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Our experience with femoral analgesia after orthopaedic surgical procedures on lower extremities

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Abbreviations:
TKR – Total Knee Replacement
ACL – Anterior Cruciate Ligament
VAS – Visual Analog Scale Score
ASA – American Society of Anaesthesiologists Physical Status Classification System

Key words: femoral analgesia, visual-analog scale, orthopaedic surgical procedures, total knee replacement surgery, anterior cruciata ligament reconstruction

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Abstract

***Background and Purpose**: Orthopaedic surgical procedures require good postoperative pain control since they are considered the most painful procedures. Continuous femoral analgesia via femoral catheter is recognised as a good method in postoperative analgesia. The objective of this study is to analyze the efficiency, technical difficulties and complications of femoral analgesia after orthopaedic surgical procedures on lower extremities.*

***Materials and Methods**: The Ethics Committee of the University hos pital approved this study and 90 patients gave a written consent to participate in this prospective randomized study. 36 out of 90 patients underwent total knee replacement surgery (group TKR), 54 underwent anterior cruciate ligament reconstruction (group ACL). All patients recived analgesia via femoral catheter using continuous 0.25% levobupuvacain. We analyzed the efficiency of analgesia technique by assessing visual-analog scale score, difficulties in identification of femoral nerve and catheter fixation, time necessary to set the catheter, early and later complications and patient satisfaction with analgesia.*

***Results**: There were a statistically significant difference noted in gender, age and ASA score distribution of patients ($P<0.05$). Statistically significant difference in VAS score between groups occurred 8 hours after the operation ($P<0.001$). There were no statistically significant differences between the groups regarding development of early and later complications, number of punctures or accidental punctures neither of veins nor in the time necessary to fixate the catheter. The femoral catheter was sucessfully fixated in all patients.*

***Conclusion:** Femoral analgesia is a good method of postoperative analgesia in patients after orthopaedic procedures in lower extremities.*

INTRODUCTION

There is a trend in orthopaedic surgical procedures to shorten the duration of postoperative hospital stay, increase quality and quantity of treatments *(1)*. In order to perform orthopaedic procedures in every day surgical practice it is necessary to adjust analgesia, decrease the use of analgesics which have a certain number of side effects and in doing so, extend hospital stay *(2)*. On the other hand, inadequate analgesia in early postoperative period leads to hormonal-metabolic stress response as well as to inflammatory response, both having negative effects on other organ systems *(3)*, developing nociceptive central sensation and prolonging the beginning of early rehabilitation and the time of joint function recovery *(4)*. The algorithms of regional anaesthesia in

orthopaedic procedures are being increasingly accepted in our community by recommendation of European societies.

Peripheral regional analgesia is one of various techniques in postoperative analgesia in painful orthopaedic surgical procedures predominantly on lower extremities *(5)*. Peripheral regional analgesia is associated with less complications than central neural analgesia (epidural analgesia) in terms of hypotension, urinary retention, collision with tromboembolic prophylaxis and possible neurologic complications *(6, 7)* and the trend in abandoning such practice in this population of orthopaedic patients is growing. Analgesia must adjust to the area of surgical procedure in terms of peripheral regional analgesia and techniques of wound infiltration *(2)*.

The knee is innerved with nerves from the lumbar plexus *(1)*. Lumbar plexus is formed by the first three and the greater part of the fourth lumbar ventral rami. A contribution of the 12th thorasic nerve is common. In the literature, the exact location of the LP remains controversial. Some authors place the plexus between the psoas and quadratus lumborum muscles. Recent studies on the plexus place the nerve branches within the psoas muscle between its anterior and posterior masses. The lateral femoral cutaneous nerve supplies the skin of the lateral part of the thigh. The femoral nerve provides sensory and motor innervation of the anterior thigh, the anterior part of the knee and hip joints, and the medial aspect of the leg until the first metatarsal (saphenous nerve). The obturator nerve innervates the adductors brevis and longus, the pectinueus and gracilis muscles (anterior branch), and the adductor magnus muscle (posterior branch). It sometimes gives sensory innervation to the medial or posterior aspect of the knee.

