Ain Shams University
Faculty of Medicine
Department of Anesthesia and Intensive Care

Ultrasound Guided Lumbar Plexus Block

Thesis

Submitted for Partial Fulfillment of Anesthesiology M.D Degree

By

Mohamed El-Sayed Mahmoud Yousef EL-Zayat,
M.B., B.Ch; M.Sc.

Under Supervision of:

Prof. Dr. Nehal Gmal El-Din Nouh
Professor of Anesthesiology,
Faculty of Medicine, Ain Shams University.

Prof. Dr. Ayman Mokhtar Kamaly
Professor of Anesthesiology,
Faculty of Medicine, Ain Shams University.

Dr. Hanan Mahmoud Farag
Assistant Professor of Anesthesiology,
Faculty of Medicine, Ain Shams University.

Dr. Heba Bahaa El-Din El-Serwi
Assistant Professor of Anesthesiology,
Faculty of Medicine, Ain Shams University.

Dr. Osama Mohamed Hetta
Assistant Professor of Radio-diagnosis,
Faculty of Medicine, Ain Shams University.

Faculty of Medicine
Ain Shams University
2011

بسم الله الرحمن الرحيم

اقرأ باسم ربك الذي خلق ﴿١﴾ خلق الإنسان من علق ﴿٢﴾ اقرأ و ربك الأكرم ﴿٣﴾ الذي علم بالقلم ﴿٤﴾ علم الإنسان مالم يعلم ﴿٥﴾

صدق الله العظيم

(العلق :١ الى ٥)

ACKNOWLEDGEMENTS

THANKS ARE ALL TO **GOD**, THE BENEFICENT AND THE MERCIFUL, FOR BLESSING ME THIS WORK UNTIL IT REACHED ITS END, AS A LITTLE PART OF HIS GENEROUS HELP THROUGHOUT MY ENTIRE LIFE.

I WOULD LIKE TO EXPRESS MY DEEPEST GRATITUDE TO **PROF. DR Nehal Gmal El-Din Nooh, P**ROFESSOR OF **A**NESTHESIA AND **I**NTENSIVE **C**ARE, **F**ACULTY OF **M**EDICINE, **A**IN **S**HAMS **U**NIVERSITY, FOR HER SUPPORT, GUIDANCE AND ENCOURAGEMENT.

IT HAS BEEN AN HONOUR WORKING UNDER THE SUPERVISION OF **PROF. DR. Ayman Mokhtar Kamaly P**ROFESSOR OF **A**NESTHESIA AND **I**NTENSIVE **C**ARE, **F**ACULTY OF **M**EDICINE, **A**IN **S**HAMS **U**NIVERSITY, WHO HELPED ME IN EVERY WAY HE COULD.

I'M GREATLY INDEBTED TO **DR. Hanan Mahmoud Farag and DR. Heba Bahaa El-Din El-Serwi ,** ASSISTANT PROFESSORS OF **A**NESTHESIA AND **I**NTENSIVE **C**ARE, **F**ACULTY OF **M**EDICINE, **A**IN **S**HAMS **U**NIVERSITY, WHO PROVIDED ME WITH SUPPORT FROM THE VERY BEGINNING OF THIS WORK.

I would like to thank Dr. **Osama Mohamed Hetta, A**ssistant **P**rofessor OF **R**adio-diagnosis, **and Faculty of** Medicine**, A**in **S**hams **U**niversity, for his valuable advices and instructions .

I WOULD LIKE TO EXPRESS MY DEPPEST APPRECIATION TO **DR. Max kyi Maung & DR. Bernard MCclement** Consultant Anaethetists, Good Hope Hospital, Heart of England Foundation Trust Who Taught me the ultrasound techniques.

MOHAMED EL-ZAYAT

CONTENTS

List of Tables

List of Figures

List of Abbreviations

ASA: American Society of Anesthesiologists.

BMI: Body Mass Index.

CT: Computed tomography.

DBCM: decibel per centimetre.

ECG: Electrocardiogram.

IJ: Internal jugular vein.

IM: Intramuscular.

LBP: Lumbar plexus block.

