A COMPARISON OF THE EFFECTIVENESS AND SUCCESS RATE BETWEEN PRELOCATION OF THE NERVES USING PERCUTANEOUS ELECTRODE GUIDANCE VS CONVENTIONAL TECHNIQUE FOR 3 IN 1 BLOCK

By

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ABBREVIATIONS

ASA	American Societies of Anaesthesiologists
ASIS	Anterior Superior Iliac Spine
BMI	Body Mass Index
BP	Blood Pressure
cc	cubic centimeter
°c	degree Celsius
cm	centimeter
CNS	central nervous system
CVS	cardiovascular system
DM	diabetes mellitus
ECG	Electrocardiogram
FMB	Femoral Motor Block
FSB	Femoral Sensory Block
G	Gauge
Gp1	Group1
Gp2	Group2
h	hour
Hz	Hertz
Kg	kilogram
L	liter
L2	lumbar2

L3	lumbar3
LA	Local Anaesthetic
LCD	Liquid Crystal Display
LFCN	Lateral Femoral Cutaneous Nerve
LFCNSB	Lateral Femoral Cutaneous Nerve Sensory Block
LP	Lumbar Plexus
mA	miliampere
Min	minute
ml	milliliter
mm	millimeter
N	number
NIBP	Noninvasive Blood Pressure
OMB	Obturator Motor Block
OSB	Obturator Sensory Block
PEG	Percutaneous Electrode Guidance
PNS	Peripheral Nerve Stimulator
SD	Standard Deviation
SPSS	Statistical Package for the Social Science
VAS	Visual Analog Scale
VRS	Verbal Rating Score
Vs	Versus

ABSTRACT

TITLE: A comparison of the effectiveness and success rate between prelocation of the nerves using percutaneous electrode guidance (PEG) vs conventional technique for 3 in 1 block.

BACKGROUND AND OBJECTIVES: Peripheral nerve block provide analgesia and anaesthesia but the procedure itself can produce pain and discomfort to the patient This study evaluated the effectiveness of PEG for the prelocation of the nerves in the 3 in 1 block before nerve stimulator needle is introduced. The specific objectives of the study are to compare between PEG group and conventional group in terms of success rate, mean duration of performing 3 in 1 block, onset of blockade and number of attempts and redirection of nerve stimulator needle.

METHODS: Prospective randomized single blinded study. Seventy orthopaedic patients with lower limb procedure were divided into 2 groups, group 1 (n=35) prelocation with PEG, group 2 (n=35) no prelocation/ conventional. Local anaesthetic agent used was 10ml 1% Lignocaine and 20ml 0.375% Ropivacaine.

RESULTS: There was no significant difference in success rate and mean duration of performing the 3 in 1 procedure, P value > 0.05. However the onset of sensory blockade was statistically significant, P value < 0.05, where group 1 patients (prelocate with PEG) showed faster onset than group 2 patients (without PEG). Group 1 also had statistically significant less number of redirection of nerve stimulator needle.

CONCLUSION: The use of PEG is effective in identifying the nerves with evidence of faster onset of blockade and reduces number of redirection of nerve stimulator needle but there was no statistically significant difference in success rate and duration of performing 3 in 1 block compared to conventional technique.

ABSTRAK

TAJUK: Perbandingan peratus kejayaan dan keberkesanan penggunaan "percutaneous electrode guidance"(PEG) untuk prelokasi saraf berbanding dengan kaedah konvensional bagi pembiusan separa ' 3 dalam 1'.

LATARBELAKANG DAN OBJEKTIF: Pembiusan saraf periferal adalah salah satu kaedah untuk pembiusan dan mengelakkan kesakitan selepas pembedahan. Tetapi prosedur untuk melakukan pembiusan saraf periferal tersebut boleh menyebabkan pesakit merasa kesakitan dan ketidak selesaan. Kajian ini adalah untuk menilai keberkesanan penggunaan 'PEG' untuk prelokasi saraf di dalam pembiusan separa 3 dalam 1 sebelum penggunaan jarum stimulasi saraf. Objektif kajian ini adalah untuk membandingkan kumpulan PEG dan kumpulan kaedah konvensional/ tiada prelokasi di dalam peratus kejayaan, jangkamasa yang di ambil untuk prosedur 3 dalam 1, masa permulaan blok, jumlah percubaan dan halaan jarum stimulasi saraf.