Bouaziz *et al. (8)* demonstrated that cutaneous distribution of the obturator nerve is highly variable and frequently absent *(9)*. Ischiadicus nerve (L4-S3) is responsible for innervation of posterior part of the thigh *(10, 11)*.

The primary studied end point was the assessment of postoperative analgesia using the visual analog numerical scale (VAS scoring; 0=no pain, 10=worst pain) at rest and motion in early postoperative period (24 hours) after elective orthopaedic procedures on lower extremities.

Secondary end points included the analysis of technical difficulties in identification of the exact position of femoral nerve (number of punctures and accidental puncture of veins), success rate in fixation of catheter, monitoring complications in femoral analgesia: early complications (cardiovascular complications in terms of hemodynamic instability: drop of blood pressure 20 % of starting values; heart rhythm disorders and neurological complication: tinnitus, peroral tingles, metallic taste, epileptic seisures), breaking of catheter, infections at the puncture site; late complications: damage in femoral nerve 3 months after the procedure (follow up) after the surgical procedure (assessed by electromyography) and patient satisfaction (satisfied or not satisfied).

MATERIALS AND METHODS

The Ethics Committee of the University hospital approved this study and 93 patients gave a written consent to participate in this prospective randomized study. Three patients were excluded from the study because their femoral catheter fell out during early postoperative period (1 hour after the procedure). 36 out of 90 patients underwent total knee replacement surgery (group TKR), 54 underwent anterior cruciate ligament reconstruction (group ACL). The patients were randomized using Medcalc program for Windows, version 11.3.

In order to be excluded from the study, the patients had to meet at least one the following criteria: previous vascular surgery in the region of femoral veins or arteries, confirmed coagulopathy, local infection, hepatic and renal insufficiency, dementia, body mass index (BMI) >30 kg/m^2, allergy to local anaesthetics, morphine and non-steroid anti inflammatory drugs, previously diagnosed neurologic deficit and ASA score>III.

All patients were anaesthetized using spinal anaesthesia with 2.5–3 mL of 0.5% levobupivacain in the region of L3/L4 or L4/L5 segments. All patients received premedication consisting of midazolam per os 0,1mg/kg 45 minutes before their arrival to the operation room. Standard monitoring was used through the procedure (including non-invasive arterial blood pressure, electrocardiography, heart rate and oxygen saturation).

Femoral catheter was set before the spinal anaesthesia with patients in the supine position, with a nerve stimulator (Stimuplex HNS 11,B.Braun,Germany) set to deliver a stimulus at a frequency of 2Hz and duration of 0.1 ms. The intensity of the current, initially set to 1.2 mA, was gradually decreased to 0.3 mA (<0.5 mA) while the stimulation of the femoral nerve was maintained. The puncture site was located 5 cm caudal to inguinal ligament and 2 cm lateral to the femoral artery and then advanced in a lateral and posterior direction just distal to the inguinal ligament. The femoral nerve was identified by contractions of the quadriceps muscle, referred to as »dancing« patella. Femoral nerve catheter was inserted from 5–10 cm beyond the tip of the needle in a cephalad direction (Contiplex Tuohy 18G, B.Braun, Germany). Fixation of the femoral catheter was performed by LockIt Plus ™ (Smiths; Catheter Securement Device). An anaesthesiologist who was trained in the techniques of regional anaesthesia set the femoral catheter.

During the first 24 postoperative hours after the sensory and motor recovery from spinal anaesthesia and when VAS score was higher than 3 all patients were given bolus dose of 10 mL 0.25% levobupuvacain, followed by continuous infusion 0.25% levobupivacain 3–5 mL per hour with nonsteroidal anti-inflammatory drug IV supplement every 12 hours during first 24 postoperative hours. VAS score was assessed every 2 hours within first 24 postoperative hours in motion and at rest. VAS scores were assessed by persons who were not involved in femoral catheter setting techniques. VAS score under 3 was considered satisfactory analgesia.

