ORIGINAL ARTICLE

The effects of early femoral nerve block intervention on preoperative pain management and incidence of postoperative delirium geriatric patients undergoing trochanteric femur fracture surgery: A randomized controlled trial

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ABSTRACT

BACKGROUND: Hip fracture is a common clinical problem which causes severe pain in geriatric patients. However, severe pain following fracture may bring on mental disorders and delirium. A neuroinflammatory response with IL-6 and IL-8 has been shown to be associated with the pathophysiology of delirium. In this study, our primary hypothesis is that preoperative femoral nerve block (FNB) intervention in geriatric patients will more effectively attenuate pain following trochanteric femur fracture than the preoperative paracetamol application. Our secondary hypothesis is that interleukin levels (IL-6, IL-8) in cerebrospinal fluid (CSF) will be lower in the femoral nerve block group than the paracetamol group. Our tertiary hypothesis is that the incidence of postoperative delirium will be lower in the femoral nerve block group.

METHODS: The patients over 65 years of age with ASA status II-IV and admitted to the Emergency Service for femur fracture were included in this study. Recommendations of the "delirium prevention table" were applied to all of the patients at arrival. In the first group, 15 mg/kg paracetamol was administered intravenously every eight hours. In the second group, femoral nerve blockage was performed, and a catheter was placed. Then, 0.5 mL/kg bupivacaine 0.25% was applied every eight hours. In both groups, pain scores four hours after interventions were recorded. All patients were operated within 48 hours under spinal anesthesia. During spinal anesthesia, 2 mL of CSF samples were taken from all patients for analysis of IL-6 and IL-8 cytokines, and pain scores during positioning were recorded.

RESULTS: VAS scores four hours after the first preoperative pain treatment and during the positioning for regional anesthesia were significantly lower in the femoral nerve block group. IL-8 levels are significantly lower in the femoral nerve block group but not in IL-6 levels. The incidence of delirium was less in the femoral nerve block group, but the difference was not statistically significant.

CONCLUSION: The femoral nerve block was more effective in preoperative pain management of trochanteric femur fracture and preventing pain during regional anesthesia application. The mean IL-8 level was lower in the femoral nerve block group when compared to the paracetamol group. There is no difference in the postoperative delirium incidence between groups.

Keywords: Delirium; femoral nerve block; hip fracture; interleukin 8.

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INTRODUCTION

Hip fracture is a common clinical problem in geriatric patients with a high mortality rate. The incidence of severe pain in the first 24 hours after femur fractures is 50–70%.[1] Previous studies[2,3] reported that the majority of patients with hip fracture had received inadequate pain treatment and almost 40% of the patients have never received any analgesic drugs in the preoperative period. However, it has been suggested that adequate pain treatment should be commenced before admittance to the hospital[4] since the severe pain following fracture may cause mental disorders and delirium.[5] Preoperative health status and cognitive functional capacity of the patients, neurotoxic effects of anesthetic agents, perioperative events during surgery and the used cement for prosthetic implantation are associated with postoperative cognitive problems.[6]

Delirium is one of the most common complications in hospitalized elderly patients. Previous studies have shown that delirium is associated with both short and long-term poor outcomes. It is a medical condition that must be treated urgently because it significantly increases morbidity and mortality, prolongs the length of hospital stay, and may lead to a decrease in functional capacity.[7] The pathophysiological mechanisms of delirium are not precise, a neuroinflammatory response is suggested to play a role.[8] Up to date, many studies have analyzed different serum inflammatory markers in order to elucidate the pathophysiology of delirium.IL-6 and IL-8 have been shown to be associated with delirium.[9,10]

In this study, our primary hypothesis is that preoperative femoral nerve block (FNB) intervention in geriatric patients will more effectively attenuate pain following trochanteric femur fracture than the preoperative paracetamol application. Our secondary hypothesis is that interleukin levels (IL-6, IL-8) in cerebrospinal fluid (CSF) will be lower in the femoral nerve block group than the paracetamol group. Our tertiary hypothesis is that the incidence of postoperative delirium will be lower in the femoral nerve block group.

