The Efficacy of Two Different Approaches Combined Sciatic and Femoral Nerve Blocks on Thigh Tourniquet Pain Tolerance during Arthroscopic Knee Surgeries

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Abstract

Background: Tourniquet pain is a consequence of lower limb surgery that is not much talked about. It’s a pain that occurs in the upper thigh because of the tourniquet the surgeon uses to both restrict blood loss and make the surgical field bloodless so he can carry out the procedure with greater accuracy and speed.

Objective: The aim of the present, prospective, randomized, blinded study was to compare thigh tourniquet tolerance when a proximal (posterior subgluteal) or anterior sciatic nerve approach was performed in patients scheduled for elective arthroscopic knee surgery.

Methods: In this prospective, randomized, blinded study we assessed thigh tourniquet tolerance when posterior subgluteal approach versus anterior approach of the sciatic nerve was used for arthroscopic-knee surgery.

One-hundred-twenty patients in Cairo University Hospital (Orthopedic Department) for 2 years (2013-2015) were divided into two groups of (60). A posterior subgluteal (Group 1) or Anterior (Group 2) sciatic nerve block was performed with 25mL Bupivacaine 0.25%. In both groups, a femoral nerve block was achieved. Patient comfort during block performance, sensory block was assessed, then the success rate, and thigh tourniquet tolerance were recorded by another anesthetist who was not involved in the induction of the block to avoid bias. Performance of the block was significantly more comfortable in Group 1 than in Group 2 (p<0.01). Completeness of the block at t 30min. and success rate were comparable in both groups.

Result: Thigh tourniquet pain increased with time in both groups. No statistically significant difference was observed between groups. We conclude that despite a complete sensory blockade of the posterior femoral cutaneous nerve in 91% of the patients, posterior subgluteal approach of the sciatic nerve provides no better thigh tourniquet tolerance than the anterior approach. The posterior approach is as efficient as anterior but more comfortable for the patient and is the preferred technique for knee surgery.

Conclusion: This randomized, prospective, blinded study demonstrates that the anterior approach of the sciatic nerve provides no better tolerance of a thigh tourniquet than the subgluteal approach. As it is as efficient but less comfortable for the patient, posterior subgluteal sciatic nerve block would be the preferred technique for arthroscopic knee surgeries.

Key Words: Thigh torniquet pain – Femoral nerve blocks – Arthroscopic knee surgeries.

Introduction

COMBINED femoral-sciatic nerve block is well for below-knee surgery [1,2]. A pneumatic tourniquet is often used to provide a bloodless operating field during such surgery [3,4].

When the tourniquet is located below the knee, it could interfere with the operative field and potentially lead to common peroneal nerve trauma [5,6]. That is why a tourniquet at the proximal thigh is usually used. In this circumstance, many authors advocate performing a proximal sciatic nerve approach because it provides anesthesia of the Posterior Femoral Cutaneous Nerve (PFCN) [7] at the same time as the sciatic nerve [6,7]. However, this is not supported by data.

Patients and Methods

After informed consent and with Institutional Review Board (IRB) of Ethical Committee in the hospital approval, 120 ASA physical status I-II patients scheduled for elective arthroscopic knee surgery under combined femoral/sciatic nerve blockade were included in this prospective, randomized study. Exclusion criteria included the presence of coagulation disorders, infection at the site of block placement, preoperative sciatic or femoral neuropathy, diabetic patients, and inability to comprehend a visual analog pain (VAS) scale.
No premedication was given. In all patients, an IV line and standard ASA monitors were placed.

A femoral (F) nerve block was performed following Winnie et al.’s approach [8]. A 50-mm short beveled, was introduced 1 cm lateral to the F arterial pulse and 2 cm below the inguinal ligament guided by ultrasound. After negative aspiration test for blood, 25 mL of 0.25% bupivacaine was injected.

Patients were then randomly divided into two groups of 60 by a random number generator.

