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ORIGINAL ARTICLE

Does the continuous intraarticular pain pump effective to decrease the pain after total knee arthroplasty?

Tuğcan DEMİR[1]
Fatma ALKAN BAYBURT[2]
Muhammet BOZOĞLAN[3]
Azime BULUT[2]
Kürşat AYTEKIN[1]

1. *Department of Orthopedics, Giresun University*
2. *Department of Anesthesiology and Reanimation, Giresun University*
3. *University of Health Sciences, İzmir Tepecik Health Research Center Department of Orthopedics*

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Corresponding Author: Tuğcan DEMİR, ORCID ID: 0000-0002-0273-832X

Department of Anesthesiology and Reanimation,Giresun University Faculty of Medicine, Giresun 28100, Turkey

E-mail: tugcandem@hotmail.com

Abstract

Objective: This study aims to show the efficiacy of continuous intraarticular pain pump administration after total knee arthroplasty for pain management.

Material and Methods: This retrospective study was conducted on bilateral knee arthroplasty surgery patients. The patients who has one-sided continuous intraarticular pain pump were investigated. The Visual analogue scale (VAS), at the 8th hour, 24th hour, 2nd weekend 1st month and the range of motion (ROM) at the 24th hour, 2nd weekend 1st month were evaluated at both knees.

Results: Twenty-six patients (25 female, 1 male) met the study criteria. The mean age was 71.66±5.07 years (63-81 years). The continuous intraarticular pain pump used knees were associated with a significant decrease in the VAS at the 8th and 24th hours. Though there were no differences in the range of motion between pain pump used and non-used knees at the 48th, 2nd weekend 1st month. No pain pump-related complications were detected.

Conclusion: Using a continuous intraarticular pain pump is effective in treating pain after total knee prosthesis. This benefit on pain relief does not make a significant difference in the range of motion of the knee.

Keywords: Total knee arthroplasty; pain pump; visual analogue scale; range of motion

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Introduction

Total knee arthroplasty (TKA) is the major treatment method for relieving pain in severe joint impairment but has a very painful erly post-operative period. High postoperative pain levels may cause patient dissatisfaction, decreased knee range of motion, increased narcotic analgesic use and prolonged hospital length of stay [1]. Besides, if severe postoperative pain is managed inadequately, the increased oxygen demand and higher strain on the cardiovascular system after a major operation such as TKA may pose serious damage to the patient [2].

Therefore, proper pain management after TKA is essential for the comfort of the patient, early functional recovery and to decrease the length of stay in the hospital. Multiple techniques have been used to provide pain control such as epidural analgesia, peripheral nerve block, periarticular injection and patient-controlled analgesia [3,4]. Continuous intraarticular local anesthetic infusion through elastomeric pumps is one of these techniques. Concern on chondrotoxic effects of local anesthetics in recent years have limited the use in arthroscopic surgeries but reports on their effectiveness after TKA are increasing in numbers. Mauerhanet al reported continuous intraarticular bupivacaine administration decreases pain but only four hours postoperatively [3]. Gomez–Cardero et al used ropivacaine and reported decreased pain, opioid use, and reduced hospital stay [4].

Our aims were to evaluate the effecivenesst of continuous intraarticular bupivacaine injection for postoperative pain control and to determine the effect of the pain pump on the recovery of postoperative range of motion of the knee.

Material and Methods

After ethics committee approval (19/09/2018, KAEK-57), patients who underwent bilateral total knee arthroplasty between January 2015 and July 2018 were screened retrospectively. The patients whose medical files were accessible, diagnosed with bilateral primary gonarthrosis, underwent bilateral total knee arthroplasty, operated under spinal anesthesia, had at least one month follow-up and applied a single knee continuous intraarticular pain pump were included to the study. Inflammatory diseases, diabetic neuropathy, psychiatric diseases, and allergies to morphine or local anesthetics medicines were the exclusion criteria for the study.

The biggest health insurance provider in our country only pays for one continuous intraarticular pain pump in one surgical session. All patients included in the study were informed in detail preoperatively about the function of the continuous intraarticular pain pump and also were informed that the pain pump could only be applied to one knee. An informed consent form was obtained from all the patients.

All the patients were operated as the first case in the morning and underwent spinal anesthesia. A tourniquet was placed on both lower extremities but not inflated. The tourniquet was inflated only at the cementation phase. Both lower extremities were stained with povidone-iodine. Firstly, surgery was performed on the left knee. The right lower extremities were re-stained and re-covered before beginning right knee surgery. All the patients underwent surgery with the same surgical team. All surgeries were done with a medial parapatellar approach. All patients had the same brand of prostheses (Smith & Nephew, Genesis II CR, USA). At the end of the surgery, the skin was closed with subcutaneous absorbable sutures and stapled.