LP: Lumbar plexus.

MHZ: Mega-Hertz

PNB: Peripheral nerve block.

SD: Standard deviation.

TGC: Time gain compensation.

US: Ultrasound.

VAS: Visual analogue score.

Introduction

The key requirement for successful regional anesthetic blocks is to ensure optimal distribution of local anesthetic around nerve structures. This goal is most effectively achieved under sonographic visualization.

The main concern with continuous blocks is placement of catheter close to the nerve so that local anesthetic drug is optimally distributed around nerves. Nerves are not blocked by the needle but by the local anesthetic and unsuccessful blocks mean that the local anesthetic is not where it should be (Ilfield et al., 2002).

Direct visualization of the distribution of local anesthetics with high-frequency probes can improve the quality and avoid the complications of nerve block techniques. Ultrasound guidance enables the anesthesiologist to secure an accurate needle position and to monitor the distribution of the local anesthetic in real time. The advantages over conventional guidance techniques, such as nerve stimulation and loss-of-resistance procedures, are significant (Marhofer et al., 2005).

The first block was done under direct vision in 1884. Since then, this goal has been achieved by various methods. Traditionally, blocks have depended on fascial clicks and/or elicitation of paresthesia with or without the use of nerve stimulators. Blind blocks are known to produce serious complications and the motor response to nerve stimulation may be absent when the needle is on or even in the nerve. Also damage to nerve structures by direct puncture can happen (Dhir et al., 2007).

Imaging is playing a major role in all fields of medicine. During the past ten years the interest of anesthesiologists around the world for ultrasongraphy in regional anesthesia has continuously increased. It is being used for almost all of the peripheral nerve blocks in the western world. Ultrasound assisted nerve block has been described for localization of the brachial plexus, femoral nerve, lumbar plexus and sciatic nerve (Perlas et al., 2003).

While ultrasound application for regional anesthesia is a relatively new and evolving concept, its use to accurately locate target lesion for tissue biopsy has been standard medical practice for many years. Ultrasound (US) guidance has also proven to facilitate the neural blockade as well as improve block quality. Ultrasongraphy allows one to visualize the neural structures, its surrounding structures at risk such as pleura and vessels as well as spread of the delivered local anesthetic in proximity to the nerves. Ultrasound also allows one to estimate the tip of catheter location using color Doppler and see the spread of anesthetic in real time. One is able to reduce the dose of local anesthetic required because the drug is delivered precisely near the target (Gray et al., 2004).

This technology is particularly useful to rescue blocks when a block has failed using neuro-stimulation or paresthesia. It is also useful in situations where neuro-stimulation induced motor twitches can be very painful for the patients following trauma and fractures. This technique is particularly useful in obese patients or patients with altered anatomy. This is the only technique that sheds light on anatomical variations between individuals. Major barriers to the implementation of ultrasound in regional anesthesia into daily clinical practice are the expense of the equipment and the need for specialized training (Sites et al., 2005).

Concerning Lumbar plexus block, Lumbar plexus block (LPB) is traditionally performed using surface anatomical landmarks and the site for local anesthetic injection is identified using loss of resistance, paresthesia, or by observing quadriceps muscle contraction to nerve stimulation. Surface anatomical landmarks are useful but are only surrogate markers and can vary among patients. This can result in a failure to contact the transverse process or elicit quadriceps muscle contraction resulting in inadvertent deep needle insertion, renal, or vascular injury (Marhofer et al., 2005).

According to Kirchmar, wide variety of approaches to the Lumbar plexus have been suggested, along with different methods of nerve identification. None of the approaches have success rates above 70–80%, and all involve serious complications. Psoas compartment blocks are difficult to perform under ultrasound guidance because the lumbar plexus is located relatively deep at the level of the Psoas compartment [5.5 (1.4) cm at L2/3; 5.5 (1.4) cm at L3/4; and 5.8 (1.3) cm at L4/5]. Therefore, the quality of ultrasound imaging is reduced, and clear anatomical reference points are not present (Kirchmar et al., 2003), so for these reasons we will conduct our study to recommend the best approach to block the lumbar plexus.