MATERIALS AND METHODS

After the approval of the Muğla Sıtkı Koçman University, Clinical Research Ethics Committee in 17.05.2016 with a decision number 2016/50, 114 patients who were over 65 years of age with ASA status II-IV and admitted to the Emergency Department due to trochanteric femur fracture were included in this study. Patients with preexisting delirium at the admission to emergency service, femur fracture due to metastatic carcinoma, bupivacaine allergy, cholinesterase inhibitors or levodopa medication, parkinsonism or epilepsy, and a contraindication for nerve blockage were excluded from this study.

Ethics, Consent, and Permissions

A written informed consent form was obtained from all patients who agreed to participate in this study.

Interventions

The recommendations of the "delirium prevention table" defined by Björkelund et al.[11] were applied to all of the patients as soon as their arrival to the emergency service, oxygen support has been given at 3–4 lt/min and pulse oximeter measurements have been followed, a standard nutritional support was applied, hemoglobin values were raised above 10 gr/dL and hypo-hyperthermia were prevented in all cases. Preoperative cognitive functions of the patients were assessed by the 30-point Minimental Test (MMT). In the emergency service, patients were allocated into two groups. In the first group (Group I), 15 mg/kg paracetamol within 15 min was administered intravenously. In the second group (Group II), intermittent FNB was performed in the emergency room. A high-frequency linear ultrasound probe (Fujifilm Sonosite, Bothwell, USA) was located in the inguinal area. When the femoral artery was found, the probe was moved slightly laterally to pinpoint the femoral nerve. When the ultrasonographic view of the femoral nerve was seen, the injection site was anesthetized with 2–3 mL of 2% lidocaine under aseptic conditions. An 80 mm 21-gauge plexus block needle (Stimuplex(R) B-Braun medical, Melsungen, Germany) was inserted in-plane view of the ultrasound probe. When a quadriceps muscle contraction was observed with a nerve stimulator (Braun Stimuplex® HNS 12), 10 ml of 0.25% bupivacaine was applied via a plexus block needle. Following block intervention, a nerve catheter was placed in the same site with ultrasound (USG) guidance.

Routine Analgesia and Pain Assessment

After the initial pain treatment in the emergency service, patients were transferred to the surgical ward. In the first group, the paracetamol treatment was repeated every eight hours. In the second group, 0.5 mL/kg bupivacaine 0.25% was applied every eight hours via a femoral nerve catheter. If sufficient analgesia could not be achieved, 0.5 mg/kg tramadol was intravenously applied as rescue analgesia in both groups. The pain levels of all patients were assessed by 100-mm Visual Analogue Scale (VAS) and recorded at the 4th hour after initial pain treatment.

Anesthesia Procedure

All patients were operated within 48 hours after admission to the hospital. If the operation was delayed more than 48 hours, the patients were excluded from this study. In the operation room, ECG, pulse oximeter and noninvasive blood pressure monitoring were performed. All patients were positioned for the spinal-epidural combined block. The pain occurred during positioning was assessed using VAS and recorded. During spinal anesthesia, 2 mL of CSF samples were taken from all of the patients. These samples were stored at -80° until the CSF specimens were analyzed for IL-6 and IL-8 cytokines using the enzyme-linked immunoassay method (sandwich method) in the Biochemistry Laboratory. For spinal anesthesia, 10 mg bupivacaine + 20 mcg fentanyl were administered intrathe-

cally. Following spinal anesthesia, femoral nerve catheters of patients in Group II were removed. After the operation, all patients received 0.125% bupivacaine + 100 mcg fentanyl through the epidural catheter with an infusion rate of 5 ml/h for postoperative pain control. Pain levels of patients were evaluated at the postoperative 1st, 4th, 12th and 24th hours by 100-mm VAS. The delirium status of patients was assessed using "Delirium Rating Scale-R-98 (DRS-R-98)" in the postoperative period for three days.

