Comparative study between ultrasound guided and nerve stimulator guided femoral and sciatic nerve blocks in lower limb surgeries

Hazem Abd-Allah Mohammed Ali, Anis Mekhaimer Abd-Elhady, Magdy Ahmed Abd-Elmoenem and Ali Ahmed Mahmoud Mahareak

Department of Anesthesiology and Intensive Care, Faculty of Medicine, Al-Azhar University, Cairo, Egypt.
tabibhazem@yahoo.com

Abstract: Peripheral nerve block (PNB's) involves the anesthesia of an area of the body without necessarily affecting the patient level of consciousness. The use of ultrasound (US) is the first major change in regional anesthesia practice since the introduction of neuro stimulation for nerve location. There has been an increased interest in performing lower extremity PNB's because of the potential complications associated with neuraxial blockade. The aim of the work was to compare efficacy of US guided femoral nerve (3in1 technique) & sciatic nerve (lateral popliteal approach) blocks(FSNB's) with nerve stimulator (NS) guided blocks regarding the block performance time, onset of the block, time needed to start the surgery, block quality, duration of analgesia, incidence of complications and patient discomfort during the block. Seventy patients scheduled for lower limb surgeries (mainly below knee)were included in the present study. Patients were randomly allocated into two groups: **Group I**: Electric nerve stimulator guided femoral and sciatic nerve blocks. **Group II**: Ultrasound guided femoral and sciatic nerve blocks. Sensory block was assessed using Pinprick test in the middle of the dermatomal distribution of each nerve, motor block was assessed using Bromage scale, degree of the block was assessed using a three-level scale, Patient satisfaction was assessed using 10mm in length numerical analogue scale (NAS), success rate and the incidence of complications (hematoma, parathesia or vascular puncture) were documented. No significant differences were found between both groups as regard to demographic data, hemodynamic changes, arterial O2 saturation, respiratory rate, site of operation and success rate. On the other hand there were significant differences found between both groups as regard to block performance time, onset time of sensory and motor block, duration of block, time of complete sensory and motor block, success rate, patient discomfort and complications. **Conclusion:** Ultrasound guided femoral and sciatic nerve blocks decrease onset time of sensory and motor block, time to start surgery, patient discomfort and complications. Beside to it increases the duration of the block.

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Key words: Ultrasound, Electric nerve stimulator, sciatic nerve block, femoral nerve block.

1. Introduction

The use of US is the first major change in regional anesthesia practice since the introduction of neurostimulation for nerve location. The ability to now both visualize the nerve and confirm correct local anesthetic solution placement is a very exciting development and has already demonstrated its efficacy in terms of success rates, speed of onset and reduced local anesthetic volume for a number of neural blocks(**Buys *et al*., 2010).**

Whether US guided blocks will replace neurostimulation techniques is debatable especially when regional anesthesia is performed by specialists in the field. However US does offer an increased margin of safety or at least improved confidence for particular blocks or specific patient situations **(Cataldo *et al*., 2012).**

The innervation of the lower extremity comes from the lumbar and sacral plexuses. There is no single peripheral block technique can provide anesthesia of the whole lower extremity **(Bonnie *et al*., 2009).**

During femoral nerve block, it has been advocated to apply firm pressure just distal to the needle during and a few minutes after injection to block the femoral, lateral femoral cutaneous, and Obturator nerves, the so-named "3-in-1 block" **(Suresh and Tim, 2013).**

The sciatic nerve is the largest nerve derived from the sacral plexus, innervates the posterior thigh and almost the entire leg below the knee. The most common indications for sciatic nerve block are anesthesia and analgesia for foot and ankle surgery **(Kim *et al.*, 2015).**

Lateral approach to sciatic nerve block is chiefly used for foot and ankle surgery, it provides anesthesia for the entire leg below knee save the skin of medial aspect of the calf and foot which enervated by saphenous nerve (terminal branch of femoral nerve) **(Andres *et al*., 2012).**

The aim of the work was to compare efficacy of ultrasound guided femoral nerve (3in1 technique) & sciatic nerve (lateral popliteal approach) blocks with nerve stimulator guided blocks regarding the block performance time, onset of the block, time needed to start the surgery, block quality, duration of analgesia, incidence of complications and patient discomfort during the block.

