Comparison of Ultrasound-Guided Femoral Nerve Block with Combined Spinal Epidural Anesthesia in Total Knee Arthroplasty

Total Diz Artroplasti Operasyonlarında Kombine Spinal Epidural Anestezi ile Ultrason Eşliğinde Femoral Sinir Blokajı Karşılaştırılması

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ABSTRACT

Objective: The objective of this study was to compare postoperative early (48 hours) visual analogue scale (VAS) scores following combined spinal epidural anesthesia (CSEA) and ultrasound-guided femoral nerve block (FNB) in patients undergoing total knee arthroplasty (TKA).

Material and Methods: This retrospective study included 302 patients who underwent CSEA (Group CSEA) and FNB (Group FNB) for elective unilateral total knee arthroplasty between May 2016 and May 2017. Postoperative Visual analogue scale (VAS) scores at rest and during activity (30th min, 2, 6, 12, 24 and 48th hours), the total amount of morphine consumed (48th hour) by the patient controlled analgesia (PCA) device, and the complications were evaluated.

Results: The demographic characteristics of the patients were similar ($p>0.05$). There was no statistically significant difference between the two groups in terms of resting and active VAS scores according to timepoints ($p>0.05$). However, there was a significant difference in complications (hypotension, nausea and vomiting, neurological damage, respiratory depression, pruritus) between the two groups ($p<0.05$).

Conclusion: Pain levels after total knee arthroplasty showed that FNB had a similar effect with CSEA in providing pain relief, but FNB was superior to CSEA in terms of postoperative complications.

Key Words: Total knee arthroplasty, Femoral nerve block, Ultrasound, Combined spinal epidural anesthesia, Visual analogue scale

ÖZ

Amaç: Çalışmada, total diz artroplastisi (TDA) cerrahisi uygulanan hastalarda kombine spinal epidural anestezi (KSEA) ile ultrasonografi eşliğinde femoral sinir blokajı (FSB) uygulamasının postoperatif erken dönem (48 saat) ağrı skorları ve komplikasyonlarının karşılaştırılması amaçlanmıştır.

Gereç ve Yöntemler: Retrospektif çalışmaya, Mayıs 2016-Mayıs 2017 tarihleri arasındaki elektif tek taraflı total diz artroplasti için KSEA (Grup KSEA) ile FSB (Grup FSB) uygulanan 302 hasta dahil edildi. Hastaların postoperatif dinlenme ve harekette görsel analog skala (VAS) ile ağrı skorları (30.dk, 2, 6, 12, 24 ve 48. saat) hasta kontrollü analjezi (HKA) cihazı ile tüketilen toplam morfin miktarı ve komplikasyonlar 48. saatte değerlendirildi.

Bulgular: Hastaların demografik özellikleri benzer bulundu ($p>0.05$). Her iki grubun zamana göre dinlenme ve hareket halindeki VAS skorları arasında anlamlı fark görülmedi ($p>0.05$). Gruplar arasında komplikasyonlar da ise anlamlı fark bulundu ($p<0.05$).

Sonuç: Total diz artroplastisi sonrası ağrı düzeylerinin FSB nin KSEA ile benzer etkiye sahip olduğu ancak postoperatif komplikasyonlar açısından FSB nin KSEA ye üstün olduğu bulundu.

Anahtar Sözcükler: Total diz artroplasti, Femoral sinir bloğu, Ultrasonografi, Kombine spinal epidural anestezi, Görsel analog skala