TATACARA: Kajian ini adalah kajian prospektif, 'single blinded randomization'. Ia melibatkan 70 pesakit ortopedik yang akan menjalani pembedahan anggota peha. Mereka di bahagikan kepada 2 iaitu kumpulan 1 (penggunaan PEG untuk prelokasi saraf) dan kumpulan 2 (konvensional/ tiada penggunaan PEG). 10cc 1% Lignocaine dan 20cc 0.375% Ropivacaine digunakan sebagai ubatan pembiusan

KEPUTUSAN: Tiada perbezaan di dalam peratus kejayaan dan jangkamasa yang di ambil untuk prosedur 3 dalam 1 di mana P value > 0.05. Tetapi masa permulaan blok terdapat perbezaan yang terbukti dari segi statistik diantara dua kumpulan tersebut. Kumpulan 1 juga mempunyai jumlah halaan jarum stimulasi saraf yang kurang berbanding dengan kumpulan 2.

RUMUSAN: Penggunaan PEG adalah berkesan di dalam menentukan permulaan blok yang lebih cepat dan mengurangkan halaan jarum stimulasi saraf tetapi peratus kejayaan dan masa yang diperlukan untuk prosedur 3 dalam 1 tiada perbezaan dengan teknik konvensional dari segi statistik.

1. INTRODUCTION

Regional anaesthesia for lower limb extremity is a technique of choice in recent times and in comparison to general anaesthesia of having a higher incidence of morbidity and mortality. This will increase overall healthcare cost. (Rodgers, 2000).

Among the factors that contribute the higher morbidity and mortality in general anaesthesia compared to regional anaesthesia are, vascular event 44% higher, myocardial infarction 33% higher, pneumonia 39% higher, respiratory depression 59% higher, renal failure 43% higher (Rodgers, 2000).

Anaesthesia then looking towards neuroaxial blockade; however a few conditions are contraindicated for epidural and spinal anaesthesia. For example, condition that may potentiate bleeding into central nervous system example blood dyscrasia and coagulopathies, condition may cause infection of the meninges example local infection and septicaemia, deformity of lumbosacral spine and cardiovascular compromise because neuroaxial blockade will cause marked physiological derangement (P. Prithvi Raj, 2002).

Regional anaesthesia with specific peripheral nerve block comes into role when neuroaxial blockade are contraindicated. It also can be used in combination with general anaesthesia to cover post operative pain.(McNamee, 2002).Experience and skills are required whom going to perform regional anaesthesia procedure. Traditionally the procedure relies on anatomical landmark (bony, muscle and groove), vascular structure (pulsation of artery) and paraesthesia (Chan, 2002).

Nerve stimulator was then introduced in 1912. Conventionally by using nerve stimulator needle, the operator requires exploration for the nerve blindly to get specific muscle contraction. This technique may required multiple redirection of the needle and this may lead to patient discomfort, increase risk of complications and lengthen the procedure time (Xavier Capdevila, 2004).

Withdrawal and repositioning of needle is the major contributing cause of pain (Sia, 2004) and Fanelli demonstrated that despite overall success rate of 94%, only 74% of the patient would request the same technique if they are required similar surgery in the future (G. Fanelli, 1999).

Many approaches and tools then invented to facilitate the procedure of peripheral nerve blocks, which includes the usage of ultrasound and percutaneous electrode guidance. Ultrasound was proven to improve success rate for nerve block but its require skill and understanding regarding ultrasound(P. Marhofer, 2005). Percutaneous electrode guidance (PEG) was introduced; it theoretically narrows the search for target nerve and is a non invasive procedure. By using PEG, rate of successful block is higher and pain verbal analogue score value during the procedure were significantly lower(Xavier Capdevila, 2004).

Study by William F urmy in 2002 shows successful blockade of femoral nerve and popliteal fossa peroneal nerve with guidance of PEG. However the use of PEG will add one more step before the use of nerve stimulator needle, this supposed to further prolong the procedure time.

As for the lower limb procedure, the inguinal perivascular block (3 in 1) is well known to provide anaesthesia and analgesia for multiple lower limb procedures particularly for femoral shaft fracture, femoral neck fracture, knee procedures and others (P. Prithvi Raj, 2002). Three in one block involve the blockade of femoral nerve, lateral femoral cutaneous nerve and obturator nerve. The technique is similar to femoral nerve block alone but its require of application of firm pressure just distal to the needle for a few minutes after injection (Hadzic, 2005).PEG was chosen in this study as its ability to prelocate the nerve percutaneously. We would like to do a study to see whether the use of PEG will improve effectiveness, shorten the procedure time and obtain faster onset of blockade, compared to other techniques.

1.1. Objective Of The Study

1.1.1 General Objective

To compare the effectiveness and success rate between prelocation of the nerves using PEG vs conventional method for 3 in 1 block (femoral, lateral femoral cutaneous and obturator nerve).

1.1.2 Specific Objectives

i) Comparison of success rate between PEG group and conventional group

ii) Comparison of mean time required for the performance of procedure

iii) Comparison of time to obtain success block.

1.2 Hypothesis

The prelocation of the nerves by using PEG will give higher success rate and more effective than the conventional method.