2. Patients and Methods

The present study was performed on 70patients of ASA physical status I & II of both sexes and age18-60 years old with body mass index ≤ 35 kg/m^2 and normal neurological status, The required number of patients to be included in the study was calculated from a preliminary study, they were selected from AL-Azhar University Hospitals and were scheduled for surgery in the lower limb (below knee surgeries) during the period from November 2014 till November 2016. The aim of the study and procedure were explained for each patient and subsequently informed written consent from the patient and approval by our local committee on human research was obtained. The patients randomly assigned into two groups:

Group (1): Electrical nerve stimulator (**NS**) guided femoral and sciatic nerve block group consists of (**35)** cases.

Group (2): Ultrasound (**US**) guided femoral and sciatic nerve block group consists of (**35)** cases.

Exclusion criteria included: Clinically significant coagulopathy, Infection at the injection site, Allergy to local anesthetics and Patient refuse of the technique.

Materials: Insulated needles (stimuplex A) 100 mm 20 Gauge. Peripheral nerve stimulator. Sonosite M turbo ultrasound machine with linear probe 25mm. Local anesthetic: 40 ml volumes of 0.5% bupivacaine (20 ml for femoral block & 20 ml for sciatic block. Midazolam HCL (0.05-0.1 mg/Kg). Monitor for vital signs and Anesthesia machine.

Techniques: patient was sedated with Midazolam 0.05mg⁄kg then:

I) Femoral nerve block: By:

1) Nerve stimulator technique: Palpate the anterior superior iliac spine and pubic tubercle, mark a line joining these 2 points; this is the surface marking of the inguinal ligament. Palpate the femoral artery (midpoint of inguinal ligament) and mark a point 1-2cm distal to the inguinal ligament and 1cm lateral to the femoral artery. Prepare the skin with bovidone iodine 10% followed by 70% isopropyl alcohol. Anesthetize the skin with a subcutaneous injection of 1% lidocaine at the point of needle insertion. Insert a 50mm short-beveledstimulating needle attached to a nerve stimulator and set to 1.5ma, 0.1msec, 2Hz pulse through the skin at an angle of 30–45º in a cephalic direction.2 distinct losses of resistance or 'pops' should be felt as the needle is advanced: 1st fascia lata, 2nd fascia iliacus. The nerve is usually located at a depth of 12mm ± 4mm from the skin. Look for stimulation of the quadriceps muscles from the posterior division of the femoral nerve 'patella twitch'. Manipulate the needle until stimulating current is between 0.3 and 0.5mA. disconnect syringe before injection to exclude passive reflux of blood and inject 5mL aliquots of LA, aspirating regularly to exclude intravascular injection.

2) Ultrasound technique: Ultrasound settings: Probe: high-frequency (10-15MHz) linear L38 broadband probe. Settings: B mode resolution. Depth: 3–4cm. Needle: 50–80mm. Orientation: transverse (slightly oblique).

Place the probe on the patient in a transverse/oblique position, i.e. longitudinally along the inguinal crease. Identify the femoral artery (pulsatile, anechoic) and the femoral vein (compressive distensible anechoic).Scan caudate and cephalic identifying the division of the common femoral artery into the superficial femoral and profundafemoris arteries and ensure you are above this level, close to the inguinal ligament. Scanning laterally identify the iliacus and sartorius muscles. From superficial to deep identify 2 hyperechoic fascia layers, the superficial fascia lata (this fascia continues medially, superficial to the femoral sheath) and the deeper fascia iliacus (enclosing the iliacus muscle, passing posterior to the femoral sheath). The femoral nerve can be identified beneath the iliacus fascia on the medial border of iliacus, lateral and deep to the femoral artery.

Either an in-plane or an out-of-plane technique can be used. Prepare the skin with 0.5% chlorhexidine in 70% alcohol. Anesthetize the skin with a subcutaneous injection of1% lidocaine at the point of needle insertion. For either technique, aim to introduce the needle just lateral to the artery just underneath the fascia iliaca.

Local anesthetic and volume: After application of a tourniquet 5-10 cm distal to injection site a slow injection of 20 mL of 0.5% bupivacaine is usually used to produce a 3-in-1 block by lateral spread of local anesthetic.

