Single-injection femoral nerve block

Effects on the independence level in functional activities in the early postoperative period in patients with total knee arthroplasty

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ABSTRACT

Objective: To investigate the efficacy of single injection femoral nerve block (FNB) on the independence level in functional activities in the early postoperative period in patients with total knee arthroplasty (TKA).

Methods: We conducted this prospective, randomized, blinded trial in the Department of Orthopedics and Traumatology, Hacettepe University Hospital Ankara, Turkey, between June 2003 and April 2004. Twenty-three patients scheduled for elective TKA were randomly divided into 3 groups. Group I received preemptive single injection FNB, group II received postoperative single injection FNB, and group III served as a control group. Intravenous morphine patient controlled analgesia (PCA) was used following surgery in all groups. Morphine dose and pain score defined by the visual analog scale (VAS) were recorded postoperatively at the 15th minute, 30th minute, 1st, 4th, 6th, 12th, 24th, and 48th hours. A standard rehabilitation protocol was applied for all patients. The independence level in functional activities was assessed during the first 2 postoperative days and at discharge with the Iowa Level of Assistance Scale (ILAS) and the Iowa Ambulation Speed Scale (IASS). Physical therapists that enrolled in the study were blinded to the groups.

Results: Pain scores were significantly different between the groups ($p<0.05$). The preemptive and postoperative FNB group's VAS scores were both significantly lower than the control group ($p<0.05$). However, there was no significant difference in VAS scores between preemptive and postoperative FNB groups ($p>0.05$). There was no statistically significant difference between the groups in any of the functional scores in the first 2 postoperative days, and at discharge ($p>0.05$).

Conclusion: Single injection FNB provided effective analgesia in patients undergoing TKA. However, the independence level in functional activities in the early postoperative period was not influenced by the analgesia method.

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Postoperative pain after total knee arthroplasty (TKA) is a major problem.[1] Intensive pain can be a major factor that affects postoperative knee rehabilitation by impeding early physical therapy.[2] Mahoney et al[3] showed that intensive pain experience and inadequate control of postoperative pain are associated with poor functional recovery. After TKA, postoperative pain relief can be achieved by a variety

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of techniques such as patient-controlled analgesia (PCA), epidural analgesia and peripheral nerve block.[1,4,5] Femoral nerve block (FNB) is a method used as an adjunct to analgesic medication.[6] The effects of continuous infusion of local anesthetics via a femoral catheter on pain control in the early postoperative rehabilitation period were investigated previously by several researchers.[4,6] Single-injection FNB eliminates the need for a catheter or other extra equipment and does not require continuous monitoring; therefore compared to continuous analgesic infusion, single injection FNB is a preferred method.[7] Physical therapy and rehabilitation is an essential part of treatment in patients with TKA. Ensuring the patient's transfer and ambulation activities independently from the early postoperative period is one of the major goal of the rehabilitation, thus, the length of hospital stay can be reduced. Although there are several studies investigating the effects of different anesthesia methods on postoperative pain control and rehabilitation outcomes in the early period, the effects of these methods on the independency level in transfer activities in the early postoperative period in patients with TKA are not well documented in the literature. This study was designed to investigate the efficacy of single - injection FNB on the independence level in functional activities in the early postoperative period in patients with TKA.

