ULTRASOUND-GUIDED SCIATIC POLITEAL NERVE BLOCK: A COMPARISON OF SEPARATE TIBIAL AND COMMON PERONEAL NERVE INJECTIONS VERSUS INJECTING PROXIMAL TO THE BIFURCATION


Abstract

Objective: Block of the sciatic nerve at the popliteal fossa can be performed using the ultrasound machine; it may be proximally or distally to the bifurcation of the sciatic nerve using lateral, medial, or posterior approaches. It is frequently used for surgeries below the knee specially the foot and ankle operations.

Purpose: This study compares one and two injections of the sciatic nerve in the popliteal fossa with ultrasound-guided block in foot or ankle surgeries.

Methods: Forty patients received ultrasound-guided sciatic nerve block with the nerve stimulator, using the posterior approach. The patients were enrolled into two groups (20 patients each), group 1: received one injection at 2 cm cephalad to the bifurcation of the sciatic nerve, and group 2: received two injections caudate to the sciatic bifurcation; one for tibial nerve and the other for common peroneal nerve. All patients received 20 ml of levobupivacaine 0.5%. The block performance time, block efficacy, success rate, complications and patient’s satisfaction were evaluated.

Results: Block the tibial and common peroneal nerves separately (two injections) distal to the point of bifurcation of the sciatic nerve has a significantly (P<0.05) faster time to complete sensory block of tibial and common peroneal nerves compared to a pre-bifurcation sciatic nerve block (one injection). The complete motor block, block time performance, success rate and patient’s satisfaction were not significantly different between groups (P>0.05).

Conclusion: The block of tibial and common peroneal nerves separately distal to the sciatic nerve bifurcation is superior to single injection block of sciatic nerve above the bifurcation in the popliteal fossa as regard complete sensory block time.

Keywords: sciatic nerve block; popliteal fossa; ultrasound-guided.

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Introduction

Ultrasound guidance for peripheral nerve blocks reduces the number of complications and improves the quality of regional blockade in adults, compared with blind techniques or nerve stimulator guidance. Ultrasound guidance may, theoretically, offer an advantage over conventional technique since it allows direct visualization of nerve structures, needle pathway and local anesthetic spread in real time. Foot surgery is often associated with severe and long standing postoperative pain requiring large amounts of parenteral opioids. The sciatic nerve block at popliteal fossa is frequently used for surgeries below the knee; it may be used alone or in combination with other peripheral nerve blocks for orthopedic procedures involving the lower limb.

Several approaches to block the sciatic nerve have been described. There are some approaches for popliteal sciatic nerve block have been described as posterior, lateral and medial. The classical posterior approach to the sciatic nerve in the popliteal fossa requires placement of the patient in the prone position, which may be contraindicated in pregnant women or impossible in trauma patients. The medial approach did not need elevation of the limb or change the position.

A sciatic nerve block via a lateral approach is an especially useful technique for foot surgery, because it provides prolonged anesthesia rapidly and effectively below the knee especially in patients in whom the supine position is impossible or extremely uncomfortable (pregnancy, trauma). The lower limb must be sufficiently elevated to enable adequate space around the knee joint for transducer application.

The multiple twitch technique is based on searching and identifying the targeted nerve by eliciting each nerve’s motor component with nerve stimulation. It has been associated with a reduction in sensory and motor block onset and a greater efficacy than a single injection technique. Recently, ultrasound guidance has been introduced in order to improve the efficacy of peripheral nerve blocks, to shorten procedural time, to reduce the minimum local anesthetic volume required for a successful block and to lower the incidence of complications and side-effects. Ultrasound guidance may, theoretically, offer an advantage over conventional technique (anatomical landmarks and nerve stimulation) since it allows direct visualization of nerve structures, needle pathway and local anesthetic spread in real time.