Evaluation of the Data

The power analysis of the study was based on studies investigating the development of delirium after femur fracture operation. After the calculations were made with α=0.05 and 80% power (1-β=0.8), the number of patients required in each group was found to be 45. It was assumed that there could be a 20% drop out during the study; therefore, 55 patients were included in each group. For the statistical analysis, Statistical SPSS 20.0 (statistical package for social sciences for Windows 16.0) program was used. The normality tests of the distributions of the variables were performed using the Kolmogorov-Smirnov test. For numerical values with a normal distribution, the difference between the averages of the variables was evaluated using one-way ANOVA or Independent Sample t-test. The Wilcoxon test was used for the analysis of the abnormally distributed variables. For all statistical tests, $p < 0.05$ was considered statistically significant. Chi-square analysis was applied for categorical variables. Pearson test was applied for correlation.

RESULTS

All in all, 110 patients were included in this study. Fourteen patients were excluded due to delay in the operation time, three patients died in the early postoperative period, and two patients were excluded due to change in anesthesia procedure. Consequently, 45 patients in Group I and 46 patients in Group II completed the study (Fig 1). The demographic variables of the patients are listed in Table 1. There was no significant difference between groups.

Mean VAS scores at the 4th hour after first preoperative pain treatment and during the positioning for regional anesthesia were significantly lower in Group II ($p<0.01$). None of the patients' required rescue analgesic in Group II. However, seven patients needed rescue analgesic in Group I ($p\leq0.05$) during the preoperative period (Table 2). There was no significant difference regarding VAS scores during the postoperative period between groups ($p>0.05$) (Table 2).