II) Sciatic block, lateral(popliteal) approach: By:

1) Nerve stimulator technique: Position the patient supine with the leg slightly flexed to help identify the lateral groove (groove between vastaslateralis above and the long head of biceps femoris below). Mark the point of intersection between the groove and a line droped from the superior border of the patella. Prepare the skin with 0.5% chlorhexidine in 70% alcohol. Anesthetize the skin with a subcutaneous injection of 1% lidocaine at the point of intersection. Insert a

50mm, 21g, insulated short-beveled stimulating needle attached to a nerve stimulator and set to 1.5ma, 0.1msec, and 2Hz pulse. Direct 30° posteriorly and 5–10° caudally and advance until either a motor response is elicited or the needle has been inserted more than the radius of the leg. Manipulate the needle until stimulating current is between 0.3 and 0.5ma.

2) Ultrasound technique: **Ultrasound settings**: Probe: high-frequency linear L38 broadband probe. Settings: B mode resolution. Depth: 3– 6cm. Needle: 50–100 mm.

This block carried out with the patient in the supine position. With the knee flexed at 90° and the heel supported by an assistant on the bed or raised up on a pillow. Adequate space around the posterior aspect of the thigh is required to allow for placement of the probe. Place a linear probe in a transverse position at the level of the popliteal crease and firstly identify the popliteal artery and vein (color flow Doppler may be useful). Identify the muscle bellies of semimembranosus medially and the long head of biceps femoris laterally. The nerves sit between these muscles. Scan proximally while observing the tibial nerve move to the lateral side of the artery and gradually converge with the common peroneal nerve to form the sciatic nerve.

Technique: Prepare the skin with 0.5% chlorhexidine in 70% alcohol. Anesthetize the skin with a subcutaneous injection of 1% lidocaine. In-plane (lateral) approaches were used.

Local anesthetic and volume: A slow injection of 20 mL of 0.5% bupivacaine is usually used to produce complete block.

Assessment: All patients in the studied groups were assessed and monitored for:

- Hemodynamic parameters block performance time.
- Sensory assessment: By pin prick test in the middle of the dermatomal distribution of each nerve using four point score (Clearly felt=0. Attenuated=1. Felt only as a tactile=2. Pin prick not felt at all=3).
- Motor assessment: By Bromage scale (Complete block=3. Almost complete block=2. Partial block=1. No motor block=0).
- Degree of the block: By a three-level scale: (No block = normal motor or sensory function. Partial block = the presence of either sensory or motor block at any of the examined nerves. Complete block = complete sensory and motor block at all nerves examined).
- Quality of the block: adequate block (no need for additional analgesia or sedation) or inadequate block (patients required additional analgesia and/or sedation during surgery) e.g. patients had tourniquet pain.
- Complications: Hematoma, vascular puncture or nerve injury.
- Patient satisfaction: By 10mm in length numerical analogue scale from (0) no pain = patient satisfied (excellent) to (10) most severe pain = patient not satisfied.
- Success rate.

Statistical analysis of data:

The collected data were organized, tabulated and statistically analyzed using statistical package for social science (SPSS) version 22(SPSS Inc. USA). For numerical (quantitative) data, mean and standard deviation (SD) were calculated and for comparison between two means, the independent sample t-test was used. For qualitative data, frequency and percent distribution were calculated and for comparison between groups, Chi square (X^2) was used. For interpretation of results, P value≤0.05 was considered significant.

3. Results

Demographic data (age, sex, ASA classification and BMI) were presented in table (1) and no significant difference was found between both groups (age, sex, ASA classification and BMI). In addition, there was no significant difference between both groups as regard type or duration of surgery.

Table (1): Comparison between studied groups as regard demographic data

Data	Groups	Group I (No=35) (Nerve stimulator)	Group II (No=35) (Ultrasound)	P value
Age(year)	**Mean ± SD**	38.06 ± 11.76	38.86 ± 12.3	**0.782 (NS)**
Sex (No & %)	**Males**	17 (48.6 %)	20 (57.14 %)	**0.473(NS)**
	Females	18 (51.43 %)	15 (42.86 %)	
ASA (No & %)	**I**	18 (51.43 %)	16 (45.71 %)	**0.632(NS)**
	II	17 (48.57 %)	19 (54.29 %)	
BMI(kg/m^2)	**Mean ± SD**	31.35 ± 5.16	31.82 ± 4.9	**0.695(NS)**

SD= standard deviation. (NS) = non-significant. No= number.