INTRODUCTION

Total knee arthroplasty (TKA) is an effective surgery for late-stage knee osteoarthritis or rheumatoid arthritis. However, most patients experience postoperative pain at intermediate and advanced levels (1,2). In the postoperative period, adequate pain control results in increased patient satisfaction, easier rehabilitation of the knee, and shortened hospital stays (3). The task of anesthesiologists is not only to create favorable conditions during surgery, but also to reduce postoperative morbidity and mortality. This is related to selecting the best analgesic technique for that operation (4). Several anesthetic regimens and techniques have been investigated to reduce postoperative pain and to increase rapid healing after TKA (5). Analgesia after TKA is usually multimodal and includes intravenous opioids, peripheral nerve blocks, epidural analgesias, joint or synovial opioids, local anesthetics, and oral analgesics. Patients who undergo TKA are generally older and often have impaired cardiovascular and pulmonary functions, and have diseases that threaten spinal stability. These factors also prevent general anesthesia (6). Hemodynamic changes resulting from morbid obesity, anatomic deformities, or antiplatelet or anticoagulant therapy to prevent ischemic cardiac events can often make combined spinal epidural anesthesia (CSEA) inappropriate (7). Alternative anesthetic techniques are required for TKA in the presence of these factors. There are many reports about femoral/sciatic nerve block as postoperative analgesia after TKA. Femoral nerve block (FNB) has become popular due to less respiratory depression and hemodynamic imbalance, fewer neurological complications, and because of the ability to safely administer it in the presence of septic or anticoagulant disease (8).

The purpose of this retrospective study was to compare early postoperative (48 hours) Visual analogue scale (VAS) scores and complications following CSEA and FNB as used in our clinic for unilateral TKA.

MATERIALS and METHODS

This was a retrospective clinical study. Ethical approval was given by the observational ethics committee of the Selcuk University Medical School (Ref no: 2017/233). From all patients admitted from May 2016 to May 2017, surgical and anesthesia data from the hospital automation system of 302 patients aged 18-85 years who were American Society of Anesthesiologists (ASA) risk group I-III were evaluated. Patients who underwent only spinal anesthesia (n=37) or general anesthesia (n=13) or that needed to be administered general anesthesia at any time of the intraoperative period and patients with incomplete data (n=5) were excluded from the study. The patients were allocated into two groups according to the anesthesia/analgesia method picked by themselves; Group CSEA (n:95) and Group FNB (n:152) [(patients who were routinely practiced FNB in our clinic were selected)]. The anesthesia methods applied to the patients were routinely based on the preference of the patient, the laboratory and clinical data of the patient, and the choice of the anesthesia practitioner. Both of these two methods were used with the i.v. morphine patient controlled analgesia device (PCA) that is in routine use at our clinic.

Sociodemographic data, operation times, tourniquet times, side of surgery and pain scores at time points (30th min, 2, 6, 12 24 and 48th hours) were evaluated using postoperative visual pain scale (VAS) scores at rest and during activity by the postoperative patient controlled analgesia (PCA) device. Total morphine consumption was recorded at the 48th hour.

In Group CSEA, the epidural space was entered with an 18 G Tuohy needle from the L2-3 or L3-4 interspinous area in the sitting or lateral decubitus position. Then, a needle was inserted through the needle into the spinal cord with a 26 G Quincke needle, and 3 ml of 0.5% spinal bupivacaine (15 mg) was applied. After the spinal needle was removed, 20 G epidural catheter was advanced in the epidural space for 3-4 cm.

In Group FNB, femoral nerve block was performed after spinal anesthesia with ultrasonic guidance using a linear probe (10-18 MHz) using the "in-plane" technique to observe the femoral nerve and motor activity (0.5 mA, 0.1 ms) in the neurostimulatory cord quadriceps, and 20 mL of 0.25% bupivacaine was applied to the nerve periphery, was performed after spinal anesthesia. Then, routine spinal anesthesia (spinal bupivacaine (15 mg) and 25 gauge spinal needle) was performed.

The same type of (PCA) device was used in all cases as adjusted for a bolus dose of 1mg and lockout period of 10 minutes. In Group CSEA patients, the epidural infusion was adjusted to give 5 ml 0.125% bupivacaine bolus dose with a lockout period of 20 minutes. The total amount of morphine consumed at the end of the 48th hour postoperatively was evaluated. All patients received 50 mg oral dexketoprofen and 3 g oral paracetamol per day.