Intraarticular drains were placed in both knees. The continuous intraarticular pain pump (ON-Q® PainBuster®, 270 mg, USA) was used only in one knee (left). The pain pump was prepared with 180 ml saline and 60 ml Marcaine® (AstraZeneca, Turkey, Kırklareli). The pain pump was inserted into the joint and was activated at the end of the operation with a 5 ml/hour infusion. The activation of the drain began in the second hour for 15 minutes and continued in this way every two hours. The standard protocol for painkillers was administered (Paracetamol 100 mg infusion 4X1 (Perfalgan®, Bristol-MyersSquibb, France), tramadol hydrochloride 100 mg 4X1 (Ultramex, ADEKA, Turkey), dexketoprofentrometamol 50 mg 1x1 (Arveles, Menarini, Turkey). In addition, 15 minutes of cold application was used every 2 hours. Subcutaneous enoxaparin 0.6 mL 1x1 (Clexane, Sanofi Aventis, Turkey) was applied for deep vein thrombosis prophylaxis for the first 10 days. For infection prophylaxis, cefazoline sodium 2x1 g (Cefamezine, Zentiva, Turkey) and gentamicin 80 mg (Genta, Bilim,

Turkey) were administered for two days. At the first postoperative day, all patients began active knee flexion with closed chain exercises for knee flexion and isometric quadriceps exercises with straight leg raise for knee extension. The patients were ambulated with double crutches. The pain pump and drains were removed at 48 hours. VAS values at the 8th and 48th hours, second weekend first month postoperatively were evaluated for each knee separately. The evaluations were made by the same orthopedic resident using the standard VAS pain scale. The loss of knee extension degree and flexion degree during knee closed chain were measured via a goniometer at 48th hours, second week and first month, postoperatively.

Statistical analysis

All data were analyzed using SPSS vn. 21.0 software (IBM Corpn., Armonk, NY, USA). Shapiro-wilk test was used to evaluate whether the data had a normal distribution or not. Two dependent variables with normal distribution were analyzed with the paired sample test and the wilcox on signed ranks test was used for two dependent variables that did not have a normal distribution. In all the comparisons, statistical significance was set at the level of $p<0.05$.

Results

The study consisted of 26 patients (25 female, 1 male) and the mean age was 71.66 ±5.07 years (63-81years).

The VAS scores of the patients at the 8th hour were 4.73±1.079 and 2±0.938 (right and left knee, respectively)(p=0.00). At the 48th hour, the VAS scores were 6.42±0.945 and 2.50±1.068 (right and left knee, respectively) (p=0.00). At the 2nd week the VAS scores for the right knee were 2.50±1.334 and the VAS scores for the left knee were 2.31±1.192 (p=0.096). At the 1st month, the VAS scores were 1.35±0.745 for the right knee and 1.27±0.667 for the left knee (p=0.414) (Table1).

The loss of knee extension degree of the patients at 48th hours were 16.38˚±4.801 and 13.88˚±4.752 (right and left knee, respectively) (p=0.57). These values were 9.38˚±3.817 for the right knees and 8.46˚±3.952 for the left knees at second week (p=0.404). At the 1st month, the loss of extension degrees of the right knees were 3.58˚±2.802 and the loss of extension degrees of the left knees were 2.88˚±2.123 (p=0.507) (Table2).

The knee flexion degrees of the patients at 48th hours were 68.42˚±10.458 and 72.69˚±10.781(right and left knee, respectively) (p=0.58). At the second week, the knee flexion degrees of the patients were 98.23˚±9.197 and 98.96˚±8.987 (right and left knee, respectively) (p=0.512). These values were 111.81˚±9.724 for the right knees and 113.58˚±9.257 for the left knees at the first month (p=0.411) (Table3).

There were not observed any skin complication, prolonged drainage, early enfection or systemic bupivacain side effect (eg, nausea, vomiting, dizziness) in the study group.

Discussion

This study highlights pain assessment of the patients in which a continuous intraarticular pain pump was used just for one knee after bilateral total knee arthroplasty surgery. The only difference between the knees that were evaluated in the study was whether or not to use a continuous intraarticular pain pump. VAS pain scores were found to be significantly lower in knees using a pain pump at the eight hand forty-eight hours.

