F	:	Frequency
C	:	Velocity
μ	:	Mu opioid receptor
Σ	:	Sum
n	:	Number of observations
$\overline{X}_d$	:	Mean's difference between pre and post
SE_d	:	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 perioperative anesthesia and analgesia for surgery of the upper extremity. Supraclavicular approach is the easiest and the most consistent method for surgery below the shoulder joint.The compactness of the brachial plexus in this location facilitates a rapid onset and complete block of the brachial plexus for procedures distal to the shoulder.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 ***(Amiri and Espander, 2011)***

Regional nerve blocks have been blindly performed for many years. The major drawback of the blind technique of supraclavicular nerve block is the inaccurate placement of the needle; being a risk factor for pneumothorax, vascular puncture and failure of the procedure. Ultrasound guidance is a reliable and safe technique in peripheral nerve blocks.The use of ultrasound has several benefits including faster onset and reduction in the dose of local anesthetic drugs.Ultrasound-guided needle placement reduces the risk of complications and increases the accuracy of the block.It plays an increasing and crucial role in medicine nowadays ***(Hopkins, 2015***)

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. However, the results were either inconclusive or associated with side effects ***(Gowala et al., 2009)***.

Bupivacaine is a widely used local anesthetic which is related chemically and pharmacologically to the amide local anesthetics available in isotonic solution. Various pharmacokinetic parameters of the local anesthetics can be significantly altered by the presence of hepatic or renal disease, factors affecting urinary pH, renal blood flow, the route of drug administration, and the age of the patient ***(Miller and Roland,2014).***

Dexmedetomidine is a selective α_2 receptor agonist with evidence of an increased ratio of $\alpha_2$toα_1 activity of 1620:1, as compared to 220:1 of clonidine. Dexmedetomidine not only possesses analgesic properties and many other advantageous influences, but also lacks respiratory depressionthat may make it a

useful and safe adjunct in many diverse clinical applications***(Yan etal., 2016).***

There have beenclinical studies evaluating the effect of mixing dexmedetomidine with local anesthetics during peripheral nerve blockade. Peripheral analgesic effects of dexmedetomidine have enabled an overall improved blockade quality when added to local anesthetics in a peripheral nerve block model which is thought to be mediated by α_2 receptor binding. Dexmedetomidine also causes local vasoconstriction resulting in delay of absorption of local anesthetics ***(Yoshitomi et al., 2013).***

Fentanyl is a potent synthetic opioid that produces sedation and analgesia when administered intravenously. Many authors believe that it also prolongs the effect of local anesthetics in peripheral nerve blocks through its direct effect on the peripherally-located opioid receptors***(Narei etal.,2016).***

Aim of the work

The aim of this work was to compare the effects of adding either dexmedetomidine or fentanyl to bupivacaine in ultrasound-guidedsupraclavicular nerve block, as regards the onset and the duration of the sensory and motor block, the duration of post-operative analgesia as well as the occurrence of any complication.

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 andpassing through the axilla to the upper limb. Itis 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 referredto as therootsofthe 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).***

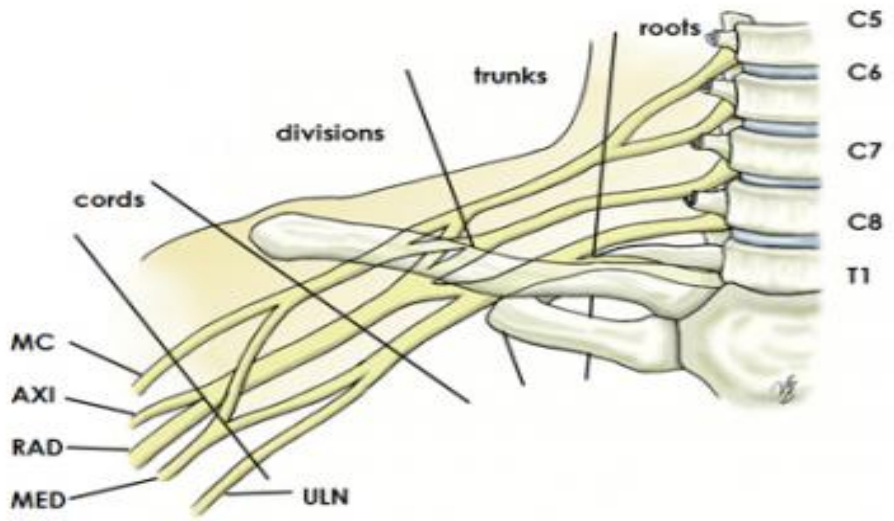

Figure (1): Brachial plexus with terminal branches labeled: MC is musculocutaneous nerve, AXI is axillary nerve, RAD is radial nerve, MED is median nerve, and ULN is ulnar nerve (***Andres & Sala, 2001)***.

The roots then get exit through the transverse processes of the cervical vertebraejustposterior 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 withinthe sulci which isformed by these structures (***Gloss et al., 2006).***

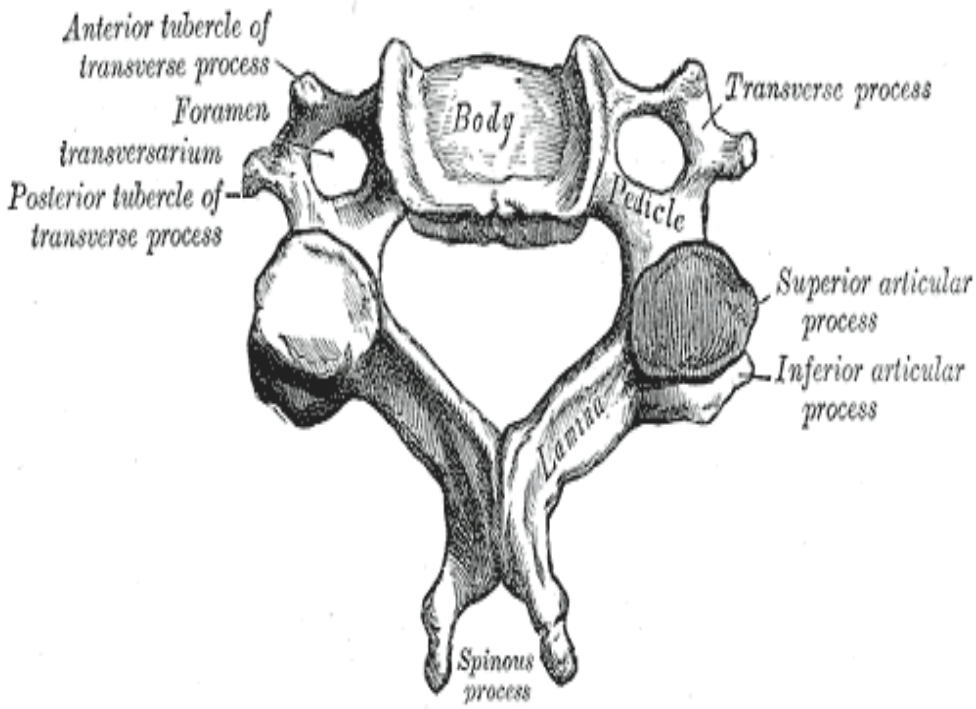

Figure (2): Typical cervical vertebra (***Gloss et al., 2006).***