The statistical analyses of the study were performed using SPSS 20.0 software. Descriptive measures of continuous and categorical variables were extracted and are presented as tables and graphs. Continuous variables are presented in the form of mean ± standard deviation or error and the frequencies and percentages of categorical variables are given. The Kolmogorov-Smirnov normality test was used for continuous variables. Group comparisons of the variables that showed normal distribution were performed using one-way analysis of variance. Mann-Whitney U variance analysis was used for discrete numeric variables

that did not show normal distribution. Relationships between the categorical variables were determined by preparing crosstabs and using the Chi-square ($\chi 2$) test. In all analyses, $p<0.05$ was accepted as statistically significant.

RESULTS

The results of this study were determined from hospital anesthesia records from May 2016 to May 2017. A total of 302 patients underwent an elective one-sided total knee arthroplasty operation during a 12-month period. Fifty five patients who underwent only spinal anesthesia (n=37) or general anesthesia (n=13) and patients with incomplete data (n=5) were excluded from the study.

Demographic characteristics and clinic data were similar ($p>0.05$) (Table I).

Within the first 48 hours postoperatively, there was no significant difference between the VAS at rest and during activity (mean±standard error) for Group FNB and Group CSEA ($p>0.05$) (Figure 1,2).

The total morphine consumption was 22.3 ± 5.4 and 25.6 ± 6.8 mg in Group FNB and Group CSEA, respectively. The difference between the two groups was not significant ($p>0.05$) (Table II).

There was a difference between the two groups in terms of postoperative complications ($p<0.05$). Group FNB/Group CSEA included 19 (12.5%)/33 (34.7%) patients with hypotension ($p=0.012$); 23 (15.1%)/29 (30.5%) patients with nausea and vomiting ($p=0.020$), and 0 (0.0%)/8 (7.6%) patients with pruritus ($p<0.001$). Neurological damage and respiratory depression were not seen in either group (Table III).

DISCUSSION

Combined spinal epidural analgesia and femoral nerve block in the first 48 hours of pain treatment after total knee arthroplasty had similar effects, but FNB was superior to CSEA in terms of postoperative complications.

Inadequate pain control after TKA prevents early rehabilitation and can lead to postoperative infection,

Table I: Patient characteristics and clinical data.

	Group FNB N=152	Group CSEA N=95	*P*
Age (yr)	69.8±7.3	69.7±6.9	0.949
Gender (F/M)	40/117	23/62	0.542
Weight (kg)	90.8±10.9	90.6±11.3	0.867
Height (cm)	165.2±7.0	165.7±6.6	0.706
Duration of surgery (min)	116.0±18.7	114.9±17.2	0.557
Tourniquet time (min)	104.1±18.1	102.7±17.4	0.769
Side of surgery (R/L)	78/74	49/46	0.795

Abbreviation: **yr,** year; **F/M,** female/male; **R/L,** right/left.

Table II: Comparison of total consumed morphine amounts between groups.

	Group FNB n=152	Group CSEA n=95	*p*
Total consumed morphine amounts (mg)	22,3 ± 5,4	25,6 ± 6,8	0.644

Table III: Complications observed after 48 hours postoperatively.

	Group FNB n=152	Group CSEA n=95	*p*
Hypotension	19 (%12.5)	33 (%34.7)	0.012
Nausea and vomiting	23 (%15.1)	29 (%30.5)	0.020
Neurological damage	0	0	-
Respiratory depression	0	0	-
Pruritus	0	8 (%7.6)	<0.001

deep vein thrombosis, pulmonary embolism, or fluid or electrolyte imbalance (9).

However, focusing only on postoperative pain management is an incomplete approach because early ambulation and immediate physiotherapy are other measures that improve postoperative outcomes and reduce morbidity (10,11).