Levobupivacaine is the latest local anesthetic introduced into clinical practice. Levobupivacaine is a S(-) -enantiomer of the racemic formulation of bupivacaine. While both the R- and S-enantiomers of bupivacaine show anesthetic activity, preclinical studies suggested that levobupivacaine might be less cardiotoxic than the racemic bupivacaine.

Aim of this study was to compare ultrasound-guided one injection; cephalad 2 cm to the bifurcation, of the popliteal sciatic nerve versus two injections of TN and CPN separately, caudate to the bifurcation as regard the performance time and efficacy of the block.

Patients and Methods

After obtaining approval from the Regional Ethics Committee and written informed consent had been obtained from patients, forty adult patients (ASA I, II or III), undergoing ankle or foot surgery, were enrolled and randomized into two groups (20 patients each). Group 1: the patients received a popliteal sciatic nerve block cephalad to its bifurcation with single injection. Group 2: the patients received a popliteal sciatic nerve block caudate to the bifurcation with separate injection of TN and CPN. All patients received 20 ml of levobupivacaine 0.5%. Exclusive criteria were patients with allergy to local anesthetics, blood coagulopathy, pregnancy and neurologic or neuromuscular disease. All patients received i.v. 2 mg of midazolam and 50 mcg fentanyl pre-block. Before the nerve block, continuous electrocardiogram, SpO2, and non-invasive blood pressure were monitored during the nerve blockade and throughout the operation. We used the posterior approach at the popliteal fossa in the supine position with ultrasound guidance and the use of nerve stimulator. Patients in group 1, the sciatic nerve was traced cephalad to the bifurcation at least 2 cm and a seesaw sign visualized, then levobupivacaine 0.5% was injected around the nerve in 5 ml increments, after negative aspiration test for blood, to a total volume of 20 ml. Patients in
group 2, the sciatic nerve was identified in a similar manner as in group 1, and then traced caudally from the bifurcation where TN and CPN could be clearly identified, then every nerve was injected with 10 ml levobupivacaine 0.5%. Because most of surgeries were performed under proximal tourniquet above the ankle joint and femoral nerve supply the medial aspect of the leg and ankle, a saphenous nerve (terminal branch of femoral nerve) block was performed for all patients. We used below-knee field block approach, with the patient in the supine position by identifying and palpation the tibial tuberosity, then Injection of 10 ml of levobupivacaine 0.5% into the subcutaneous tissue, beginning at the medial aspect of the tibial tuberosity and ending at the medial border of the tibia just below its medial condyle, then after 10 minutes we evaluated its sensory block by pin prick. TN and CPN sensory blocks were evaluated with pin prick test on their distribution and it was rated as (0=normal sensation, 1=reduced sensation, and 2=no sensation). The motor block was evaluated using flexion (for tibial nerve) or extension (for common peroneal nerve) of the first toe, and it was rated as (0=normal force, 1=reduced force, and 2= total immobility). A score of 2/2 was considered a complete sensory-motor block².

The block performance time (time between the initial skin puncture and the withdrawal of the needle), complete sensory and motor blocks (evaluated by an independent blinded observer) were recorded. During surgery, if the patient complained of pain at the site of the surgery or tourniquet, fentanyl and midazolam were administrated until a maximum dose of 100 mcg and 3 mg respectively. If the surgery could not be completed under these conditions, a general anesthesia was then induced and patient excluded from the study. Duration of tourniquet, type and duration of the surgery, and complications including vascular puncture, hematomas, and neurological sequels were recorded. The patients were asked at the end of the procedure to rate their satisfaction with the technique (0=poor, 1=fair, 2=good, 3=excellent).

Statistical Analysis

The findings of the groups were statistically compared using SPSS version 16 (SPSS Inc., Chicago, IL). Data were expressed as mean±SD, number and percentage. Nominal non-parametric data were analyzed using Chi-Square test. Parametric data were compared using unpaired t-test. Ordinal non-parametric data were analyzed using Mann-Whitney U-test. P-values < 0.05 were considered statistically significant.

