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Research Article

Sciatic nerve block made easy for resident trainers

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KEYWORDS

Sciatic nerve block;
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Abstract *Background:* The infragluteal parabiceps approach to sciatic nerve might be easier to be learnt by trainees with reasonable success rate and performance time and less incidence of complications.

Methods: After ethical approval, infragluteal and Labat approaches for sciatic nerve block ($n = 50$ for each) were performed by five trainees at 3rd grade of anesthesia training program. We recorded the changes in the times to performance of the block, and onset of sensory block, the patients' satisfaction and difficulty of the technique for the trainees.

Results: Performance time was 3–3.5 min with Labat approach and 2–2.75 min with infra-gluteal approach ($P < 0.001$). Sciatic nerve stimulation was observed at a depth of 70 ± 8 mm after (2–10) needle redirection in group Labat, and at a depth of 58 ± 13 mm after (2–7) needle redirection in infragluteal group ($P < 0.001$). Failed nerve block was reported in 5 cases in group Labat and 2 cases in infra-gluteal group ($P = 0.13$). Thirty cases in Labat group would refuse the same anesthetic if required in the future for another surgery, while only twenty five cases in infragluteal group would refuse the same technique in the future ($P = 0.13$). Three resident trainer described the infragluteal approach as a simple approach and easy to perform by a beginner, whereas only two trainers accepted the Labat approach ($P = 0.52$).

Conclusion: Infragluteal approach for the sciatic nerve block was considered rapidly and easy to use and the preferred approach regardless of previous experience compared with Labat approach.

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1. Introduction

The sciatic nerve is the thickest nerve in the human body, with a long course in the inferior extremity. Its division into the tibial and common peroneal nerves can occur at any level from sacral plexus to inferior part of the popliteal space [1].

For lower limb procedures; regional anesthesia occupies the first priority and improves the quality of postoperative pain relief [2,3]. Many regional anesthesia techniques were described for the lower limb. Among them; the sciatic nerve block is a

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well established procedure, and it can be used alone or in association with other nerve blocks [3].

A peripheral nerve blocking technique must have some qualifications to be widely accepted in clinical anesthesia practice. It should be technically simple, produce minimal patient discomfort, and provide rapid onset of surgical anesthesia [4,5].

The clinical use of the sciatic nerve block was limited by the trainees at the authors' university center due to technical difficulties in performing the block using standard approaches, substantial patient discomfort during the procedure.

The authors have implemented the infragluteal approach for sciatic nerve block to the training program for anesthesia trainees at their center in an effort to improve their experience in the use of the sciatic nerve block.

We hypothesized that the use of infragluteal approach for sciatic nerve block would be rapidly performed and easy to use among anesthesia trainees.

We compared the use of infragluteal and Labat approaches for sciatic nerve block for lower limb orthopedic surgery among anesthesia trainees on the times to performance of block and achievement of surgical sensory block, ease of block and patients' satisfactions.

2. Patient and method

After obtaining approval of the ethical and scientific committee of the emergency hospital (Mansoura University); written informed consent was obtained from 100 ASA physical status I and II patients (>18 year) undergoing orthopedic foot procedures.

Patients with contraindications to regional anesthesia (e.g. coagulopathy, motor or sensory deficits, infection at site of block), decompensated respiratory, cardiac, renal or hepatic disease, diabetes, peripheral neuropathy, and patients receiving chronic analgesic therapy within the proceeding 24 h to surgery, were excluded.

The authors selected five resident trainers who spent about 3 years residency and have experience in nerve block other than sciatic nerve. Each one of them was informed that he or she will perform 20 sciatic nerve blocks, ten of them will done by the classic posterior approach (Labat approach), and the other ten by infra-gluteal Para biceps approach under supervision of the authors.

