Ultrasound guidance and nerve stimulation: implications for practice of regional anaesthesia in upper limb.

Essay

*Su*bmitted for partial fulfillment of Master degree
in
Anethesiology

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2009

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صدق الله العظيم

سورة طه 114

ABSERACT

Regional anesthesia for upper limp with peripheral nerve blocks (PNB) can provide superior analgesia and a lower incidence of side effects compared to parenteral anesthetics.

The key step is identifying the anatomy of brachial plexus that is formed from anterior primary ramie from C5 to T1 that **ES**and **US** helping in doing it.

ES (Electric Stimulator) based on technique that relies on physiological responses of neural structures to ES,for which there is inter-indivual variation so alone ES has it is limitation.

Ultrasound has proved helpful for regional anesthesia in two ways it allows the systematic, noninvasive, ***in vivo*** assessment of topographic sonography and its variations and provide guidance and direct visualization of needle entrance so in combination with ES the accuracy becomes higher.

Key words Bachial plexus, Ultrasound, Electric nerve stimulator

Acknowledgement

I would like to record my heartfelt thanks to my supervisors

Dr.Khaled El-Shafaey
Dr.Riham Hussien
Dr.Sameh Shoukry

For their great help in writing this essay, they are busy, practicing physician who were hard pressed to find time in their schadules to supervise me. They generously read through chapters and advised and correct me. Any remaining inaccuracies are mine.

List of Abbreviations

AAG	***Alpha-acid glycoprotein***
Ca+2	***Calcium***
cm	***centimeter***
CNS	***Central nervous system***
CSF	***Cerebrospinal fluid***
ct	***Computerized tomography***
D	***Dimensional***
ECG	***Electrocardiogram***
h	***Hour***
Hz	***Hertz***
K+	***Potassium***
kg	***kilogram***
LAs	***Local anesthetic agent***
MAC	***Minimum alveolar concentration***
MRI	***Magnetic resonance imaging***
Na+	***Sodium***
NSAID	***Non steroidal anti inflammatory drugs***
PNBs	***Peripheral nerve blocks***

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INTRODUCTION

AN ever increasing demand for regional anesthesia from both patients and surgeons matches the growing realization that both peripheral and neuraxial blockade can provide superior pain management and perhaps improve patient outcomes, to meet evolving expectations for ambulatory, cost-effective surgery. Our aging population presents with an increasing range of co-morbidities, demanding a wider choice of surgical anesthesia options, including the use of a variety of regional techniques in conjunction with general anesthesia, to optimize clinical care, while at the same time reducing the risks of complications(Nielsen&steel,2002)(Broking & Waurick,2002).

Regional anesthesia with single-shot or continuous peripheral nerve blocks (PNB) can provide superior analgesia and a lower incidence of side effects compared to parenteral anesthetics (e.g., patient-controlled opioid analgesia). However, both single shot and continuous techniques are highly dependent on the accurate delivery of a correct dose of local anesthetic to attain success, and to avoid rare but potentially devastating nerve damage(Marhofer et al,1994)(Stark,1996)(Borgeat et al,1997).

The key steps in any successful regional anesthetic technique involve identifying the exact position of the nerve, reaching it with a precisely placed needle (without damage to any adjacent structures), and, finally, carefully injecting local anesthetic. Although easy in principle, clinicians are confronted daily with the difficulty of converting this theory into practice. Knowledge of anatomy based on surface landmarks is an essential starting point but is hardly ever satisfactory alone. The introduction of the peripheral nerve stimulator into clinical practice was a major advance(Marhofer et al,1994).

ES (Electric Stimulator) was an integral step towards transforming regional anesthesia into a "science". Nerve stimulation, however, also has its limitations. The technique relies on physiological responses of neural structures to ES, for which there is considerable inter-individual variation. Accordingly, it is fitting to question the significance of the commonly accepted threshold current of 0.5 mA to ensure block success, when a range of current thresholds more realistically reflects normal physiological variability. Furthermore, ES responses are influenced by the interplay of injectates, physiologic solutions (e.g., blood) and disease. Not surprisingly, the introduction of ES failed to result in a renewed interest in regional anesthesia (La Grange et al, 1978).

One of the most exciting recent technological advances in this field has been the introduction of anatomically-based ultrasound (US) imaging.

Ultrasound-facilitated nerve blocks were first reported in 1978, and interest has increased in the past 10 yr owing to progress in transducer technology and image processing. Although early studies were limited to vascular identification by Doppler ultrasound, recent studies have tried to directly visualize the nerves (Greher et al, 2001).

Ultrasound has proved helpful for regional anesthesia in two ways: First, it allows the systematic, noninvasive, *in vivo* assessment of topographic sonography and its variations. Performing careful ultrasound measurements enhances our anatomic understanding, tests the accuracy of common block techniques, second and properly the most important, ultrasound helps to individually guide the needle in real time. Advantages of ultrasound-guidance include the direct visualization of the nerves, the entire needle, or the needle tip; identification of adjacent structures to avoid; and, finally, monitoring of local anesthetic spread (Klaastad et al,1999)(Retzl et al,2001)(Greher et al,2002).

Aim of the work

Aim of the essay is to highlight the following: anatomical review of nerves supply of the upper limb , pharmacology of different local anesthetic used in regional anesthesia , different regional anesthetic techniques used in upper limb surgery and nerve simulator , ultrasound guided nerve block.

The brachial plexus:

The brachial plexus provides the majority of sensory and motor innervations of upper extremity. **(Hughes TJ and Desgrand DA,1993**),The brachial plexus is divided into: roots, trunks, divisions, cords and terminal nerves.