2. LITERATURE REVIEW

2.1 History

Peripheral nerve block was performed in 1885 by William Steward Halsted whereby at that time he used direct exposure of nerve roots and bathed with cocaine. Though the success rate using the direct exposure technique was good, the pitfall of this opened technique is when many patient had to experience the pain of skin incision for exposing the nerves and increase numbers of infection due to poor aseptic technique (Brown, 1996).

In 1911, Hirschel and Kulenkampff start to use percutaneous technique for peripheral nerve blocks particularly in upper extremity. With development of proper technique and aseptic precautions the number of infection are decreased. However, limited technologies for proper understanding of anatomy increase the incidence of complication (Brown, 1996).

The inguinal perivascular block (3 in 1), originally described by Winnie in 1973. This technique utilizes the fascial wrapping as a conduit to allow local anaesthetic to the level of lumbar plexus which located between quadratus lumborum and psoas major muscle. In 3 in 1 block after local anaesthetic gets distributed, it will block motor for femoral and obturator nerve and block sensory for lateral femoral cutaneous nerve, femoral and obturator distribution (Bridenbaugh, 1998).

Nowadays, many equipments and tools was invented to facilitate peripheral nerve block. After the use of nerve stimulator needle, modern technologies introduce us to the PEG in 2003 for the prelocation of the nerves. Furthermore, the improvement in imaging technique for example CT scan, MRI and ultrasound give us better understanding about anatomy of the nerves and its surrounding structural relationship.

New local anaesthetic for example ropivacaine and levobupivacaine which has better safety profile has been introduced. All of this technology, equipment and drugs have its own contribution to patient's safety and satisfaction which is the priority concern for the anaesthesiologist.

2.2 Anatomy

To ensure the patient's safety during the procedure, a thorough knowledge of functional anatomy of lumbar plexus is very essential.

2.2.1 Functional Nerve Structure

Microscopically, nerve fibers have 3 layers. The outermost layers are called epineurium, made from loose connective tissue. Within this inert supporting tissue there are individual axons which are organized into fascicles by surrounding sheath called perineurium. On the other hand, the connective tissue between the axons within the fascicles is provided by endoneurium. The endothelium of the endoneural vessels and the perineurium, together act as blood nerve barrier for the fascicles (Bridenbaugh, 1998).

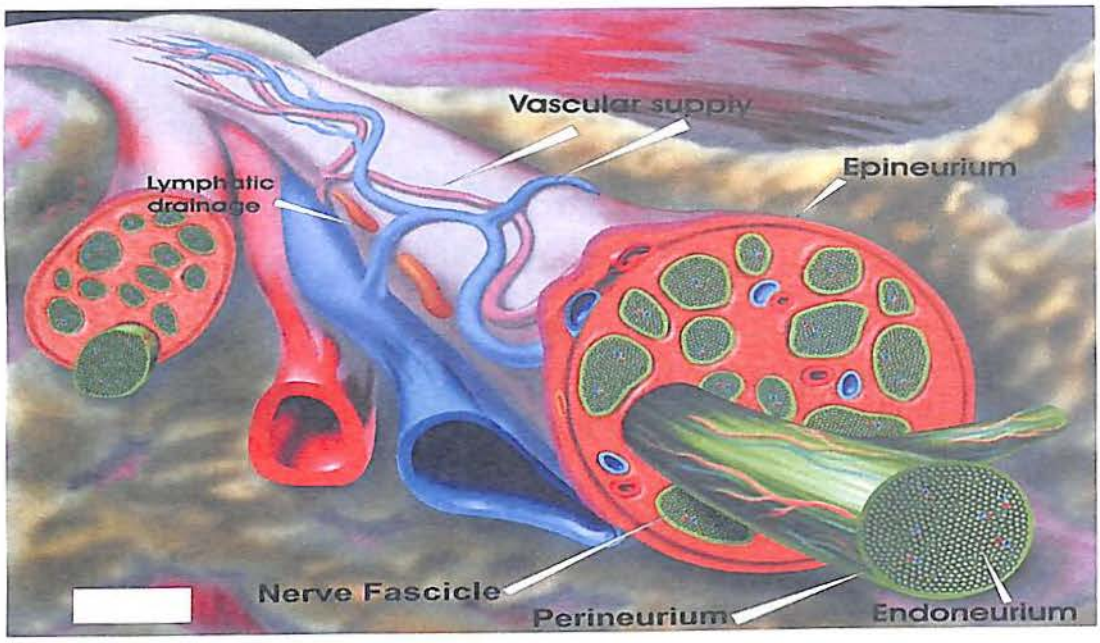

Fig 2.1 : The connective of large nerve consists of three important envelops: epineurium, perineurium and endoneurium.(Admir Hadzic, 2004)

Each individual nerve fiber, the diameter and myelination are correlated with its impulse physiology and its message – carrying function. Nerve fibers are categorized into three major anatomical classes:

- A fibers (myelinated somatic nerves)
- B fibers (myelinated preganglionic autonomic nerves)
- C fibers (non myelinated axons)

The A fibers are further divided into 4 groups, alpha, beta, gamma and delta fibers. Largest are alpha fibers which are related to motor function. Whereas delta fibers are smallest among A fibers and involved in pain and temperature sensation (Bridenbaugh, 1998).