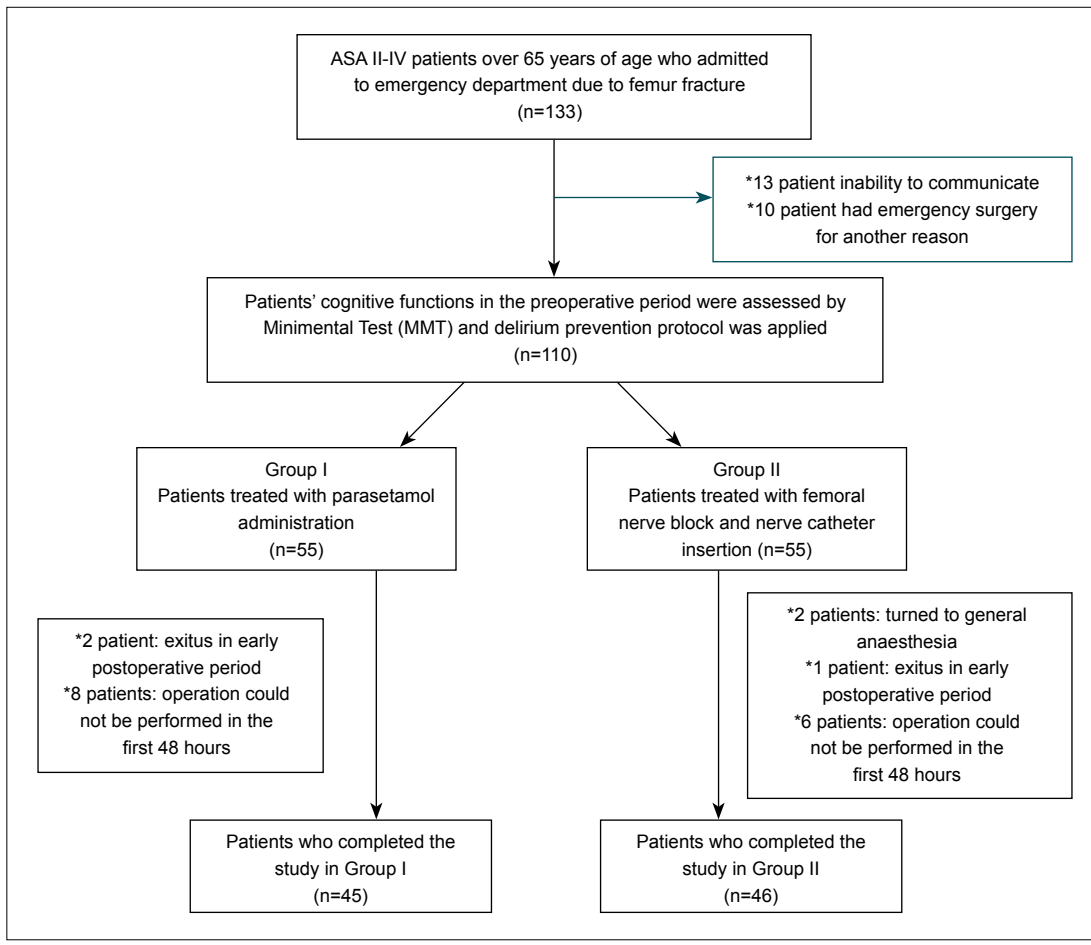

Figure 1. Operation chart.

Table 1. Preoperative features of the patients

	Group I (n=45)	Group II (n=46)
Age	82.04±6.83	81.41±8.06
Gender (Female/Male)	25/20	26/20
Preop Minimental Test score	16.12±6.11	17.05±6.44
Preop delirium score	3.52±3.12	1.75±2.14

According to assessment with DRS-R-98, the occurrence of delirium was less in group II (9 patients in Group I, five patients in Group II) in the early postoperative period. However, the difference was not statistically significant between groups (p>0.05).

IL-8 levels were significantly lower in Group II than Group I (p<0.01). The mean level of IL-8 in patients who developed delirium in Group I was 0.1885±0.13 and in Group II was 0.111±0.025. The IL-6 levels were similar between groups (p>0.05) (Table 3).

A negative correlation was detected between preoperative MMT scores and postoperative 1st, 2nd, 3rd hour delirium scores in both groups. This relation was statistically significant (1st day: r=-0.47, p<0.001, 2nd day: r=-0.49, p<0.001, 3rd day: r=-0.52, p<0.01).

DISCUSSION

In the present study, early intermittent FNB was found to be more effective than intravenous paracetamol administration for pain management of geriatric patients following femur trochanteric fracture. However, there was no significant difference between groups concerning delirium development. Although mean IL-8 levels were significantly lower in the FNB group, mean IL-6 levels were similar between groups.

One of the main problems after hip fracture is severe pain. Up until now, various methods have been used for both preoperative and postoperative pain management.[12] In the preoperative period, intravenous administration of non-steroid drugs and opioids[13,14] and performing nerve blocks[15,16] have been frequently used for pain control. However, pain after femur fracture may not arise solely from the hip joint. The damaged soft tissue after surgery is also a severe pain source, and intravenous agents may be inadequate in postoperative pain treatment. Therefore, the use of peripheral blocks in the preoperative period has gained popularity in recent years. Some previous studies reported that the fascia iliaca block could provide effective analgesia after femur fracture in the elderly.[16,17]

Moreover, Kassam et al.[18] found the fascia iliaca block to provide a morphine-sparing effect in the preoperative period. In the present study, we aimed to apply an intermittent nerve block (instead of a single-shot block) by placing a nerve catheter; therefore, we preferred to perform FNB and provided bet-

Table 2. Preoperative, intraoperative, postoperative VAS scores and the number of patients who required preoperative rescue analgesic among the groups

	Group I	Group II	p
VAS scores at the 4th hour	4.47±1.06	3.32±0.92	<0.01
Preoperative rescue analgesic need (n)	7	0	0.05
VAS scores during positioning	5.55±1.77	4.02±1.80	<0.01
VAS scores at postop 1st hour	3.30±1.06	3.12±1.09	0.47
VAS scores at postop 4th hour	3.22±1.12	3.45±0.71	0.28
VAS scores at postop12th hour	3.17±0.74	3.07±0.79	0.56
VAS scores at postop 24th hour	3.12±0.72	2.82±0.67	0.06

VAS: Visual Analogue Scale.