Table (2): Comparison between studied groups as regard Performance time, Number of needle puncture, complete sensory block time, complete motor block time and Duration of surgical analgesia.

Data / Groups	Group I (No = 35) (Nerve stimulator)	Group II (No = 35) (Ultrasound)	P value
Performance time(minute) (Mean± SD)	12.95±1.28	8.22±0.98	<0.001
Number of needle puncture (Mean± SD)	2.43± 0.56	2.03± 0.17	<0.001
Complete sensory block time(minute) (Mean± SD)	31.37±1.24	26.46±7.89	0.001
Complete motor block time (minute)(Mean± SD)	34.71±2.32	28.94±5.39	<0.001
Duration of surgical analgesia (minute)(Mean± SD)	333.43±21.41	420.86±21.61	<0.001

SD= standard deviation. No= number.

Table (3): Comparison between studied groups as regardTourniquet pain, success rate Success rate and complications.

Data / Groups		Group I (No = 35) (Nerve stimulator)	Group II (No=35) (Ultrasound)	P value
Tourniquet pain (No & %)		4(11.43%)	0(0%)	0.114(NS)
Success rate (No & %)		30 (85.71%)	35 (100%)	0.020
Complications (No & %)	**Parathesia**	12 (34.28%)	0 (0%)	<0.001
	Vascular puncture	4 (11.43%)	0 (0%)	<0.001
	No complications	19 (54.29%)	35(100%)	<0.001

NO=number. NS= no significant.

Table (4): Comparison between studied groups as regardPatientsatisfaction.

Patient satisfaction / Groups	Group I (No=35) (Nerve stimulator)	Group II (No=35) (Ultrasound)	P value
Not satisfied (No& %)	5 (14.23%)	0(0%)	<0.001
Fair (No& %)	7 (20%)	0(0%)	
Good (No& %)	9 (25%)	5 (14.23%)	
Excellent(No& %)	14 (40%)	30 (85.71%)	

NO= number.

4. Discussion

The use of ultrasound to perform peripheral nerve blocks isa relatively new technique that is rapidly gaining in popularity over the more traditional techniques of peripheralnerve stimulators and parathesia **(Hite and Cartney, 2007).**

Below knee surgeries are mostly performed under regional nerve blockade, which does not interfere much with normal physiology. Popliteal block is a rapid, effective and safe anesthesia for below knee surgery or for pain relief after surgery. The location of the sciatic nerve varies among individual seven with landmarks that can be easily identified **(Fernandez *et al.*, 2001).**

In this study the sciatic nerve is blockedin the area justabove the popliteal fossa. The classic posterior approach is anatomically reliable and provides good results. The main disadvantage of the posterior approach to the block of the sciatic nerve in the popliteal fossa is the need to place the patient in the prone position. This may preclude use of posterior block patients who could benefit most from this technique i.e. those with trauma, morbidobesity, spine problems, pregnant and hemodynamic instability **(Domingo *et al.*, 2004).**

Sciatic nerve in the popliteal fossa can also be reliably accessed in supine position using lateral approach that is performed with the patient in supine position is as effective and safe, as the classical posterior block**(Suarez *et al.*, 2005).**

The combination of sciatic nerve and femoral blocks is analternative to general or neuro-axial blocks

for patients undergoing surgery of the lower extremities **(Macalus *et al*., 2009).**

Borghi and Wulf (2010) demonstrated that feomoral and sciatic nerve block (FSNB)with US guidance increased the success rate resulting in improved block quality compared with a NS alone**.** Besides the anatomical variants, US is useful in patients with difficult landmarks, for example the obese patient, pregnant patient and scarring from previous surgery.

The study was designed to compare between the US guided versus NS guided FSNB. Main finding of the present study showed significant difference between both groups as regard Performance time, Number of needle puncture, complete sensory block time, complete motor block time (less in ultrasound group < nerve stimulator group), and Duration of surgical analgesia (more in ultrasound group > nerve stimulator group).

In their work, **Dufour *et al*. (2008)** reported that block procedure time did not differ significantly between US versus NS with a double injection technique.