Data on baseline demographic characteristic (age, sex) and ASA score were collected. Furthermore, duration of surgical procedure and duration of tourniquet application were assessed. We analyzed technical difficulties in identification of femoral nerve – the number of punctures in identification of the femoral nerve, accidental punctures of veins, time necessary for catheter fixation, the success rate of catheter fixation according to groups, cardiovascular and neurological complications, early complications (breaking of catheter, infections at puncture site) and later complications (damage in femoral nerve within the 3 months of the procedure) and patient satisfaction with analgesia.

Mann-Whitney U test and Chi-square test were used to analyse socio-demographic characteristics, duration of operation and patient satisfaction. Chi square test was used to analyse differences between LCA and TKR groups in VAS score groups. ANOVA for repeated measures was used to assess average VAS differences between measured times concerning both groups. P values below 0.05 were considered significant. All statistical procedures were made with Statistica v.9.1.

RESULTS

There were a statistically significant difference noted in distribution of patients according to gender and age ($P<0.05$). In TKR group the average value (mean) in age was 69 years (interquartile range 66–72), whilst in ACL group it was 34 years (interquartile range 30–41). In TKR group 45.7% patients were female, and 54.3% male (Table 1). In ACL group 10% patients were female and 90 % were male. Statistically significant difference exists in distribution of patients according to ASA score ($P<0.05$) (Table 1). Satisfactory VAS score at rest was measured every 2 hours in TKR group in more than 50% of patients. Only six hours after the surgical procedure VAS score higher than 3 was present in 51.4% patients. In TKR group the dynamic VAS score was higher than 3 in 72% of patients (unsatisfactory analgesia) during the 4th hour after the procedure, as well as in 61% six hours after the procedure. At other times measured dynamic VAS score (in motion) was satisfactory for more than 50% patients. In ACL group, VAS score lower than 3 at rest was satisfactory with 55.4–100% patients. Dynamic VAS score was higher than 3 in ACL group only six hours after the procedure in 30.4% patients, and in the other assessments in more than 55% patients it was satisfactory. Statistically significant difference in VAS score (at rest and in motion) between groups occurred only 8 hours after the procedure. ($P<0.001$). There was not any statistically significant difference noted in the number of punctures while fixating femoral catheter (one puncture in 89% of patients in ACL and 80% in TKR; 2 and more punctures in 11% of patients in ACL and 20% in TKR, $P=0.332$). There were not any accidental punctures of blood vessels in groups. We did not register any cardiovascular or neurological complications of continuous femoral analgesia 24 hours after the surgical procedure in groups, neither breaking of the catheter nor infections at puncture site. Subsequent later complications were not detected in either of the groups. There was not any statistically significant difference in groups regarding the time necessary for the fixation of femoral catheter median was10 min (interquartile range 8.5 – 10 min), nor in operation duration (P 0.248). Significant differences were noted in duration of »tourniquet« application (longer use in group TKR; $P=0.013$). There was not any statistically significant difference in patient satisfaction in analgesia according to groups. ($P=0.172$).

DISCUSSION

According to our experience femoral analgesia is a good method of postoperative analgesia after orthopaedic surgical procedures in lower extremities; easy and simple for identification of femoral nerve, without significant complications. There is a significant pain relief noted in over 50% of patients (Figures 1, 2) included in the study with decrease in the consumption of »rescu« analgesics. This technique significantly reduces the use of opiods and enables early rehabilitation *(4)*. Early rehabilitation and mobilization after orthopaedic surgical

TABLE 1

Socio-demographic, operation duration, patient satisfaction: Mann-Whitney U test and Chi-square test.

	Group		P
	ACL (N=54)	TKR (N=35)	
Age (years): median (interquartile range)	34 (30–41)	69 (66–72)	0.05
Body mass index (kg/m2): median (interquartile range)	27.2 (25.0–29.0)	26.0 (24.5–27.3)	0.401
Female gender: N (%)*	5 (90.0%)	16 (45.7%)	0.05
ASA score III**: N (%)*	0 (0.0%)	16 (45.7%)	0.05
Operation duration (min): median (interquartile range)	90.0 (65.0–98.8)	90.0 (80.0–110.0)	0.248
»Tourniquet« duration (min): median (interquartile range)	72.5 (65.0–95.0)	85.0 (80.0–95.0)	0.013
Satisfaction with analgesia: N (%)*	50 (90.0%)	29 (82.9%)	0.172