Major CSEA benefits are the need for lower doses of medications, lower incidence of motor blockade, adequate sensory block, the ability to extend the area of blockade if the surgical field needs to be extended, and excellent analgesia (12). These benefits give CSEA an advantage in TKA. However, patients who undergo TKA are mostly elderly patients. These patients frequently have life-threatening cardiovascular and pulmonary function disorders and impairment of spinal stability. Factors such as morbid obesity, anatomic deformities, or antiplatelet/anticoagulant treatments that can change hemodynamic responses can often make CSEA contraindicated (6). These factors often prevent the use of CSEA (13). Therefore, alternative anesthetic techniques are being developed for TKA. In the past, peripheral nerve blocks have not been the preferred anesthetic technique for anesthesiologists in TKA patients. However, ultrasound use is becoming popular as the preferred method due to its effectiveness in anesthesia practice. FNB is an excellent anesthetic choice for patients who are not candidates for spinal or epidural anesthesia, because the peripheral nerve block can be safely applied in patients with septic or anticoagulant disease. In addition, FNB causes minimal respiratory and hemodynamic imbalances compared with neuroaxial anesthesia, and does not cause severe neurological complications such as spinal hematoma or cauda equina syndrome (14). Most importantly, FNB preserves contralateral extremity strength which facilitates adequate postoperative analgesia and postoperative rehabilitation after TKA (15).

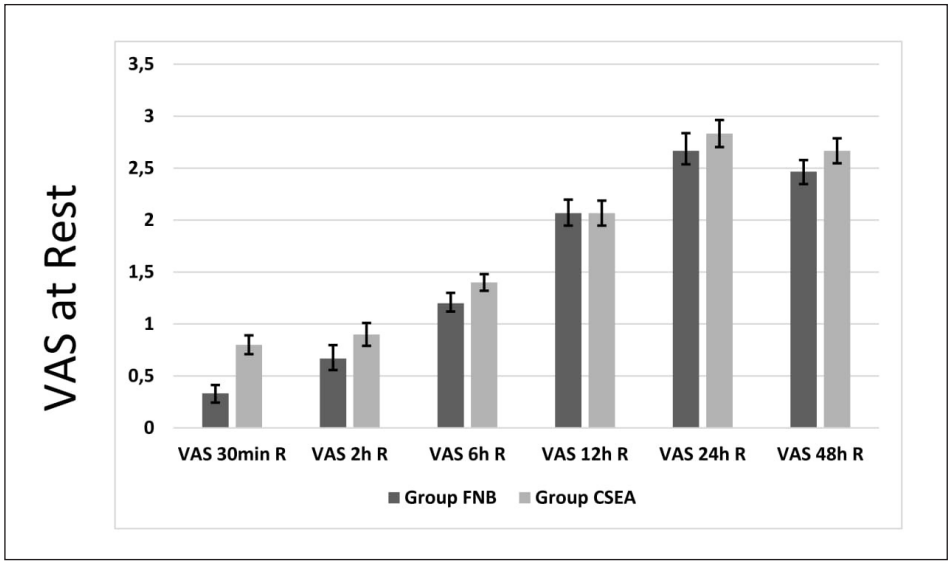

Figure 1: Comparison of postoperative VAS scores at resting time of both groups. There was no statistical in the VAS scores of both groups at rest according to the time.