A continuous fascial sheath extends from the cervical transverse processes to several centimeters beyond the axilla to enclose the entire brachial plexus from the cervical roots to the terminal arm

(Bridenbaugh LD,1988)

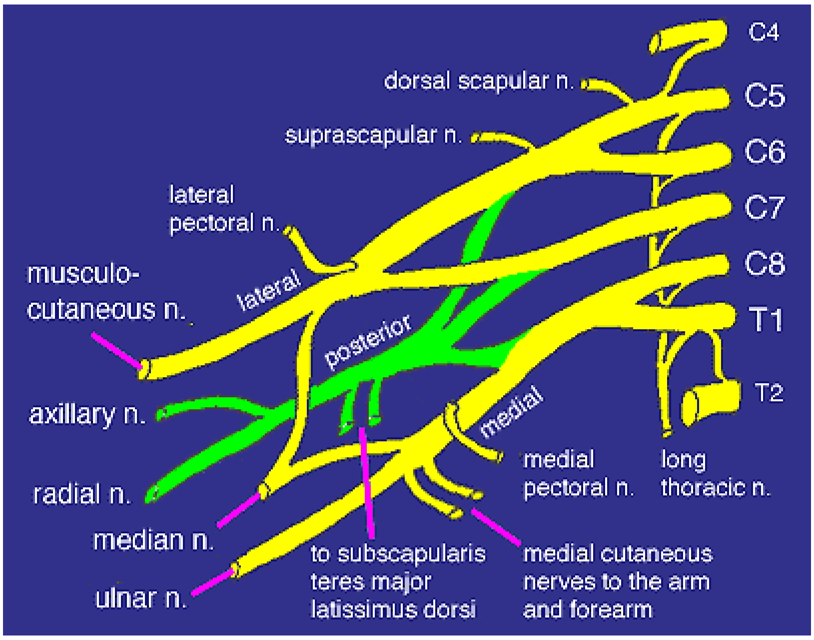

Figure 1
Formation of the brachial plexus. (Thompson etal 1983)

The roots of the brachial plexus are formed by the anterior primary ramie of the fifth, sixth, seventh, and .eighth cervical nerves and the first thoracic nerve. In two thirds of the patients the fourth cervical nerve contributes to the brachial plexus. The nerve roots emerge from the intervertebral foramina and course behind the vertebral artery. They then pass anterolaterally and inferiorly between the anterior and middle scalene muscles, where they form the superior (C5,C6))middle (C7), and inferior (c8, tl) trunks of the brachial plexus**. (Winnie AP, 1983)**

The trunks emerge from the interscalene groove, pass cephalic and posterior to the subclavian artery, and at the lateral portion of the first rib divide into anterior and posterior divisions. These divisions pass below the midportion of the clavicle to enter the axilla through its apex. The fibers of the plexus then recombine to form the three cords of brachial plexus.

The cords are named in relation to axillary artery. the lateral cord is formed by the union of the anterior division of the superior and middle trunks. The medial cord is a continuation of the anterior division of the inferior trunk. The posterior cord is formed by the posterior division of all three trunks at the lateral border of the pectoralis minor muscle, the three cords divide to form the peripheral nerves of the upper extremity The lateral and medial cords give off branches to form the lateral and the medial heads of the median nerve. The lateral cord continues as the musculocuteneous nerve. The medial cord also gives rise to the ulnar nerve. The posterior cord divides into the axillary nerve and the radial nerve **(Brown D, 1993).**

Relations of the brachial plexus:

Roots:

Between the scalene muscles, The roots of the plexus lie above the second part of the subclvian artery.

Trunks:

In the posterior triangle, the trunks of the plexus, invested in a sheath of pre-vertebral fascia are superficially placed, being covered only by skin, platysma and deep fascia. However they are crossed by a number of structures-the inferior belly of omohyoid, the external jugular vein, the transverse cervical artery and the supraclavicular nerves. Within the posterior triangle, in the thin individual the trunks are easily rolled under the palpating fingers. the upper and middle trunk lies above the subclavian artery as they stream across the 1st rib but the lower trunk lies behind the artery and may groove the rib immediately posterior to the subclavian groove.

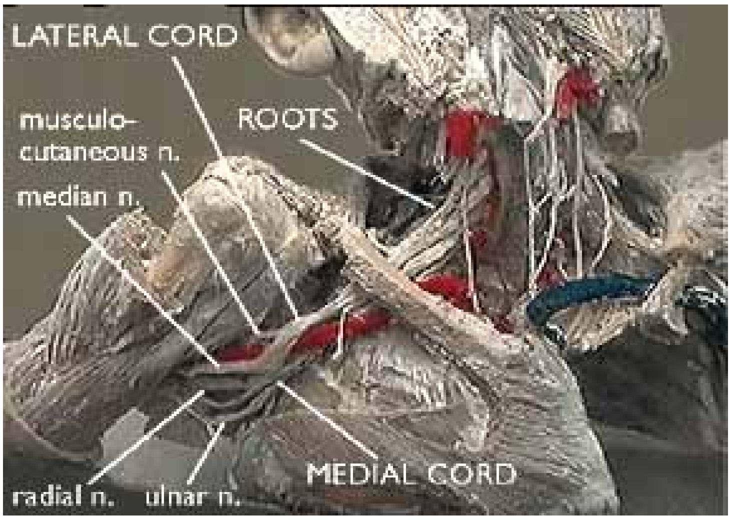

Figure 2

Dissection of the brachial plexus, University of Washington Department of Biological Structure. (Partridge et al 1987)