Table 3. Number of patients with delirium among groups and IL-6, IL-8 levels in CSF samples

	Group I	Group II	p
Delirium	9 (20.0%)	5 (10.9%)	0.227
Interleukin levels-6	3.30±1.57	3.12±1.44	0.57
Interleukin levels-8	73.15±73.35	43.23±38.52	0.017
Interleukin levels-8 (with delirium)	0.1885±0.13	0.111±0.025	0.213
Interleukin levels-6 (with delirium)	2.29±1.10	3.14±0.57	0.213

IL: Interleukin levels; CSF: Cerebrospinal fluid.

ter pain control than paracetamol did. Similar to our study, Ranjit et al.[19] compared the effects of FNB and intravenous fentanyl administration on patients with a femur fracture. They assessed the pain during positioning for spinal anesthesia and reported that pain was significantly lower in the FNB group.

Delirium is one of the most common postoperative complications in elderly patients with an incidence of 5% and 61% after femur fracture surgery.[20] The underlying pathophysiology is not fully understood; however, postoperative pain is believed to trigger delirium development in elderly patients. Morrison et al.[13] assessed 541 patients with a femur fracture. They found the incidence of delirium 16% and reported that severe pain was highly associated with the development of postoperative delirium. Moreover, adequate pain control starting from the early preoperative period was previously shown to reduce the postoperative delirium incidence.[21] In our study, preoperative pain scores were significantly lower in the cyclic FNB group. Although the postoperative delirium incidence was lower in the FNB group, the difference between groups was not statistically significant. We believe that there are two main reasons for this result. First, we maintained effective pain control as early as possible in both groups. Second, we implemented a "delirium prevention program" to all patients starting from the admittance to emergency service. "Delirium prevention program" is a list of recommendations stated by Björkelund et al.[11] It was reported to reduce the incidence of postoperative delirium from 34% to 22%. In our study, the delirium incidence was 20.0% in the paracetamol group and only 10.9% in the FNB group.

Central nervous system inflammation that arises from systemic inflammation is another blamed hypothesis for delirium development after femur fracture. Previously, IL-6 and IL-8 were reported to be higher in geriatric patients who developed delirium after femur fracture operation.[9,10] In the study of MacLullich et al.,[22] the increase of IL-8 levels in the CSF was reported to be associated with postoperative delirium. Similarly, elevated IL-6 level was also reported as the signature of post-stroke delirium in a recent study.[23] In the present study, IL-8 levels were found significantly lower in the FNB group. We think that the most likely reason for this result is the attenuation of the inflammatory response by effective pain management with FNB. On the other hand, we did not detect any differences in IL-6 levels between groups. Similar to our results, Lemstra et al.[24] did not find any association between preoperative IL-6 and the incidence of delirium after a hip surgery. We think that the data concerning IL-6 and IL-8 are still limited and conflicting.

The preoperative cognitive function level of patients are thought to play an essential role in the development of delirium.[25,26] Our results are consistent with the current literature, we detected a negative correlation between preoperative MMT scores and the incidence of delirium in the first three postoperative days. Moreover, there was a positive correlation between preoperative MMT scores and delirium scores.

Limitations

Our study has some limitations: (1) Although the sample size is large enough to meet the primary outcome, our study is probably underpowered to detect a relation between the incidence of delirium and cytokine levels, or incidence of delirium and femoral nerve block. (2) The release of IL-6 and IL-8 may also be affected by other factors, such as the current metabolic condition, the usage of previous medications, the previous story of fractures and operations. Therefore, we may not be able to standardize these factors during the study period because of the comorbidities of patients. (3) Preoperative erythrocyte transfusion to some patients according to the "delirium prevention program" may affect cytokine responses.