2.2.2 Functional Anatomy of Lumbar Plexus

The lumbar plexus (LP) is formed by the first three and the greater part of the fourth lumbar ventral rami (refer Fig 2.1) A contribution of the 12th thoracic nerve is common. In the literature, the exact location of the lumbar plexus remains controversial. Some authors place the plexus between the psoas and quadratus lumborum muscles(Enneking FK, 2000). Recent studies on the plexus place the nerve branches within the psoas muscle between its anterior and posterior masses (Farny J, 1994).

The lumbar plexus is formed within the psoas muscle from the anterior rami of T12-L4. The branches of this plexus, the iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, and femoral and obturator nerves emerge from the psoas laterally, medially, and anteriorly. Of these, the femoral, lateral femoral cutaneous, and obturator nerves are most important for lower-extremity surgery (Enneking FK, 2000).

2.2.3 Femoral Nerve

The femoral nerve is formed by the dorsal divisions of the anterior rami of the second, third, and fourth lumbar nerves. The femoral nerve emerges from the psoas muscle in a fascial compartment between the psoas and iliacus muscles, in which it gives off articular branches to the hip. It enters the thigh posterior to the inguinal ligament. There it lies lateral and posterior to the femoral artery. These relationships to the femoral artery exist near the inguinal ligament, but not after the nerve enters the thigh (refer Fig 2.4 and 2.5). As the nerve passes into the thigh, it divides into an anterior and a posterior division. At the level of the inguinal ligament, there are dense fascial planes, the fascia lata, and fascia iliaca. The femoral nerve is situated deep to these fascial planes. The femoral artery, vein, and lymphatic reside in a separate fascial compartment medial to the nerve (Enneking FK, 2000).

The anterior division of the femoral nerve gives off the medial and intermediate cutaneous nerves that supply the skin of the medial and anterior surfaces of the thigh. The muscular branches of the anterior division of the femoral nerve supply the sartorius muscle and the pectineus muscle and articular branches to the hip. The posterior division of the femoral nerve gives off the saphenous nerve, which is the largest cutaneous branch of the femoral nerve, and the muscular branches to the quadriceps muscle and articular branches to the knee (Enneking FK, 2000). The terminal nerves of the posterior division of the femoral nerve, the saphenous and the vastus medialis nerves, continue distally through the adductor canal. After leaving the adductor canal, the saphenous nerve emerges from behind the sartorius muscle, in which it gives off an infrapatellar branch and then continues distally to supply the cutaneous innervations of the anteromedial lower leg down to the medial aspect of the foot (Enneking FK, 2000).

2.2.4 Obturator Nerve

The obturator nerve is a branch of the lumbar plexus formed within the substance of the psoas muscle from the anterior division of the second, third, and fourth lumbar nerves. It is the nerve of the adductor compartment of the thigh, which it reaches by piercing the medial border of the psoas and passing straight along the sidewall of the pelvis to the obturator foramen. After entering the thigh through the obturator groove, the nerve divides into an anterior and posterior division.

The anterior division has three branches including the muscular branches to the adductor muscles, an articular branch to the hip joint, and a cutaneous branch to the medial side of the thigh. The extent of these cutaneous sensory innervations has been investigated by Bouaziz et al in 2002. These investigators performed an isolated obturator nerve block on patients before a femoral nerve block. All the obturator nerve blocks were successful as shown by adductor paresis. In 57% of the patients, there was no cutaneous sensory loss demonstrable. In 23% of patients, a zone of hypoesthesia was present on the superior medial aspect of the popliteal fossae. Only 20% of the patients showed a sensory deficit on the inferior aspect of the medial thigh. The inconsistency of the sensory distribution of the obturator nerve must be considered when evaluating reports of obturator nerve block success rates based on sensory findings only (Bouaziz H, 2002).

The posterior division of the obturator nerve descends with the femoral and popliteal artery to the knee joint, and forms 2 branches: a muscular branch to the external obturator and adductor magnus muscles and an articular branch to the knee. The divergence of the obturator nerve from the femoral nerve begins as they emerge from the substance of the psoas muscle. At the level of the inguinal ligament, the obturator nerve lies deep and medial relative to the femoral nerve and is separated from it by several