Methods. Twenty-three knee osteoarthritis patients who were hospitalized for TKA were enrolled in this prospective, randomized, blinded, controlled study. The study was carried out at the Department of Orthopedics and Traumatology, Hacettepe University Hospital, Ankara, Turkey, between June 2003 and April 2004. The mean age for the whole group was 66.04±6.99 years (range 51-78 years). Patients in the American Society of Anesthesiologists (ASA) physical status class I -III, scheduled for elective knee arthroplasty due to osteoarthritis were included in the study. Subjects with significant medical or psychiatric problems, unable to cooperate with the study protocol, and who had contraindications to regional anesthesia were excluded from the study. After patients gave written informed consent, they were randomly assigned to either the preemptive single injection FNB group (Group I, 7 women, 1 man), postoperative FNB group (Group II, 5 women, 2 men) or control group (Group III, 8 women). The patients underwent posterior cruciate ligament substituting primary TKA with the use of a midline skin incision and medial parapatellar approach with tourniquet. A mobile polyethylene insert was fixed cement in all patients. Hemovac drainage was applied during the first postoperative 24 hours. General anesthesia was induced in all patients. Anesthesia was induced with 2 mg/kg propofol, 1 mg/kg fentanyl, and 0.1 mg/kg vecuronium bromide and maintained with 2% sevoflurane in oxygen/N_2O. In group I, femoral nerve injection (FNI) was performed after application of propofol and fentanyl and before muscle relaxation. The femoral nerve was identified in the inguinal area with a nerve stimulator eliciting quadriceps contraction at ≤0.5 mA. After this, 40 ml 0.25% bupivacaine was injected. In group II; FNI was performed with the same method after the reverse of the effect of muscle relaxants with 0.01 mg/kg atropine and 0.05 neostigmine, and before emergence from general anesthesia. The FNI was not performed in the control group. Intravenous morphine patient-controlled analgesia (PCA) was used following surgery in all groups. When PCA was initiated, a 4 mg loading dose of morphine was given to all patients. The PCA device delivered 1 mg doses of morphine with a 5 minute lockout period between doses. Morphine dose was recorded postoperatively, at the 15th and 30th minutes, 1st, 4th, 6th, 12th, 24th and 48th hours. Pain score defined by Visual Analog Scale (VAS/0-100 mm) was recorded at the postoperative 15th and 30th minutes, 1st, 4th, 6th, 12th, 24th, and 48th hours. All the patients received the same postoperative physical therapy protocol. Transfers in and out of bed, ambulation weight bearing as tolerated with a walker or crutches, and therapeutic exercise was initiated within the first postoperative day (20 to 24 hours after surgery). Therapeutic exercises included; active dorsiflexion and plantar flexion, quadriceps and gluteal setting, knee flexion and extension in sitting, hamstring stretches, proprioceptive neuromuscular facilitation (PNF) techniques, and range of motion (ROM) exercises to the non operated extremity. These exercises were applied by physical therapists, from the first postoperative day until discharge. Patients were taught to climb stairs before their discharge. An immobilizer was used during ambulation until active quadriceps contraction was achieved. In the preoperative and postoperative periods, the following evaluations were used: Knee Society Clinical Rating System: This system (knee and function score) was used as an objective measure of knee status in patients in the preoperative period.[8] Functional Level Test: The independence level during the 4 functionally related activities – transfer from supine to sitting, transfer from sitting to standing, ambulate 15 ft (4,572 m), and climb up and down 3 steps – were assessed with the Iowa University Level of Assistance Scale (IULAS) as follows: Score 0 = independent, 1 = supervision, 2 = minimal assistance, 3 = moderate assistance, 4 = maximal assistance, 5 = failed with maximal assistance, 6 = not tested.[9,10] The first 3 activities were assessed in the postoperative first 2 days and at discharge, climbing up and down 3 steps was assessed only on the day of discharge. Ambulation

Speed Test: Patients were asked to ambulate 13.41 m (44 ft) as quickly as possible on the day of discharge. The result of the test was assessed using the Iowa Ambulation Speed Scale (IASS) as follows: Score 0 = ≤20 seconds (s), 1 = 21-30 s, 2 = 31-40 s, 3 = 41-50 s, 4 = 51-60 s, 5 = 61-70 s, 6 = >70 s.[2] All these postoperative functional assessments were applied by blinded physiotherapists.

Kruskall-Wallis test was used to compare the quantitative parameters of the 3 groups. The Statistical Package for Social Sciences (SPSS) 11.5 for Windows was used for statistical analyses. The level of significance was set at $p<0.05$.