Conclusions

We found that intermittent femoral nerve block was more effective in preoperative pain management of trochanteric femur fracture and preventing pain during regional anesthesia application. Moreover, the mean IL-8 level was lower in the femoral nerve block group when compared to the paracetamol group. However, we could not find a difference in the postoperative delirium incidence between groups.

Ethics Committee Approval: Approved by the local ethics committee (date: 17.05.2016, no: 2016/50).

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Conflict of Interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Trokanterik femur kırığı operasyonu geçirecek yaşlı hastada erken dönemde yapılan femoral sinir blokajının ağrı yönetimi ve deliryum insidansına etkisi: Randomize kontrollü çalışma

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AMAÇ: Kalça kırığı yaşlı hastalarda şiddetli ağrıya neden olan yaygın bir klinik problemdir. Bununla birlikte kırık oluşumunu takip eden şiddetli ağrı mental rahatsızlıklar ve deliryum gelişimine neden olabilir. IL-6 ve IL-8 ile birlikte olan nöroinflamatuvar yanıtın deliryum patofizyolojisi ile ilişkili olduğu gösterilmiştir. Bu çalışmadaki primer hipotezimiz ameliyat öncesi femoral sinir bloğunun trokanterik femur kırıklarında parasetamole göre daha etkin ağrı tedavisi sağlayacağıdır. Sekonder hipotezimiz IL-6 ve IL-8 düzeylerinin femoral sinir bloğu yapılanlarda daha düşük olacağıdır. Üçüncü hipotezimiz ise ameliyat sonrası deliryum insidansının femoral sinir bloğu uygulananlarda düşük olma durumudur.

GEREÇ VE YÖNTEM: Hastane acil servisine femur kırığı nedeniyle başvuran 65 yaş üzeri ASA II-IV hastalar çalışmaya dahil edildi. "Deliryum önleme tablosu"ndaki öneriler tüm hastalara başvuru anından itibaren uygulandı. İlk gruba sekiz saatte bir 15 mg/kg parasetamol intravenöz olarak verildi. İkinci gruba femoral sinir blokajı uygulandı ve kateter yerleştirildi. Ardından 0.5 mL/kg bupivakain %0.25 her sekiz saatte bir kateter yoluyla verildi. Her iki grupta ağrı skorları ilk analjezik uygulandıktan dört saat sonra kaydedildi. Bütün hastlar 48 saat içerisinde spinal anestezi altında ameliyat edildi. Spinal anestezi sırasında verilen pozisyona bağlı ağrı skorları kaydedildi ve 2 mL beyin omurilik sıvısı (BOS) örneği tüm hastalardan IL-6 ve IL-8 sitokinleri analizi için alındı.

BULGULAR: Ameliyat öncesi ilk ağrı tedavisi sonrası dördüncü saatteki ve rejyonal anestezi için verilen pozisyon ağrısı belirgin olarak femoral sinir blok grubunda düşüktü. IL-8 düzeyleri femoral sinir blok grubunda belirgin olarak düşük iken IL-6 düzeyleri benzerdi. Deliryum insidansı femoral sinir blok grubunda daha azken istatistiksel farklılık yoktu.

TARTIŞMA: Femoral sinir bloğu ameliyat öncesi ağrı tedavisinde ve rejyonal anestezi sırasındaki pozisyon ağrısını önlemede üstündür. Ortalama IL-8 düzeyi femoral sinir blokajı uygulanan hastalarda daha düşüktür. Deliryum insidansı her iki grupta benzerdir.

Anahtar sözcükler: Deliryum; femoral sinir bloğu; interlökin 8; kalça kırığı.

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