Standard monitoring including electrocardiography, non-invasive arterial blood pressure(BP), heart rate(HR) and pulse oximetry (SPO2) were applied. An IV line was placed and base line BP, HR and SPO2 were recorded. All patients were premedicated with midazolam 2–5 mg i.v before performing the blocks. Following, 5 mL kg^{-1} h^{-1} of lactated ringer's solution was infused. Nerve blocks were done using a nerve locator (Innervator232, Fisher&Paykel Healthcare, New Zealand). The stimulation frequency was set at 2 Hz and duration of pulse stimulation at 0.1 ms. The intensity of the stimulating current, initially set to deliver 1.5 mA, was gradually decreased to ⩽0.5 mA while maintaining the appropriate motor responses.

In Labat group, the patient is placed in the lateral (sim's position) with the side to be blocked uppermost and rotated forwards. The upper thigh and knee are flexed 90° and the dependant lower extremity is extended. A line was drawn from the posterior superior iliac spine to the midpoint of the greater trochanter. A perpendicular line was drawn bisecting this line and intersecting a second line drawn from the greater trochanter to the sacral hiatus. The intersection of these two lines indicated the point of needle entry (Figure 1).

The stimulating needle was inserted with a 90° angle to the skin and advanced until stimulation was obtained of either the tibialis nerve (plantar flexion of the foot) or the common peroneal nerve (dorsiflexion and eversion of the foot). The position of the needle was adjusted to maintain an adequate muscular response with a stimulating current ⩽0.5 mA; then 30 mL of 0.5% bupivacaine was injected slowly with careful aspiration every 5 mls of the injected volume [6]. The block was done in a mean of 3 min.

Patients receiving infra-gluteal parabiceps block were placed in prone position or lateral position with the limb to be blocked up and the knee flexed 90° if the patient can't lie prone, the site of needle insertion is the point of bifurcation of lateral border of biceps femoris muscle and gluteal crease. The lateral border is identified by asking the patient to flex the knee against resistance applied to the calf muscle. Needle is inserted along this border 0–1 cm caudal to the gluteal crease (See Figure 2).

After local skin infiltration, a 10-cm, 22-gauge insulated Tuohy needle connected to a nerve locator was introduced with the tip oriented cephalad at an angle with the skin of about 80°. To seek the sciatic nerve, the needle is moved only in one plane from the lateral to medial direction. The femur lies lateral to the nerve and biceps femoris is medial to the nerve. If the needle contacts the femur, it is withdrawn to the superficial tissue plane, the skin is retracted medially in 2–3 mm increments, and the needle reintroduced. If biceps contraction occurred, the needle is withdrawn to superficial tissue plane the skin is retracted laterally in 2–3 mm increments, and the needle reintroduced. The position of the needle was adjusted to maintain the good motor response with a stimulating current of ⩽0.5 mA. Then, 20 mL of 0.5% bupivacaine was injected slowly in 5-mL increments, ensuring negative aspirations for blood between aliquots [6].

Patients showed discomfort and irritability during the procedure (verbal rating score for pain >4) were given fentanyl 50–100 μg IV. No tourniquet was used in either techniques.

Figure 1 Labat approach.

Figure 2 Infragluteal parabiceps approach.

Primary outcome of the present study was the time from needle insertion into the skin to successful achievement of the appropriate motor response (performance time). Secondary outcomes included the number of needle redirections required before getting the required motor response, the changes in BP, HR and SPO2 values and sensory and motor blocks every 5 min after block performance, readiness to surgery (the time from end of injection to complete loss of pinprick sensation in the distributions of both tibialis and common peroneal nerve with inability to move ankle and toes, total intraoperative fentanyl consumption, adequacy of sciatic nerve block. After the block placement, patients satisfaction with the block and ease of the block by the trainees (1 = not difficult; 2 = moderately difficult; 3 = extremely difficult) and the incidence of complications (Paresthesia, dysesthesia, prolonged anesthesia or un expected motor deficits) during the hospital stay and 1 week and 1 month after surgery by telephone follow up.

All times were recorded by an independent nurse blinded to the study protocol using a stop watch.

The nerve block was considered as adequate; if neither sedation nor analgesics were required during surgery, inadequate, if 50 μg IV boluses of fentanyl were required during surgery and failed if general anesthesia was required during surgery.

An independent observer blinded to the block approach and to the performing anesthesiologist collected the study data.