Results. A total of 23 patients with TKA were included in the study. There were 7 female and one male patients in group I, 5 female and 2 male patients in group 2, and 8 female patients in group 3. The demographic characteristics, preoperative pain severity and Knee Society scores were similar among the 3 groups (**Tables 1 & 2**). There were statistically significant differences between the postoperative VAS scores among the 3 groups ($p=0.002$). The preemptive and postoperative FNB group's VAS scores were both significantly less than the control group ($p=0.018$, $p=0.001$) (**Figure 1**). However, there was no significant difference in VAS scores between preemptive and postoperative FNB groups ($p>0.05$). There were statistically significant differences between groups in the postoperatively given dose of morphine (30 seconds and one hour) ($p=0.006$). The control group's morphine dose was more than the other groups. There was no statistically significant difference between groups in terms of total morphine dose and total bolus ($p>0.05$) (**Table 3**). There was no statistically significant difference between groups in any of the functional scores and ambulation of velocity in the postoperative first 2 days and at discharge ($p>0.05$). There was also no statistically significant difference between groups in the length of hospital stay ($p>0.05$).

Discussion. In this prospective, randomized, blinded study, we demonstrated that pain intensity in the postoperative first 2 days was considerably lower in the nerve block groups than the controls. However, this result did not affect the patient's independence level in functional activities. Since there was no significant difference in VAS scores between preemptive and postoperative FNB groups, it can be speculated that preemptive FNB does not provide additional benefit to postoperative pain control.

Clinical research has established that FNB, in conjunction with analgesic medication, provides significant efficacy in controlling postoperative pain beyond that achieved with medication alone.[11-13] However, results from clinical trials on the efficacy of preemptive analgesia are conflicting. Some reports on the use of preoperative infiltration with local anesthetic, compared with placebo or no infiltration, observed prolonged reduction in postoperative pain,[14] other studies only found a short term benefit in reduction of pain or opioid consumption after surgery.[15] Also in some studies, preoperative FNB has been shown to reduce postoperative pain after arthroscopic knee surgery and anterior cruciate ligament repair.[16,17] Rosaeg et al,[18] in a study investigating the effects of preemptive multimodal analgesia on knee ligament repair reported good pain control by multimodal analgesia in conjunction with preemptive femoral block and postoperative analgesia. There was no difference in pain scores between the 2 groups. Allen et al[19] investigated the effects of single-injection FNB on pain intensity after TKA and reported improved analgesia between 24-38 hours postoperatively. In some studies comparing continuous infusion with single injection FNB, it was shown that continuous infusion had no additional beneficial effect on pain control.[6,20] Szczukowski et al[21] reported that preoperative single injection FNB with 1:200.000 epinephrine and 0.5% bupivacaine can be effectively used in postoperative pain therapy in patients with TKA.[21] Our results suggest that when compared with the control, both preemptive and postoperative FNB causes significant reduction in early postoperative pain in patients with TKA. We also showed that the amount of morphine delivered postoperatively was less than the other patients in the postoperative 30th minute and first hour in postoperative FNB patients. Our findings support the results of other studies indicating FNB in TKA patients improves the postoperative pain control. Since there was no difference in pain reduction between preemptive and postoperative FNB groups, it seems that both methods can be used as an alternative to each other. However, although there was no statistically significant difference; in the postoperative FNB group, pain control was slightly better than the preemptive group. Thus, postoperative FNB may be a better choice. Studies on larger patient groups are necessary to clarify this issue.

Only a few previously published studies have investigated the effects of FNB on rehabilitation. Captavila et al[22] reported improved knee flexion with FNB and continuous passive motion therapy.[22] Similarly, Singelyn et al[4] reported that continuous infusion FNB improved knee flexion from the postoperative first day up to 6 weeks.[4] Wang et al reported that single injection FNB provided effective analgesia and facilitated early mobilization in TKA patients.[7] Although, there are few studies on the effects of FNB on rehabilitation outcomes; we could

Table 1 - Demographic characteristics of patients.