Results

All patients completed the study without induction of general anesthesia. There was no significant difference between groups as regard patient’s characteristics, duration of surgery, tourniquet application, and type of surgery (table 1).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n=20)</th>
<th>Group 2 (n=20)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>35±14</td>
<td>38.7±14</td>
<td>0.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>65.5±11</td>
<td>68±7</td>
<td>0.7</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>168.5±8</td>
<td>167±7</td>
<td>0.8</td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>13/7</td>
<td>15/5</td>
<td>0.5</td>
</tr>
<tr>
<td>ASA (I/II/III)</td>
<td>10/7/3</td>
<td>9/8/3</td>
<td>0.9</td>
</tr>
<tr>
<td>Duration of surgery (minute)</td>
<td>47±1.5</td>
<td>44±2</td>
<td>0.1</td>
</tr>
<tr>
<td>Tourniquet (none/above the ankle)</td>
<td>(8/12)</td>
<td>(9/11)</td>
<td>0.74</td>
</tr>
<tr>
<td>Duration of Tourniquet (minute)</td>
<td>35±1.7</td>
<td>37±5</td>
<td>0.55</td>
</tr>
<tr>
<td>Type of Surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foot</td>
<td>9(45%)</td>
<td>8(40%)</td>
<td>0.934</td>
</tr>
<tr>
<td>Ankle</td>
<td>5(25%)</td>
<td>5(25%)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>6(30%)</td>
<td>7(35%)</td>
<td></td>
</tr>
</tbody>
</table>

Fentanyl and midazolam IV received intra-operatively, block performance time, and patient’s satisfaction were comparable between the two groups (table 2). The complete sensory block time (sensory score of 2) in the distribution of the TN and CPN was significantly increased (P<0.05) in group 1 compared to group 2.

Blood was aspirated but without hematoma formation in two patients, one from each group; another one patient in each group complained of paresthesia during the block technique.
Table 2
Patients received intra-operative i.v. drug supplement, and patient’s satisfaction. Data are expressed as number (%).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n=20)</th>
<th>Group 2 (n=20)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam</td>
<td>7(35%)</td>
<td>5(25%)</td>
<td>0.42</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>5 (25%)</td>
<td>3 (15%)</td>
<td>0.42</td>
</tr>
<tr>
<td>Block time (minute)</td>
<td>6±2</td>
<td>6±1.5</td>
<td>0.862</td>
</tr>
<tr>
<td>Patient’s satisfaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>2(10%)</td>
<td>2 (10%)</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>2 (10%)</td>
<td>3(15%)</td>
<td>0.86</td>
</tr>
<tr>
<td>Good</td>
<td>7(39%)</td>
<td>5(28%)</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>9(50%)</td>
<td>10 (55%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3
Complete sensory and motor blocks of TN and CPN. Data are expressed as mean±SD

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n=20)</th>
<th>Group 2 (n=20)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete sensory block of TN (minute)</td>
<td>26.3±1.75</td>
<td>22±1.4*</td>
<td>0.02</td>
</tr>
<tr>
<td>Complete sensory block of CPN (minute)</td>
<td>18.5±1.7</td>
<td>12.2±0.95*</td>
<td>0.002</td>
</tr>
<tr>
<td>Complete motor block of TN (minute)</td>
<td>27.2±1.7</td>
<td>25.8±1.3</td>
<td>0.25</td>
</tr>
<tr>
<td>Complete motor block of CPN (minute)</td>
<td>17±2.4</td>
<td>14.5±1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

TN=tibial nerve, CPN=common peroneal nerve.

Discussion

The multiple twitch technique is based on searching and identifying the targeted nerve by eliciting each nerve’s motor component with nerve stimulation6,20. It has been associated with a reduction in sensory and motor block onset and a greater efficacy than a single injection technique21. Recently, ultrasound guidance has been introduced in order to improve the efficacy of peripheral nerve blocks, to shorten procedural time, to reduce the minimum local anesthetic volume required for a successful block and to lower the incidence of complications and side-effects22,23. Various factors markedly affect the onset time of peripheral nerve blocks, these include the concentration and volume of the injected anesthetic solution, the use of additives, direction of the approach, and the intensity of the current at which peripheral nerve stimulation is achieved22,23. Because all these factors were kept constant in the two groups, the site and number of injections may explain the efficacy difference between the two groups.