In their work, **Nicholas C et al. (2014)** Compared the effectiveness of US guidance versus NS for lateral popliteal-sciatic nerveblocks, The mean times to perform block procedures were9.6 minutes with NS and 3.4 minutes with US, number of needle redirections required for each group was 20 for NS versus 4 for US guidance, complete sensory block time for tibial nerve (NS 21.3 ±6.8 &US20.0±8.8) and for peroneal nerve (NS12.9 ±5.4 &US13.8 ±7.4), complete motor block time for tibial nerve (NS28.3 ± 7.2&US27.9 ± 9.4) and for peroneal nerve (NS20.4 ± 8.9 &US 25.4 ±10.1), Block duration time for NS group was 659min and for US group was 667minand had found that no significance between the two groups as regard duration of surgical anesthesia.

In addition, **Kim Young *et al*.(2015)**Study twenty-three patients who underwent metal fixation under US-guided lower extremity blockade FSNB blockades were performed The mean procedure time for the nerve block was 15.3 minutes, complete sensory and motor block time was 113.5minutes, block duration was 667min. Nerve block satisfaction was excellent in 74%, good in 21.7%, and unsatisfactory in 4.3%and had found that no significant difference between the two groups as regard duration of surgical anesthesia.

In their work, **Cataldo *et al.* (2012)** perform sciatic nerve block lateral approach showed that block performance time (NS 7.69 ± 2.54min. & US 6.33 ± 2.42min.), number of needle punctures were less in NS group (1.6 ± 0.73) than in US group(2.2 ± 0.9) and showed that no difference as regard successful rate.

While **Michael *et al.* (2010)** compared sciatic nerve block before and after bifurcation, they reported that US-aided blocks performance time of sciatic nerve before bifurcation was 2.9 ± 1.7 minutes, Block success rate before bifurcation was 97% & after bifurcation was 100%.

In addition, **Francesca *et al.* (2010)** determine the feasibility of US –guided femoral nerve blocks (3 in 1) in elderly patients with hip fractures. The median time to perform the procedure was 8 minutes and it was 100% successful**.**

In their work, **Buys *et al*. (2010)** reported that the block performance time of ultrasound guided sciatic nerve block with the lateral approach in the supine position was 2.9 ± 1.7min (mean ± SD)**.**

In addition, **Prasad *et al*. (2010)** reported that the block performance time of ultrasound guided SNB with the lateral approach in the prone position was 9 ± 3min (mean ± SD)**.**

In their work, **Eric *et al*. (2008)** had found that there were no significance as regard number of needle puncture between NS (1 ± 0) & US (1 ± 0.2) groups, Time before first analgesic demand for NS was (17.1 ±3.7) hr. and for US was (16.6 ± 2.9) hr. **BUT** successful block in NS was 16 % and for US was 65%. And showed parathesia in 4% in US group and 8% in NS group**.**

While **Vicente *et al.* (2007)** compare US Guidance for Lateral midfemoral Sciatic Nerve Block with NS showed that there was no significance between both groups as regard complete sensory and motor block time or duration of surgical anesthesia. BUT they demonstrated the tolerance to pneumatic tourniquet:

1) Good tolerance NS (48.4%) & US (93.3%).
2) Sedation necessary NS (45.2%) & US (6.7%).
3) No tolerance NS (6.5%) & US (0%).

And the demonstrated the quality of the block as:

1) Complete sensory block, NS (71%) & US (96.7%).
2) Partial sensory block NS (22.6%) & US (0%).
3) Normal sensory perception NS (6.5%) & US (3.3%).

In short, the results of the present study proved that US guided FSNB is preferred than NS guided FSNB to decrease performance time, number of needle puncture, complete sensory and motor block time and complications. And increase duration of surgical anesthesia time, success rate and patient satisfaction.