Characteristic	Preemptive (n=8)		Postoperative (n=7)		Control (n=8)		X^2	*p*
	X	SD	X	SD	X	SD		
Age (Years)	67.88	6.24	67.14	7.56	63.25	7.21	2.763	>0.05
Height (cm)	155.25	9.71	161.71	10.52	158.75	3.28	2.824	>0.05
Weight (kg)	71.00	16.25	79.00	14.09	75.50	12.00	1.602	>0.05
BMI (kg/m^2)	29.32	5.34	30.14	4.13	30.00	4.96	0.136	>0.05

Table 2 - Comparison of preoperative Knee Society Knee Score (KFKS), Knee Society Function Score (KSFS), and pain scores between the groups.

Variable	Preemptive (n=8)		Postoperative (n=7)		Control (n=8)		X^2	*p*
	X	SD	X	SD	X	SD		
KSKS	31.50	8.88	31.14	12.93	26.38	15.66	0.912	>0.05
KSFS	35.63	15.45	45.00	19.36	41.88	19.26	1.339	>0.05
VAS	92.50	8.88	71.00	32.71	94.37	9.42	3.183	>0.05
VAS - Visual analogue scale								

Table 3 - Comparison of total morphine dose and total boluses between groups.

Variable	Preemptive (n=8)		Postoperative (n=7)		Control (n=8)		X^2	*p*
	X	SD	X	SD	X	SD		
Total dose	59.00	18.67	62.28	19.50	62.12	13.47	0.242	>0.05
Total bolus	55.00	18.83	58.28	19.50	58.12	13.47	0.242	>0.05

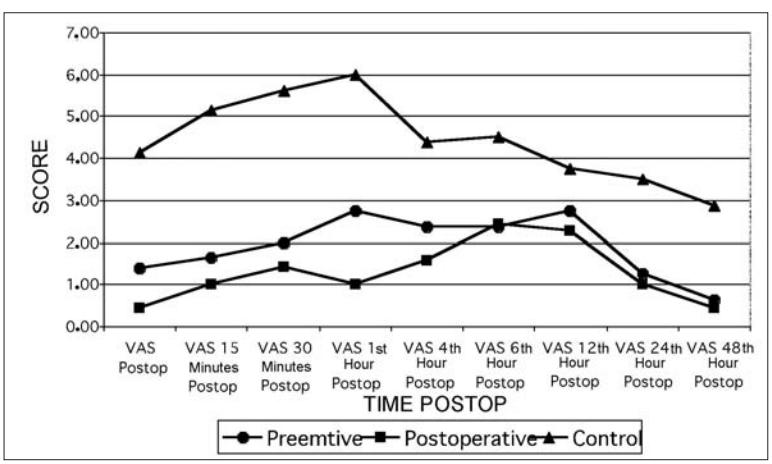

Figure 1 - Changes in visual analogue scores (VAS) in the first 48 hours postoperatively.

not find any study investigating the effect of FNB on the independency level in transfer activities in the early postoperative period in patients with TKA. The primary purpose of early rehabilitation programs in patients with TKA is to maximize the patients' functional status in ambulation and activities of daily living.[23] It was previously reported that inadequate control of postoperative pain has been associated with poor functional recovery.[3] However, our results indicate that independency level in functional activities in the early postoperative period was not related to the pain intensity. In our previous study on total hip arthroplasty (THA) patients,[24] we reported that independency level in the early postoperative period was not affected by the pain intensity. These results could be attributable to the facts that the numbers of the patients in the study groups were limited and the heterogeneity of genders. Katz et al,[25] showed that women had comparable or greater functional improvement following surgery.

We conclude that FNB provides better postoperative pain control in patients with TKA. However, preemptive FNB has no additional beneficial effect on pain control in the early postoperative period in TKA. However, this reduction of pain intensity seems to have no influence on the independence level in functional activities in the early postoperative period. Although these results are clinically valuable, low number of patients in the groups seems to be the major limitation of the study. Therefore, similar studies with larger patient groups are necessary to clarify the effects of different anesthesia protocols on the early rehabilitation outcomes.

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