The statistical analysis of data done by using *excel* program for figures and *SPSS* (SPSS, Inc., Chicago, IL). Program Statistical Package for Social Science version 16.

The description of the data done in form of mean (±) SD for quantitative data. And frequency and proportion for qualitative data.

The analysis of the data was done to test statistical significant difference between groups.

For quantitative date student *t*-test was used to compare between two groups.

Chi square test was used for qualitative data.

N.B: P is significant if $\leqslant 0.05$ at confidence interval 95%.

3. Results

With respect to demographic data; there were no significant differences between the two groups (Table 1).

The time from needle insertion to proper sciatic nerve stimulation (performance time) was 3–3.5 min with Labat approach and 2–2.75 min with infra-gluteal approach ($P < 0.001^{***}$).

Sciatic nerve stimulation was observed at a depth of 70 ± 8 mm after 6 [2–10] needle redirection in group Labat, and at a depth of 58 ± 13 mm after 4 [2–7] needle redirection in group infra-gluteal ($P = < 0.001^{***}$).

The onset time of sensory block in those receiving Labat approach was 5–25 min and in those receiving infra-gluteal approach was 3–25 min ($P = 0.002^{**}$). Whereas the onset time of motor block was 8–75 min and 5–45 min for the Labat and Infra-gluteal approach respectively ($P = < 0.001^{***}$) (Table 2).

Failed nerve block was reported in 5 cases in group Labat (10%) and 2 cases in infragluteal group (4%) ($P = 0.13$). There are 9 cases in Labat group (18%) need fentanyl supplementation to complete surgery, whereas; 4 cases (8%) in infra-gluteal group need this supplementation ($P = 0.13$). The median consumption of fentanyl was 60 μg (0–200) in Labat group and 40 μg (0–100) in infra-gluteal group ($P = 0.03^{*}$).

Thirty cases in Labat group would refuse the same anesthetic if required in the future for another surgery, while only twenty five cases in Infra-gluteal group would refuse the same technique in the future ($P = 0.13$) (Table 3).

Three resident trainer described the infra-gluteal approach as a simple approach and easy to perform by a beginner, whereas only two trainers accepted the Labat approach ($P = 0.52$) (Table 3).

4. Discussion

Nerve blocks for the lower limb not widely used in clinical practice in spite of the potential advantages. The idea taken by many of clinical anesthesiologists that sciatic nerve block is technically difficult with a variable success rate may be the cause of limited use of this technique [7–9].

Most of residency training programs do not give importance for teaching of peripheral nerve blocks, specially, the

Table 1 Demographic data.

Variables	Labat gp $n = 50$	Infrag gp $n = 50$	P value
Age mean ± SD	45.6 ± 17.5	46.9 ± 19.5	
(Range)	19–65	22–75	0.78
BMI mean ± SD	28.1 ± 1.98	28.6 ± 1.87	0.19
(Range)	19.3–33.6	70–85	
Sex	F:22	F:15M:35	# 0.14
	M:28		

P is significant if $\leqslant 0.05$ at confidence interval 95%.

Table 2 Performance time, onset time, depth of sciatic nerve, number of needle redirection, need for fentanyl supplementation.

	Labat gp (n = 50)	Infragl gp (n = 50)	P
Performance time	3.3 ± 0.11 3–3.5 min	2.24 ± 0.23 2–2.75 min	$<0.001^{***}$
Onset time (sensory)	16.6 ± 3.9 5–25 min	14.21 ± 3.88 3–25 min	0.002^{**}
Onset time (motor)	42.2 ± 12.3 8–75 min	28.7 ± 5.9 5–45 min	$<0.001^{***}$
Depth of sciatic nerve	70 ± 8 mm	58 ± 13 mm	$<0.001^{***}$
No. of needle redirection	6 (2–10)	4 (2–7)	$\#\ 0.02^{*}$
Need for fentanyl supplementation	9 cases (18%)	4 cases (8%)	# 0.13

P is significant if $\leqslant 0.05$ at confidence interval 95%.
* significant
*** highly significant

Table 3 Patient satisfaction and trainers opinion.