In Group 1, a posterior subgluteal sciatic nerve block was performed; patients in this group were placed laterally with the side to be anesthetized uppermost and the hip and the knee on the operated side flexed at approximately 45 degrees. The ultrasound transducer was positioned perpendicular to the skin on the line connecting the ischial tuberosity and greater trochanter and a clear transverse image of the hyper echoic sciatic nerve between the ischial tuberosity and greater trochanter was obtained. After skin sterilization with iodine containing solution and skin infiltration with 2% lidocaine, the block was conducted with an 18-G tuohy needle inserted in line with the ultrasound transducer from lateral to medial. While the sciatic nerve was kept in the middle of the ultrasound screen, the needle advanced slowly under real-time ultrasound guidance until it was in close proximity to the nerve. A local anesthetic solution of 15 mL of 0.25% plain Bupivacaine and 10 mL of 1% Lidocaine then was injected incrementally. The needle-tip was repositioned so that a circumferential spread of the solution could be produced.

In Group 2, anterior approach sciatic nerve block, patients in the anterior approach group was placed in supine position with the hip and knee on the operated side flexed and the leg externally rotated at approximately 45 degrees. The ultrasound transducer was first positioned perpendicular to...
the skin approximately 8 cm distal to the inguinal crease. The location then scanned by sliding and tilting the transducer until a clear transverse image of the hyper echoic sciatic nerve located posterior and medial to the lesser trochanter was obtained. After skin sterilization with an iodine-containing solution and skin infiltration with 2% lidocaine, tuohy needle 18-G was inserted parallel and in line with the ultrasound transducer covered with a sterile plastic cover and gel from antero-medial to postero-lateral of the thigh while the sciatic nerve was kept in the middle of the ultrasound screen. The needle was advanced slowly under real-time ultrasound guidance until it was in close proximity to the nerve. A local anesthetic solution of 15 mL of 0.25% plain Bupivacaine and 10 mL of 1% Lidocaine was injected incrementally. The needle-tip was repositioned so that a circumferential spread of the solution could be produced.

In all patients, a 14-cm wide pneumatic tourniquet was placed at the root of the thigh. After limb exsanguinations by gravity, it was inflated to 300 mm Hg.

Tourniquet tolerance (0=no pain, 1=minimal pain, 2=moderate pain, 3=severe pain) was assessed at inflation and thereafter every 10 min until the end of surgery by a resident not involved in block performance. When a score was moderate pain=2, patients received 50 mcg fentanyl IV. If insufficient, general anesthesia was performed. Surgical success rate was defined as total (no complementary anesthesia), partial (supplemental local anesthesia or intraoperative sedation with IV opioids), or failure (general anesthesia).

Satisfaction score: Patient underwent knee arthroscopic surgery, the same tourniquet inflation pressure was used, the duration of surgery was not more than 60 minutes, satisfaction score at the end of the surgery (VAS: 0 = never again, to 100 = totally satisfied) were also recorded.
Based on a previous study [10], we hypothesized that we would observe at least a 50% reduction in thigh tourniquet tolerance between groups.

Statistical analysis:

A power analysis (percentage of patients with a good tourniquet tolerance at 40 min of 80% in Group 2 and 40% in Group 1) estimated that 45 patients would be needed in each group to provide a 95% chance of detecting such reduction at the 0.05 level of significance. To improve the clinical significance of our results, we decided to include 60 patients per group. Statistical analysis was performed using SAS® software (SAS Institute Inc, Cary, NC.). Results were expressed as mean ± SD. Parametric data (age, weight, height, comfort during block performance, and satisfaction score) were compared using student’s t-test. Discrete variables (sex ratio, sensory block, success rate, and side effects) were compared using χ² test of the Chi-squared distribution or Fisher’s exact test when appropriate. To compare tourniquet tolerance, a survival analysis was performed using the Kaplan-Meier method. Log-rank and Wilcoxon’s tests were used to compare Groups 1 and Group 2. A p-value <0.05 was considered significant.