References:

1. Andres M, Robyn S, Maria R, Relin Y and Ralf E (2012): A 3-Dimensional Ultrasound Study of

Local Anesthetic Spread During Lateral Popliteal Nerve Block. Reg. Anesth. Pain Med;37: 627-32.
2. Bonnie D, Christopher R, Daquan X, lakshmanasamy S and Admir H. (2009): A comprehensive review of lower extremity peripheral nerve blocks. The journal of NYSORA; 12: 11-22.
3. Borghi B and Wulf H. (2010): Advantages of unilateral spinal anesthesia. Anasthesiol Intensive med Not fallmed Schmerzther; 45: 182–87.
4. Buys M, Arndt C, Vagh F, Hoard A and Gerstein N (2010): Ultrasound-guided sciatic nerve block in the popliteal fossa using a lateral approach. Anesth Analg; 110:635-37.
5. Cataldo R, Massimiliano C, Fabio C and Matteo M (2012): Starting with ultrasonography decreases popliteal block performance time in inexperienced hands: BMC Anesthesiology; 12:33-36.
6. Domingo V, Cabezudo M and Uela L (2004): Sciatic nerve block with 1% mepivacaine for foot surgery: posterior versus lateral approach to the popliteal fossa. Rev Esp Anestesiol Reanim; 51: 70-74.
7. Dufour E, Quennesson P and Van R (2008): Combined ultrasound and neurostimulation guidance for popliteal sciatic nerve block: a prospective, randomized comparison with neurostimulation alone, ANESTH. ANALG; 106: 1553-8.
8. Eric D, Patrick Q, Anne L, Van R and Franc L (2008): Combined Ultrasound and Neurostimulation Guidance for Popliteal Sciatic Nerve Block: A Prospective, Randomized Comparison with Neurostimulation Alone. ANESTHESIA & ANALGESIA; 106:1553-58.
9. Fernandez J, Andueza A and Burgos E (2001): A comparison of 9.5% ropivacaine and 1% mepivacaine for sciatic nerve block in the popliteal fossa. Acta Anaesthesiol Scand; 45: 967-70.
10. Francesca L, Beaudoin, Arun N, Roland C. Merchant and Bruce M (2010): Ultrasound-guided femoral nerve blocks in elderly patients with hip fractures American Journal of Emergency Medicine; 28: 76–81.
11. Francesca L, Beaudoin, Arun N, Roland C. Merchant, Bruce M. (2010): Ultrasound-guided femoral nerve blocks in elderly patients with hip fractures American Journal of Emergency Medicine; 28: 76–81.
12. Hite B and McCartney C (2007): Pro/Con: Teaching residents with ultrasound hinders postgraduate practice of regional anesthesia. ASRA News; 2007:6-8.
13. Kim Y, Chan K, Yong-Bum J and Kyu-Ung Y (2015): Ultrasound-Guided Nerve Blockade for Patellar Fracture. Knee Surg Relat Res;27(2):108-16.
14. Macalus V, Hogan MD and Richard E (2009): Anesthesia for total hip and knee arthroplasty: a review of lumber plexus, femoral, and sciatic nerve blocks. Am J Orthop; 38(8): 129–33.
15. Michael J, Christopher D. Arndt, Firoz V and Anna H, (2010): Ultrasound-Guided Sciatic Nerve Block in the Popliteal Fossa Using a Lateral Approach: Onset Time Comparing Separate Tibial and Common Peroneal Nerve Injections Versus Injecting Proximal to the Bifurcation. International Anesthesia Research Society; 110:335-37.
16. Nicholas C, Lam MD, Timothy R. Petersen and Neal S (2014): Ultrasound versus stimulation for Sciatic Nerve Blocks in Obese Patients. J Ultrasound Med; 33:1057– 63.
17. Prasad A, Perlas A, Ramlogan R, Brull R and Chan V. (2010): Ultrasound-guided popliteal block distal to sciatic nerve bifurcation shortens onset time. RegAnesth Pain Med; 35:267-71.
18. Suarez P, Lopez S and Sarmiento A (2005): Popliteal fossa sciatic nerve block for ambulatory hallux valgus surgery: comparison of lateral and posterior approaches. Rev Esp Anestesiol Reanim; 52: 4-8.
19. Suresh K& Tim P (2013): Ultrasound guided femoral nerve block. (ATOTW) Anaesthesia Tutorial Of The Week;284:1-10.
20. Vicente D, Salvador S, Francisco M and Dolores S (2007): Ultrasound Guidance for Lateral Midfemoral Sciatic Nerve Block: A Prospective, Comparative, Randomized Study. AnesthAnalg; 104:1270–7.

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