*Chi-square test with continuity correction for 2×2 table
**ASA score were only assessed as II or III

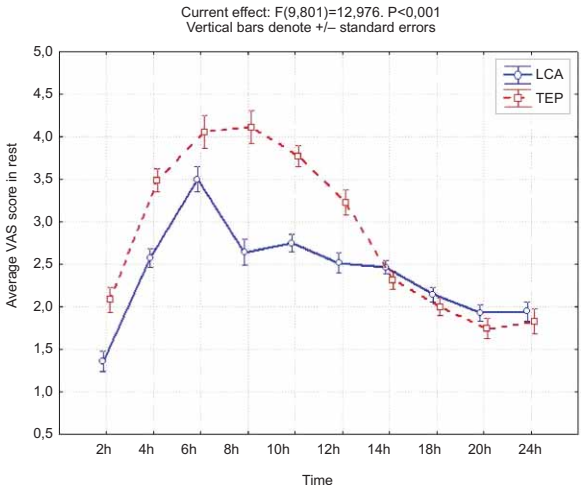

Figure 1. *Average VAS score at rest.*

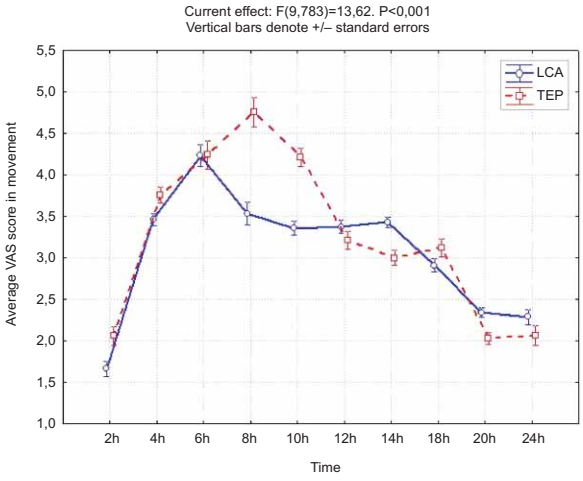

Figure 2. *Average VAS score in motion.*

procedures is important, but limited by strong postoperative pain and muscular spasm. Regional analgesic techniques contribute to better analgesia and quicker postoperative rehabilitation *(8)*.

Severe neurological complications (spinal hematoma, cauda equine syndrome) after central neural blockade are rare but should be considered when choosing safe method of postoperative analgesia *(12)*. Potential limitations *(9)* of the femoral nerve block include toxicity of the local anaesthetic and »block failure«. »Secondary analgesic block failure« after a successful block (migration of catheter or the top of catheter not being in the proximity of the nerve) is possible in the ranges from 10% (10) up to 40% *(11)*. The success of sensory and motor blocks, as well as postoperative analgesia, depends on the position of the catheter under the fascia iliaca *(13)*. We did not observe any catheter migrations within the first 24 postoperative hours in our patients. However, the position of the catheter was not checked by radiological methods. We did not notice any complications in the sense of toxic effect of local anaesthetic or catheter related infections.

This study is subject to several methodological limitations. Firstly, the femoral catheter was inserted using a nerve stimulator, but without ultrasound control *(12, 13)* because our anaesthesiology unit does not have an ultrasound machine. Secondly, the ssessment of pain and sensory analgesia was based on patients' subjective assessment using VAS score. We did not use the »pin prick test« or other objective methods to estimate sensory analgesia. Analgesia was assessed only within the first 24 postoperative hours.

Peripheral regional analgesia is a technique of choice for the postoperative analgesia after painful orthopaedic surgery *(5)* It contributes to a stronger analgesia and quicker postoperative rehabilitation with less side-effects *(15),* less morphine use (»opiods sparing effect«) *(16),* more patient satisfaction and lower cost of treatment. Our study confirmed the Procedure Specific Postoperative Pain Management (PROSPECT) *(14)* protocol for analgesia after TKR surgery and anterior cruciate ligament reconstruction.

Peripheral regional analgesia with femoral catheter is a superior method of analgesia in the system of modern multimodal balanced analgesia after orthopaedic surgical procedures in lower extremities.

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