Variable	Labat gp	Infrag gp	P value
Patient satisfaction			
	30 Cases: refuse the technique	25 Cases: refuse the technique	
	15 Cases: accept the technique	23 Cases: accept the technique	0.13
	5 Cases failed	2 Cases failed	
Trainers opinion			
	3 Trainers: moderate diff	1 Trainers: moderate diff	#
	2 Trainer: not diff	4 Trainers: not diff	0.19

P is significant if $\leqslant 0.05$ at confidence interval 95%.

lower limb blocks and this may be the main cause of very limited experience and unfamiliarity with these techniques [10–12].

Rapid growth of ambulatory surgery over the last decade leads to increased needs for peripheral nerve block techniques by orthopedic surgeons. So, many new techniques for sciatic nerve block have been described in an effort to explore for an easy and simple approach to block this nerve. These techniques can target the nerve at different points from its exit from the pelvis till the popliteal fossa [13–15]. As the sciatic nerve along its course on the anterior surface of piriformis muscle; has two divisions; the tibial nerve (medial) and the peroneal nerve (lateral), many researchers try to define techniques achieving successful complete block of both components of the nerve [16,17].

Emergency hospital in Mansoura University is the biggest center for trauma and emergency medicine in our territory. The orthopedic department contains about 50 beds with high turnover.

So, in this study we try to increase familiarity of resident trainers in our hospital with sciatic nerve block by selecting the technique which is simpler for the trainer and more comfortable for the patient.

This study reported more acceptance for the infragluteal-parabiceps approach by resident trainers over the classic posterior approach for sciatic nerve block (SNB); non-bony landmarks used in this approach, only the long head of biceps femoris and gluteal crease which were identified easily even in obese patient may be the cause.

Sciatic nerve lies over the adductor magnus distal to gluteus maximus and is crossed obliquely by long head of biceps femoris muscle, then; the sciatic nerve lies more lateral and deep to the long head of biceps femoris for 3–4 cm. Then, when the nerve become lateral to long head of biceps; becomes covered only by skin and subcutaneous tissue [2]. This course may explain the less patient discomfort during infragluteal approach as the nerve become shallower at the entry site (58 ± 13 mm as compared with 70 ± 8 mm in group Labat), and this is an advantage which increases the acceptance of the technique especially in obese patients, whereas excess adipose tissue in gluteal region is an obstacle that increases number of attempts for identifying the sciatic nerve with the usual needle through the classic posterior approach. In this context, Fanelli et al, showed that withdrawal and redirection of the needle to locate the two different branches of sciatic nerve have a negative impact on the acceptance of the technique in patient receiving sciatic nerve block [5], this finding of Fanelli et al. coupe with our results; as the infragluteal group has a significant lower number of needle redirection in comparison with Labat group and accordingly, there is more acceptance of the first technique among patients and trainers more than the second technique.

Performance time was longer than reported in previous studies; Benedetto et al. reported a time range (10–180) seconds from needle insertion till proper sciatic nerve stimulation through the classic posterior approach [2]. The longer time in our study may be attributed to lack of experience and unfamiliarity of those resident trainers with techniques of SNB. However, the performance time for the infragluteal approach was significantly lower than that for Labat approach which can be attributed to simplicity of the former in comparison with the later technique.

The type and dose (volume and concentration) of the local anesthetic used is closely related to the success rate of peripheral nerve block and quality of this block. The volume used of the local anesthetic varies according to the used approach [18]. The concept of minimum local anesthetic volume which is the

mean effective volume needed for complete nerve block in 50% of patients; this concept can guide the need for local anesthetic in different injection sites [18] and this can explain the different injection volumes in this study.

Limitations of this study include nonuse of ultrasound guided block as it is not available in the operating rooms. The non-controlled design of the study so, further studies are needed to include larger number of trainee and compare their achievement with senior stuff as a control group. Lastly, the different volume between both techniques which can be explained as before.

In summary, infragluteal approach for sciatic nerve block was considered rapidly and easy to use and the preferred approach regardless of previous experience compared with Labat approach.

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