At last, ultrasound imaging may transform the art of regional anesthesiology into a science. In the present days of advanced technology, it appears that ultrasound can be a useful aid as a real time guide of needle and/or catheter position relative to the nerve or blood vessel and can be used to define spread of the local anesthetic. It also allows anesthetists to reposition the needle if needed. Performance of ultrasound guided nerve blocks in clinical practice is a skill and needs to be acquired by practice (Karmakar et al., 2008).

References

- Dhir S, Ganapathy S., Dhir A (2007). Role of Ultrasound Guidance in Regional Anesthesia, Kuwait Medical Journal, vol. 39, no. 1,pp: 4-9.

- Gray AT, Huczko EL, Schafhalter-Zoppoth (2004): Lateral popliteal nerve block with ultrasound guidance. Regional Anesthesia Pain Medicine: vol. 29, pp: 507-9.

- Ilfield BM, Morey TE, Enneking FK. (2002): Continuous popliteal sciatic nerve block for post operative pain control at home. A randomized, double blinded, placebo controlled study. Anesthesiology; vol. 97, pp.:959-65.

- Karmakar MK, Ho AM, Li X , Kwok H, Tsang k and Ngan Kee NH(2008): Ultrasound-guided lumbar plexus block through the acoustic window of the lumbar ultrasound trident, British Journal of Anesthesia;vol.100,no.4,pp.: 533–7

- Kirchmair L, Entner T, Wissel J, Moriggl B, Kapral S, Mitterschiffthaler G (2003): A study of the paravertebral anatomy for ultrasound-guided posterior lumbar plexus block. Anesthesia and Analgesia; vol.93, pp.: 477–81

- Marhofer P, Greher H., Karpal S. (2005): Ultrasound guidance in regional anesthesia. British Journal of Anesthesia; vol. 94, pp: 7-17.

- Perlas A, Chan VW, Simons M. (2003): Brachial plexus examination and localization using ultrasound and electrical stimulation: volunteer study. Anesthesiology; vol.99, pp: 429-35.

- Sites BD, Gallagher JD, Cravero J, *et al*. (2005): The learning curve associated with a simulated ultrasound-guided interventional task by inexperienced anesthesia residents. Regional Anesthesia and Pain Medicine; vol. 29,pp.:544-48

- Winnie AP, Ramamurthy S, Durrani Z, (1974): Plexus blocks for lower extremity surgery. Anesthesiology Review: vol. 1, pp: 11–6.

Aim of the work

The aim of the study is to find the best approach for Psoas compartment block using ultrasound guidance to increase efficacy and decrease incidence of complications of the block.

ANATOMICAL CONSIDERATIONS

The Lumbar Plexus (figure 1):

The lumbar plexus is formed by the ventral rami of the first, second, third, and major part of the fourth lumbar nerves. It is located in the substance of psoas major muscle in a compartment formed by the bodies of the lumbar vertebrae medially; the psoas major muscle and its fascia anteriorly and the transverse processes, intertransverse ligaments and muscles and the quadratus lumborum posteriorly ***(Chudinov et al, 1999).***

The mode in which the plexus is arranged varies in different subjects. It differs from the brachial plexus in not forming an intricate interlacement, but the several nerves of distribution arise from one or more of the spinal nerves, in the following manner: the first lumbar nerve, frequently supplemented by a twig from the last thoracic, splits into an upper and lower branch; the upper and larger branch divides into the iliohypogastric and ilioinguinal nerves; the lower and smaller branch unites with a branch of the second lumbar to form the genitofemoral nerve. The remainder of the second nerve, and the third and fourth nerves, divide into ventral and dorsal divisions. The ventral division of the second unites with the ventral divisions of the third and fourth nerves to form the obturator nerve. The dorsal divisions of the second and third nerves divide into two branches, a smaller branch from each uniting to form the lateral femoral cutaneous nerve, and a larger branch from each joining with the dorsal division of the fourth nerve to form the femoral nerve. The accessory obturator, when it exists, is formed by the union of two small branches given off from the third and fourth nerves ***(Fennegan, 1990).***