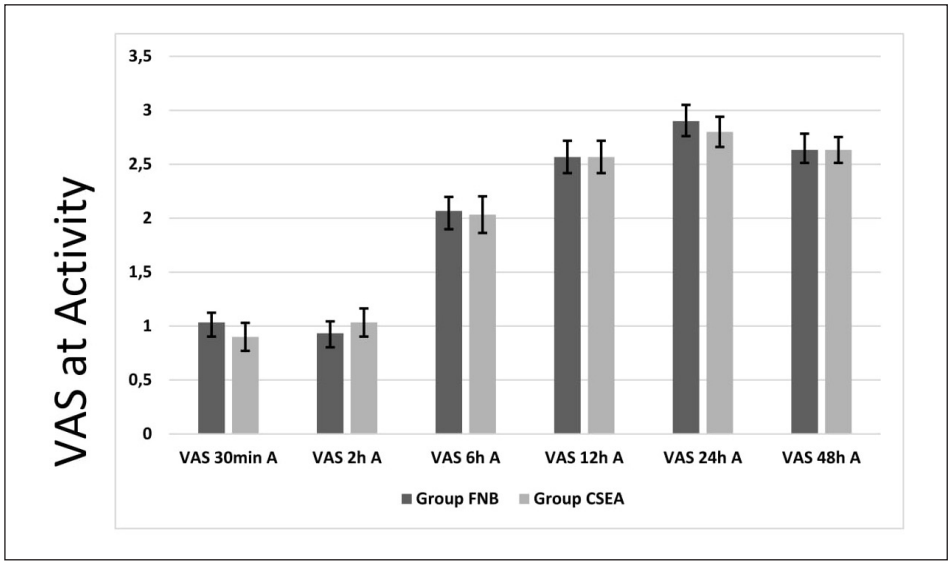

Figure 2: Comparison of postoperative VAS scores at activity time of both groups. There was no statistical difference in VAS scores at the time of movement of both groups according to time.

Allen et al.(16) have shown that peripheral nerve blocks provide analgesia between 24-48 hours postoperatively in TKA. Other studies support this data (17,18). Sundarathiti et al. reported that FNB was similar to epidural anesthesia for postoperative VAS values but postoperative complications were higher than with epidural anesthesia (19). Furthermore, in some studies there was no difference in terms of postoperative VAS scores between continuous FNB and single shot FNB (20,21). In our study, there was no difference between FNB and CSEA until 24 hours postoperation regarding VAS scores at rest and during activity. Peripheral nerve block provides better analgesia than epidural anesthesia and is superior to systemic opioids for pain relief (22). In this study, total morphine consumption amount was 22.3 ± 5.4 mg for Group FNB and 25.6 ± 6.8 mg for Group CSEA, and both groups were similar.

Hypotension, urinary retention, and pruritus are more frequent in patients undergoing epidural anesthesia (23). Capdevila et al.(24) reported a significantly higher incidence of postoperative arterial hypotension in the continuous epidural infusion group compared to the continuous femur block group. CSEA causes a higher incidence of hypotension, occurring in 15% to 20% of cases (25). In fact, although there was a similar amount of morphine consumption in both groups in this study, the difference between groups in terms of nausea and vomiting may be explained by the fact that opioids induce nausea and vomiting by stimulating the chemoreceptor trigger zone in the brain stem (26), and the absorption of morphine FNB is limited. CSEA also has side effects such as bilateral motor block, pruritus, urinary retention, and tremor (27). Another frequent complication of CSEA is postdural headache (28). In this study, complications (hypotension, nausea and vomiting, neurological damage, respiratory depression, pruritus) seen in patients with FNB were not statistically significantly different compared to patients with CSEA. This may be due to limited sympathetic blockade in peripheral nerve blocks and less vasodilatation during central blocks which often affect organs (29). FNB causes less urinary retention than epidural blocks (22). Postoperative urinary retention was not assessed because all patients in this study had a routine urinary catheter.

This study has some limitations. First, this study is a retrospective clinical study. Second, both CSEA and spinal anesthesia combined with FNB were performed by different specialists. Third, we did not statistically compare the measurements of preoperative and postoperative changes in the range knee motion due to lack of recording. Fourth, although postoperative complications were recorded, the levels of these complications (such as mild, moderate, and severe) were not specified.

In conclusion, FNB application in pain treatment after TKA is similar to CSEA, but FNB is superior to CSEA in terms of postoperative complications.

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Declaration of conflicting interests

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