We found that using ultrasound guidance with nerve stimulator to block the TN and CPN separately (two injections) distal to the point of bifurcation of the sciatic nerve in the popliteal fossa has a faster time to complete sensory block of TN and CPN compared to a pre-bifurcation sciatic nerve block (single injection). The complete motor block, block time performance, success rate and patient’s satisfaction were comparable. Danelli et al24 found that ultrasound guidance resulted in shorter procedure times and less needle punctures and redirections and less procedure related pain.

Dufour et al25 reported that combined ultrasound and neuro-stimulation guidance does not reduce block time of posterior popliteal sciatic block versus neurostimulation alone. Perlas et al26 demonstrated that block procedure time was similar between ultrasound and nerve stimulator-guided blocks when using a single injection technique. On the other hand.

The success rate of our procedure was high (100%) for both groups. Buys et al12 made a block success rate 97% for sciatic group and 100% for tibial-peroneal group, while the success rate of Arcioni et al27 study was 94% in the sciatic and tibial-peroneal groups.

Also, Arcioni et al27 showed that, when using a lateral popliteal sciatic nerve block, a single injection targeting the tibial nerve is more effective than a single injection targeting the peroneal nerve and is also as effective as a double injection of both branches of the sciatic nerve.

Our findings regarding onset time are similar to those of earlier studies6,14,28 Buys et al12 and Prasad et al28 reported that separate injections of the TN and CPN in the popliteal fossa under ultrasound guidance resulted in faster onset of block than a ultrasound-guided block before the separation of the sciatic nerve. Germain et al29 founded that there were higher rates of complete sensory block and surgical anesthesia in the group injected caudal to the sciatic nerve’s division.

On the other hand, Paqueron et al21 found that nerve stimulation of the two branches of the sciatic
nerve at the popliteal level with a posterior approach, at 10 cm from the popliteal skin crease, did not result in a reduced complete onset time or improved success rate when compared with that obtained with single stimulation. March et al found that only the superficial peroneal nerve was blocked earlier in group of double injections than in group of single injection.

Also, the higher rates of complete sensory block in separately block of TN and CPN in our study in accordance with 3 recent studies demonstrating enhanced effectiveness of the double injection technique for TN and CPN.

In our study there were no significant differences

as regard fentanyl and midazolam received intraoperatively in all patients, also adverse effects were minimal and comparable which was in agreement of other studies.

Conclusion

Double injections of TN and CPN distal to bifurcation of the sciatic nerve gives faster sensory block onset time compared to single injection of the sciatic nerve proximal to the bifurcation in the popliteal fossa.
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15. **OREBAUGH SL, WILLIAMS BA, KENTOR ML:** Ultrasound guidance with nerve stimulation reduces the time necessary for with nerve stimulation reduces the time necessary for resident peripheral nerve blockade. *Regional Pain Medicine*; 32: 448-54, 2007.


27. **arcioni r, PalmaSani S, ET AL:** Lateral popliteal sciatic nerve block: a single injection targeting the tibial branch of the sciatic nerve is as effective as a double-injection technique. *Acta Anaesthesiol Scand*; 51:1121-121, 2007.


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- 97% of BRIDION patients recovered to a TOF* ratio of 0.9 from 1 to 2 PTCs \textsuperscript{1} within 5 minutes\textsuperscript{3}

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\* Train-of-four
\textsuperscript{1} Post-tetanic counts
\textsuperscript{2} Second twitch

**REFERENCES**
1. BRIDION Summary of Product Characteristics (SPC).

Please see summary of product characteristics for full prescribing information.

MSD
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References: