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FAST TRACK KNEE ARTHROPLASTY: COMPARISON OF TWO DIFFERENT MULTIMODAL ANALGESIA METHODS

FAST TRACK DİZ ARTROPLASTİSİ: İKİ FARKLI MULTİMODAL ANALJEZİ YÖNTEMİNİN KARŞILAŞTIRILMASI

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Öz

Amaç

Bu çalışmanın amacı, Fast track Total Diz Artroplasti (TDA) ameliyatlarında multimodal protokolün, femoral sinir blokajı (FSB) ile lokal infiltrasyon analjezi (LIA) yöntemleri kullanarak pre-emptif analjezideki etkilerini hızlı bir şekilde değerlendirmektir.

Gereç ve Yöntem

Bu çalışma tek merkezli, randomize, tek kör kontrollü bir çalışma olarak planlandı. Çalışmaya, birincil veya ikincil osteoartrit nedeniyle TDA uygulanan, her iki cinsiyetten 40-80 yaş arası toplam 72 gönüllü hasta dahil edildi. Hastalar bir bilgisayar randomizasyon programı kullanılarak iki gruba ayrıldı. Grup I: FSB yöntemi uygulanan hastalar ve Grup II: LIA yöntemi uygulanan hastalar. Gruplar fonksiyonel puanlar açısından karşılaştırıldı.

Bulgular

Gruplar arasında yaş, cinsiyet, boy, kilo, vücut kitle indeksi, ASA, ameliyat edilen taraf, protez tipi ve ameliyat süresi açısından istatistiksel olarak anlamlı fark saptanmadı (p> 0,05). Her iki grupta da ölçüm zamanları arasında fonksiyon skor değerlerinde istatistiksel olarak anlamlı farklılık belirlendi (p <0.05). Hangi zamanda veya zamanlarda bir fark olduğunu belirlemek için çoklu karşılaştırma testleri (post-hoc) uygulandı. Her iki grupta da fonksiyon skor değerleri tüm ölçüm zamanlarında farklıydı, preoperatif ölçüm en düşük, postoperatif 3 aylık değerler en yüksek bulundu.

Sonuç

Çalışmamız femoral sinir bloğu veya lokal infiltrasyon analjezisi ile multimodal analjezinin kullanılmasının Fast-track TDA ameliyatlarında etkili analjezi yöntemleri olarak uygulanabileceğini ve birbirlerine alternatif olabileceğini göstermektedir.

Anahtar Kelimeler: Fast-Track cerrahi, Total diz artroplastisi, Lokal infiltrasyon analjezi, Femoral sinir bloğu, Multimodal analjezi

Abstract

Objective

The aim of this study was to evaluate the effects of a multimodal protocol in pre-emptive analgesia

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following Total Knee Arthroplasty (TKA), using epidural anesthesia with femoral nerve blockage (FNB) or local infiltration analgesia (LIA) methods in fast-track TKA.

Material and Methods
This study was planned as a single-centre, randomized, single-blind, controlled study. The study included 72 voluntary patients, aged 40-80 years, of both genders, who underwent TKA for primary or secondary osteoarthritis. The patients were divided into two groups using a computer randomization program. Group I: FNB application and Group II: LIA methods. Groups were compared in terms of functional scores.

Results
No statistically significant difference was determined between the groups in respect of age, gender, height, weight, BMI, ASA, operated side, prosthesis type, and operating time ($p>0.05$). A statistically significant difference was determined in the function score values between the measurement times in both groups ($p<0.05$). Multiple comparison tests (post-hoc) were applied to determine at which time or times there was a difference. In both groups, the function score values were different at all the measurement times, with the preoperative measurement found to be the lowest and the postoperative 3-month values the highest.

Conclusions
Our study show that used multimodal analgesia with femoral nerve block or local infiltration analgesia can be applied as effective analgesia methods in fast-track TKA and can be considered as alternatives for each other.

Keywords: Arthroplasty; Analgesia; Local infiltration analgesia; Femoral nerve block; Multi-modal analgesia

Introduction

Total knee arthroplasty (TKA) is one of the major orthopaedic surgical procedures. Almost all patients describe severe postoperative pain. Therefore, it can be associated with a difficult recovery process (1). Fast track surgery is a method that occurs in the last decade and reduces the length of hospital stay after joint arthroplasty. Fast-track surgery aims to reduce the physiological and psychological stress associated with surgery in order to increase early mobilization and rapid recovery. The greatest contribution to this process is the effective management of pain and the effectiveness of rehabilitation (2). Multi-modal analgesia techniques are used in TKA because of severe postoperative pain. However, in the last decade, powerful intravenous analgesics such as opioids, which have been the foundation of analgesia, have been used less often because of side-effects. There is now more frequent use of peripheral nerve blocks, regional blocks, and epidural pathway patient-controlled analgesia methods (1-3).

Studies in recent years have shown that peripheral nerve block (PNB) and local infiltration analgesia (LIA) are effective in postoperative analgesia following TKA operations (4, 5). It has been shown that by applying femoral nerve block (FNB) after TKA operations, continuous epidural anesthesia and patient-controlled epidural analgesia (PCEA) of similar effectiveness are provided and the side-effect profile is lower (6). Similar effects have been obtained with LIA (7-10). However, because of the single injection method, the disadvantage of both techniques is that the duration of the effect is limited. The analgesia cannot be increased on demand. There is a need for continuous local anesthesia with a catheter placed or bolus application. However, it is a risk of infection and this application requires higher drug doses to provide neuraxial blocks. Therefore, when the use of this method is desired with a single injection, the provision of neuraxial pathway analgesia can be considered in patient control with low-dose local anesthetic with an opioid solution. At the same time, by reducing the amount of local anesthetic solution used with the epidural pathway with the application of FNB or LIA, side-effects associated with pain in the central pathway are avoided and pain is reduced by obtaining a synergistic effect. To the best of our knowledge, there is no prospective, randomized, controlled study in the literature that has evaluated this effect in fast-track TKA.

The aim of this prospective, randomized, single-blind study was to evaluate the effects of multimodal analgesia methods in fast-track TKA surgery. At the same time, to evaluate whether femoral nerve blockage and LIA method are superior to each other in the multimodal analgesia protocol.

Material And Methods

This study was planned as a single-centre, randomized, single-blind, controlled study. Informed consent

was obtained from all the patients who participated in the study. All the researchers participating in the study signed the Helsinki Declaration. Local Ethics Committee approval granted from Ankara Numune Research and Training Hospital (04.12.2014 / E-14-353) for the study. In the fast-track THA surgery program applied in our clinic, patients are mobilized on the first postoperative day. Active Range of Motion (ROM) exercises are taught to the patients by a physiotherapist on the first postoperative day and they are followed up daily. In patients, the epidural catheter remains for 2 days for continuous analgesia. Patients are discharged on the 3rd day postoperatively.

The study included voluntary patients, aged 40-80 years, of both genders, in the ASA I-II-III physical risk group, who underwent TKA for primary or secondary osteoarthritis. Exclusion criteria were previous TKA surgery on the same side, infection in the application area, neuropathy, ASA IV-V physical risk group, patient non-compliance, local anesthesia allergy, cerebrovascular disease, bleeding diathesis, neuromuscular disease, renal implant, heart failure (American Heart Association grade 3), liver failure, mental disorder with difficulty in comprehension of numerical scales, or long-term use of analgesics such as NSAID and opioids. The patients were randomly separated into two groups using a computer randomization program.

Anaesthesia Technique

After the application of 0.03 mg/kg midazolam IV and 1 µg/kg fentanyl IV to both groups, 15mg of 0.5% bupivacaine heavy was applied with the combined spinal-epidural anaesthesia technique by entering the spinal gap from the L3-4, L4-5 gap. A 5cm catheter was left in the epidural gap. The start and finish times of the anaesthesia were recorded.

Femoral Nerve Block Application (Group I)

All the nerve blocks were applied by the same anaesthesia specialist. Under ultrasound guidance, 20ml 0.25% bupivacaine was applied to the femoral nerve for femoral nerve block in patients in Group I. With the patient in the anterior position, after visualization under ultrasonography of the femoral nerve lateral to the femoral artery from the medial third of the assumed line passing between the spina iliaca anterior superior and the symphysis pubis. The femoral block was applied by administering local anaesthetic solution around the nerve with a 5cm peripheral nerve block needle (Stimuplex D, B Braun, Melsungen, Germany).

Local Infiltration Anesthesia (Group II)

In Group II, the surgical team injected 60 ml 0.375% bupivacaine local anaesthetic solution during the surgical procedure. The injection was injected into 50 to 100 sites with small volumes through a small needle (22 gauge or similar), covering the entire field at multiple depths and superficially focusing on the medial aspect of the incision because of the orientation of the nerve fibres. The periarticular area, capsule, collateral ligaments, synovium, extensor mechanism, iliotibial band, posterolateral and posteromedial structures, subcutaneous tissue and pes anserinus should all be targeted. All the solution was applied to the targeted areas to be as equal as possible. The local anaesthetic solution comprised 200mg 0.5% bupivacaine, 8mg Dexamethasone, 0.15 mg Adrenalin, and 750 mg Cefazolin (Table 1).

Surgical Technique

All surgical procedures were performed by the same orthopedic surgeon. Half an hour before the operation, 2 gr cefazolin antibiotic prophylaxis was administered. A tourniquet was applied to each patient routinely. The medial parapatellar approach was applied to all patients. After the bone cuts, the solution was applied to all surrounding ligaments, capsules, subcutaneous tissue, and incision site in the LIA group. In each patient, a total of 3 liters of saline was washed before and after the prosthesis was applied. The same cemented total knee prosthesis (Vanguard, Biomet

Table 1 Local anesthetic solution content

Drug	Ml	mg
Bupivacaine % 0.5	40	200
Dexamethasone	2	8
Adrenalin	0.3	0.15
Cefazolin	7.5	750

Inc. USA) was used for each patient. The patellar component was not applied to any patients. After the tourniquet was opened in each patient, bleeding was controlled and a hemovac drain was placed. Afterward, tendinous, subcutaneous and skin tissues were sutured routinely, and Jones bandage was applied, respectively. Hemovac drain was removed on postoperative 1st day in all patients.

Postoperative Follow-up

PCEA was applied to all patients postoperatively. The PCEA solution was prepared containing 450 µg fentanyl and 75 mg 0.5% bupivacaine. The epidural bolus PCEA mode was programmed to give a 4 ml bolus with a 20-minute locked period. A record was made for each patient of the total PCEA drug demand and the amount used.

In the first 48 hours postoperatively, at regular intervals (0, 1, 2, 8, 12 and 24 hours postoperatively), the patients were questioned about pain with a Visual Analog Scale (VAS) of 10 cm where 0 = no pain and 10 = intolerable pain. For patients with a VAS score >4, 100 mg Tramadol IV infusion was started as an additional analgesic method. The time of administration was recorded as the time of requirement for first analgesic.

During follow-up, the patients were monitored for nausea, vomiting, hypotension, bleeding, bradycardia and signs of local anesthetic toxicity (dizziness, ringing in the ears, numbness of the tongue, spasm, arrhythmia).

From postoperative day 1, joint movements (maximum passive knee flexion) were started and pain during movement was evaluated with VAS. The monitoring was applied by the same person on postoperative days 1-3, 45 and 90. The knee and function scores of patients were also evaluated with the Knee Society Score (KSS) preoperatively (PR) and on postoperative (PO) days 45 and 90.

Statistical Analysis

Data Evaluation

Data analysis was applied using IBM SPSS 23.0 (SPSS Inc, Chicago, IL, USA) statistics software. In the study data evaluation, descriptive statistical methods (frequency, percentage, mean, standard deviation) were used and in the comparison of qualitative data, the Chi-square test was used. The conformity of data to normal distribution was evaluated with the Kolmogorov-Smirnov and Shapiro-Wilk tests. In the comparison between groups, the Independent Samples t-test was used and in the comparison of values between measured time points within a group, the Repeated Measures Anova test was applied. To determine at which time or times a difference originated, the Tukey HSD test was used. A value of $p<0.05$ was considered statistically significant.

Power Analysis: Power analysis was made using G*Power 3.1.9.2 statistics software. Values of n1=35, n2=37, $\alpha=0.05$, Effect size d=0.8 and power $(1-\beta)=0.92$ were determined.

Results

The study was planned to be conducted on the first 80 patients to present at our clinic. Spinal anesthesia could not be applied to 1 patient, the specified exclusion criteria applied to 6 patients and spinal nerve blockage failed in 1 patient, respectively. As a result, a total 8 patients were excluded. Thus, a total of 72 patients were included in the study for evaluation, comprising 35 in Group I and 37 in Group II. No statistically significant difference was determined between the groups in terms of age, gender, height, weight, BMI, ASA, operated side, prosthesis type, and operating time ($p>0.05$).

The results showed that in the FNB group where femoral nerve block was applied additionally to PCEA, mean 115.1 ± 20.5 ml local anesthetic solution was used and there was a need for additional analgesia at mean 9.4 ± 6.0 hours in 20 (57.1%) cases. In the LIA group, where local anesthetic infiltration was applied via the epidural route additional to PCEA, mean 111.6 ± 25.2 ml local anesthetic was used and there was a need for additional analgesia at mean 13.5 ± 7.3 hours in 21 (56.8%). Nausea as a response to treatment was seen in 2 patients in each group. In the VAS evaluations of the first 24 hours, a score of >4 was seen in a maximum of 4 patients in the FNB group and a maximum of 6 patients in the LIA group (Figure 1). There was no statistically significant difference between the groups in respect of PCEA dose, use of additional analgesia, the time of first analgesia use, and side-effects ($p>0.05$) (Table 2).

Also, there was no statistical significance between the groups in respect of flexion values at the measured times PR, 1-3 days PO and at 1.5 and 3 months PO ($p>0.05$). On PO day 1, the flexion values of group I patients were found to be higher than those of group II patients (65.7 ± 13.8 vs. 58.2 ± 13.6), (Figure 2).

In terms of functional knee scores, there was no statistically significant difference between the groups in the knee score values at all the measurement

times (p>0.05). When groups were evaluated within themselves, knee scores increased with time in both groups and this change was statistically significant. (p<0.05). Multiple comparison tests (post-hoc) were applied to determine at which time or times there was a difference. In both groups, the knee score values were different at all the measurement times, with the PR measurement found to be the lowest and the PO 3-month values the highest (Table 3).

Table 2 Analgesia and side effects monitored parameters.

Paremeters		Group I (n=35)	Group II (n=37)	P*
PCEA[1.] Dose total	*dose±SD*	115,1 ± 20,5	111,6 ± 25,2	0,512
Additional Analgesic Requirement	*n (%)*	20 (%57,1)	21 (%56,8)	1,000
Time of First Analgesia Use	*hour±SD*	9,4 ± 6,0	13,5 ± 7,3	0,056
Side-effects (nausea, vomiting)	*n (%)*	2 (%5,7)	2 (%5,4)	1,000

*Comparison between groups (Independent Samples t test), [1.] Patient controlled epidural analgesia, SD: Standard Deviasion

Table 3 Patients' degrees of knee flexion

Knee Score	Group I (n=35)	Group II (n=37)	p*
PR[1]	36,7 ± 9,6	37,9 ± 11,1	0,616
PO[2] 1.5. month	87,6 ± 4,4	85,2 ± 6,8	0,091
PO[2] 3. month	89,7 ± 3,0	90,1 ± 4,8	0,661
p**	**0,000**	**0,000**	

*Comparison between groups (Independent Samples t test), ** Intra-group comparison (Repeated Measures ANOVA),
[1] Preoperative, [2] Postoperative

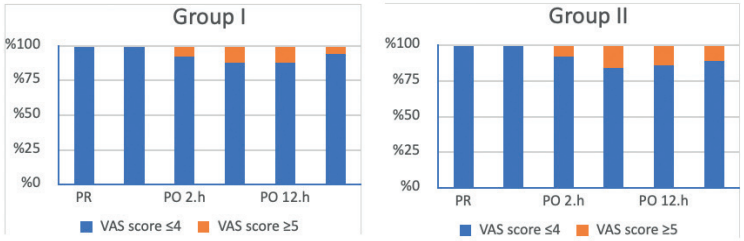

Figure 1
Comparison of Visual Analog Scale (VAS) scores
(PR: Preoperative, PO: Postoperative)