Results

One-hundred-twenty patients were finally included. Patient demographics, time to perform the block, and result were comparable in both groups.

<table>
<thead>
<tr>
<th>Table (1): Demographic data.</th>
<th>Group 1 (n=60)</th>
<th>Group 2 (n=60)</th>
</tr>
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<tbody>
<tr>
<td>Age (yr.)</td>
<td>46±15</td>
<td>44±19</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62±14</td>
<td>70±12</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167±8</td>
<td>170±9</td>
</tr>
<tr>
<td>Sex (M/F)</td>
<td>20/40</td>
<td>32/28</td>
</tr>
</tbody>
</table>

Block performance was significantly more comfortable in Group 1 than in Group 2 (p<0.01), 26 patients in Group 1 was fully comfortable compared to 15 patients in Group 2.

At t30, completeness of sciatic nerve (59 patients versus 58 patients in Groups 1 and 2, respectively), F nerve, and LCT nerve of the thigh was comparable in both groups. When compared with Group 1, a significant difference in the incidence of PFCN anesthesia was noted at t30 in Group 1 (p<0.01).
Tolerance of thigh tourniquet in each group is assessed and shows no difference between groups. In both groups, tourniquet pain increased with time. Because of a tourniquet pain, 3 patients in each group required IV opioids and 0 versus 2 patients' required general anesthesia in Groups 1 and 2, respectively. In all those patients, sciatic and F nerve blocks were completed at 30min. and the duration of surgery was not more than 60min.

Surgical success rate was comparable in both groups (total 57 patients versus 55 patients and partial 3 patients in both groups, failure 0 patient versus 2 patient in Groups 1 and 2, respectively).

The satisfaction score was comparable in both groups VAS 0 (never again) 0 patient and 2 patient. VAS 100 (totally satisfied) 8 patients and 7 patients, in Groups 1 and 2 respectively.
Discussion

The present study demonstrates that, with an efficient F nerve block, posterior subgluteal sciatic nerve approaches provide comparable thigh tourniquet tolerance. Tourniquet pain increases with time, and it is not affected by the presence of a PFCN block.

The mechanism of tourniquet pain remains controversial and many factors are thought to be implicated.

Different authors have stated that local pain from skin compression plays a predominant role [11-13]. During IV regional anesthesia, EMLA cream significantly prolonged the duration of tourniquet analgesia when compared with a control group [12]. Nevertheless, as stated by Tsai et al., [13], such result is of little clinical significance because the technique is time consuming, expensive, and variably effective. During infraclavicular brachial plexus blockade, anesthesia of the medial cutaneous nerves by a skin infiltration of local anesthetic at the root of the arm improved arm tourniquet tolerance [14]. However, tourniquet pain can complicate a spinal or epidural anesthesia despite adequate sensory anesthesia of the dermatomes underlying the tourniquet [15,16]. As demonstrated in the present study, complete skin anesthesia of the thigh did not improve tourniquet tolerance. The lack of difference between the two groups could be partially attributable to inadequate anesthesia of the obturator nerve, which innervates the medial thigh muscle compartment. This should be assessed by a specific prospective study.

Thus, local pain from skin compression appears to be one component of tourniquet pain but probably not a predominant one. This may explain the lack of effect of complete block of the PFCN we observed. Other factors such as tourniquet size, inflation pressure, and duration [17,18] and type of anesthesia [19], or adjuvant to the local anesthetic solution [20,21] have been implicated.

A wide tourniquet cuff is more efficient at a lower occlusive pressure than a narrow one [22]. It has been recommended to inflate the cuff to a pressure 150mm Hg more than the patient's systolic blood pressure [3].

In the present study, a 14-cm wide tourniquet inflated at a 300mm Hg pressure was used in all patients. Such inflation pressure is our standard institutional practice.

A retrospective review of more than 650 patients who underwent orthopedic surgery demonstrated that the incidence of tourniquet pain and the associated hypertension were correlated with tourniquet time [19]. This is confirmed by our data; less than 15% of patients at 30min but more than 50% of patients at 70min complained of tourniquet pain and required supplemental analgesia.