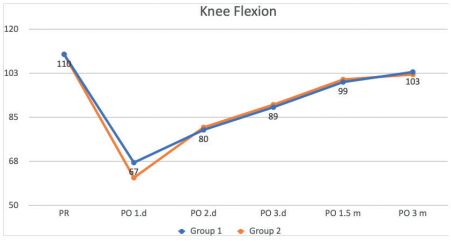

Figure 2
Comparison of knee flexion between groups
(PR: Preoperative, PO: Postoperative)
(PR: Preoperative, PO: Postoperative)

Discussion

The most important finding of this study was that both analgesia methods are seen to provide effective analgesia without causing serious complications in the early postoperative period. Considering the current orthopaedic literature, this study presents one of the largest, randomized, prospective studies investigating the efficacy and comparison of two different multimodal analgesia methods in fast-track TKA surgery.

Busch et al. reported that PCEA use was reduced, and patient satisfaction was increased with local infiltration (11). In a review of 14 studies, Kehlet and Anderson reported that a sufficient analgesic effect was not obtained with single injection LIA, which did not satisfy the practitioners and patient satisfaction was low (12). In patients applied with FNB, early postoperative mobilization may be hindered due to motor block in the quadriceps muscle, and it has therefore been reported that there could be a risk of falling for these patients (13). Fischer et al. considered LIA to be superior to FNB in postoperative analgesia after TKA as it does not create a motor block (4). Affas et al. examined four studies and reported that LIA and FNB had similar effects in postoperative analgesia after TKA, with no significant difference in pain scores or analgesia used in the first 24 hours (14). Carli et al found the analgesia quality to be better in patients applied with LIA compared to FNB, but the hospitalization period was prolonged (15). In another study by Tofdahl et al, the quadriceps function and the analgesia quality of the LIA group were found to be better than that of the FNB group, but in respect of the hospitalization period and the requirement for additional analgesia, the two groups were reported to be the same (16). According to the studies in a review by McCartney and McLeod, more effective analgesia was provided by LIA and FNB with PCEA. The pain scores and patient satisfaction were found to be similar for analgesia provided with PCEA+LIA and PCEA + FNB (17). In the current study, we found that there was no difference in both groups in terms of postoperative pain scores. LIA patients could be mobilized faster postoperative, but this did not change the hospitalization time and VAS scores.

When knee flexion values have been evaluated at postoperative follow-up examinations, there are studies that have reported no difference (18, 19) in the comparison of block and periarticular infiltration analgesia and some which have found a difference (16, 20). In the current study, while there was no difference determined between the groups in the follow-up examinations from the second postoperative day onwards ($p>0.05$), there was found to be a statistically significant difference in the degree of knee flexion in the first day evaluations ($p<0.05$). The flexion values of the patients in group I were found to be higher than those of group II on PO day 1. No statistically significant difference was determined between the groups in respect of extension values at any of the measured times ($p>0.05$).

No statistically significant difference was determined between the groups in respect of the knee and function scores at any of the measurement times ($p>0.05$). The higher joint range of movement values on the postoperative first day in the group applied with the block were considered to be associated with the prolonged inhibition of postoperative pain of the block compared to the periarticular infiltration analgesia. As low-dose local anesthetic is used in PCEA applied with LIA, there is no motor weakness in the lower extremity, allowing earlier rehabilitation compared to FNB+PCEA, patient comfort is increased, and fewer complications are seen such as deep vein thrombosis caused by immobility.

The study has some limitations. Although this study is one of the largest and prospective studies performed in fast-track THA surgery, the number of patients is still low. Although the patients were evaluated in terms of fast-track surgery, the short-term results were evaluated, but the lack of long-term results is a limitation.

Conclusion

As a result of this study, the effects of LIA and FNB methods used in addition to epidural PCEA in fast track THA surgery on analgesia and functional results were positive and similar. These two methods can be used safely in Fast track TKA surgery.

Conflict of Interest Statement
The authors have no conflicts of interest to declare.

Ethical Approval
All the researchers participating in the study signed the Helsinki Declaration. Local Ethics Committee approval granted from Ankara Numune Research and Training Hospital (04.12.2014 / E-14-353) for the study.

Consent to Participate and Publish
Informed consent was obtained from all the patients who participated in the study.

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