In the present study, all patients were ASA I and there were no predicted or detected hemodynamic instability related to the purpose of the study, so hemodynamic variables were not specifically recorded. In addition to pain, the clinician must be vigilant for increasing arterial blood pressure as a significant side effect of prolonged tourniquet time [19].

Tourniquet pain is thought to be mediated by unmyelinated, slow-conducting C fibers that are normally inhibited by fast pain impulses conducted by myelinated A delta fibers [4,23]. Mechanical compression causes loss of conduction in nerve fibers with large ones being blocked before small ones. It is suggested that, after approximately 30 minutes of tourniquet inflation, the large A delta fibers will be blocked, leaving still functioning C fibers uninhibited. Clonidine has been reported to depress nerve action potentials in C fibers [24]. Intrathecal clonidine combined with local anesthetic has been shown to decrease the incidence of tourniquet pain in the lower limb [154]. In patients undergoing upper limb IV regional anesthesia, clonidine added to the local anesthetic solution improved tourniquet tolerance [20,21]. This beneficial effect has never been demonstrated during lower limb peripheral nerve blockade. This should be evaluated in a prospective, randomized, blinded study.

During the anterior approach, the needle has to be inserted through muscles. Performed on the midline between muscles, the posterior subgluteal approach avoids muscle trauma and would thus be more comfortable for the patient. This is demonstrated in the present study. Indeed more patients assessed block performance as uncomfortable (VAS 30 of 100) in Group 2 than in Group 1 (8% versus 22% of patients respectively in Groups 1 and 2). This is in accordance with previous results [28]. It must be stressed that in the present study, patients received no sedation. Sedation before block performance routinely used in many institutions could mask early signs of systemic local anesthetic toxicity or of intraneural injection.

The present study indicates that, in most patients, such sedation is not required to perform sciatic nerve block, particularly when the posterior subgluteal approach is used.
Conclusion:
In conclusion, this randomized, prospective, blinded study demonstrates that the anterior approach of the sciatic nerve provides no better tolerance of a thigh tourniquet than the subgluteal approach. As it is as efficient but less comfortable for the patient, posterior subgluteal sciatic nerve block would be the preferred technique for arthroscopic knee surgeries.

References
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الملخص العربي

الفقر الموضعي للعصب الفخذي والوركي يعتبر خيار جيد لتسكين الألم في العمليات الجراحية لأسفل الركبة. وغالباً ما يستخدم ضاغط هوائي لتقليل التزيف خلال هذه الجراحات. إذا تم وضع الضاغط الهوائي أسفل الركبة فإنه يؤدي إلى التداخل مع مكان الجراحة، ولذا جرت العادة على وضع الضاغط على الفخذ. ويرى الكثير من الباحثين افتقار العصب الوركي قرباً من منشأه وذلك لغلق العصب الخلفي الفخذي.

ومع ذلك فإن الهدف من الدراسة العشوائية العمياء هو مقارنة تحميل المرصى للضاغط الهوائي عند غلق العصب الفخذي مع العصب الوركي.

استخدام الطريقة الأمامية مقارنة بالطريقة الخلفية.

تم انتقاء 120 مريض وتقسيمهم إلى مجموعتين كل منهما تتكون من 60 مريض تبعاً إلى طريقة غلق العصب الوركي وهم المجموعة 1، والتي تستخدم الطريقة الخلفية والمجموعة 2 والتي تستخدم الطريقة الأمامية. يتم قياس نسبة نجاح الطريقة ومدى التأثير على الأحساس والحركة ومدى راحة المريض.

والخلاصة من هذه الدراسة أن الطريقة الأمامية لم توفر تحميل أكثر للضاغط الهوائي ولكنها كانت أقل راحة للمرضى ولذا فإن الطريقة الخلفية هي الطريقة المفضلة في عمليات مناظير الركبة.