Table 1: VAS pain scores at the follow-ups

VAS	Mean±Std Degrees		p
	R Knee	L Knee	
8th hours	4.73±1.079 (3-7)	2.00±0.938 (1-4)	0.000
48th hours	6.42±0.945 (5-8)	2.50±1.068 (1-5)	0.000
2ndweeks	2.50±1.334 (0-5)	2.31±1.192 (0-4)	0.096
1st month	1.35±0.745 (0-3)	1.27±0.667 (0-2)	0.414

R: Right, L: Left, p: Significance value, VAS: Visual Analogue Scale

Table 2: Loss of knee extension degreesat the follow-ups

ROM	Mean±Std Degrees		p
	R Knee	L Knee	
48th hours	16.38±4.801(7-30)	13.88±4.752 (5-25)	0.57
2nd weeks	9.38±0.817 (4-21)	8,46±3.952 (3-20)	0.404
1st month	3.58±2.802 (0-9)	2.88±2.123 (0-7)	0.507

R: Right, L: Left, p: Significance value, ROM: Range of Motion

Table 3: Knee flexion degrees at the follow-ups

ROM	Mean±Std Degrees		p
	R Knee	L Knee	
48th hours	68.42±10.458 (40-88)	72.69±10.781(45-90)	0.58
2nd weeks	98.23±9.197 (85-119)	98.96±8.987 (85-120)	0.512
1st month	111.81±9.724 (92-130)	113.58±9.257 (95-130)	0.411

R: Right, L: Left, Std: Standart deviation, p: Significance value, ROM: Range of Motion

Knee prosthesis surgery is an effective method to improve knee functions and pain due to arthrosis. After surgery, 60% of patients feel severe pain, while 30% of patients feel pronounced levels of pain [5]. There is no gold standard protocol for pain control, which effects postoperative rehabilitation and the duration of stay in the hospital. In the literature, generally opioid, NSAID and peripheral block use were described. Though these treatments were used, a variety of side effects were reported (nausea, vomiting, motor block and other GIS side effects) [6-9]. Continuous intraarticular analgesic administration aims to reduces systematic drug requirements and thus minimizing these side effects and simultaneously ensure better pain control. Williams et al. reported pain scores and morphine consumption did not reduce using a 0.5% bupivacaine infusion pump over 48 hours [10]. Ali et al. compared an infusion pump with a placebo in a study and did not identify pronounced clinical differences in VAS pain scores, hospital stay, morphine consumption and drug side effects. They reported they stopped clinical administration due to identifying an increase in deep infections [9]. Rasmussen et al. used morphine and ropivacaine infusion to reduce pain after knee prosthesis and ensured early mobilization and they reported hospital stay shortened, knee flexion increased and morphine consumption reduced in this way [11]. Ong et al. reported that patient-controlled intravenous morphine infusion with an additional bupivacaine infusion pump was effective in reducing pain, reducing morphine consumption and increasing function [12]. Goyal et al. identified a clear reduction in VAS scores and opioid requirements, especially in the first 2 days in a study comparing placebo with bupivacaine infusion. The same study did not observe any difference between the two groups in terms of complications [13]. In this study, we identified the VAS scores were better in the 8th and 48th hours for the knees with the infusion pump. We observed the analgesic requirements for knees without pumps were more pronounced, especially in the first 48 hours. We did not identify any significant difference in VAS scores in the 2nd weekend 1st month.

There are a variety of studies about the effects on ROM of local anesthetic administration after knee surgery. Mullaji et al. administered local infiltration (bupivacaine, fentanyl, methylprednisolone acetate, cefuroxime) to single knees in addition to the analgesic

treatment protocol in patients with TKA performed on both knees. During follow-up, they identified that VAS scores were low on the infiltration side during postoperative 1st day, discharge day, 2nd and 4th week check-ups. In the same study knee flexion was found significantly better on the infiltration side at discharge, 2nd weekend 4th week. Especially in 4th week controls, only 5 patients had flexion below 120 degrees on the infiltration side, while 16 patients without infiltration had flexion below 120 degrees [14]. Busch et al. compared knee prosthesis patients with local injection of ropivacaine, ketorolac, apomorphine and epinephrine mixture with patients without injection and did not find any significant differences in terms of knee ROM at 6-week check-up [15]. Gomez-Cardero et al [4] identified a significant fall in VAS score and opioid requirements for patients with ropivacaine intraarticular infusion compared to the placebo group and stated that there was higher knee ROM especially until the 1st month, with the same level of ROM after the first month. In this study, both the extension loss and flexion degress of the knees that continuous intraarticular pain pump used or not used did not show a significant difference. Although it is thought that postoperatively good pain relief will increase functional results, we found that pain level and functional recovery were not positively correlated in this patient group.

There is variety in the local infiltrative drugs and their administration durations. These drugs have a very similar half-life time. The half-life of bupivacaine is 3.5 hours, while ropivacaine varies from 2-6 hours [12]. In their meta-analysis, Zhang et al. did not directly compare these two drugs but reported that indirect comparisons found that ropivacaine had a more protective effect against pain. Additionally, 2 cc/hour infusions were reported to be more effective on 24-hour and 48-hour VAS scores compared to infusions below 2 cc/hour [16]. The Daily recommended bupivacaine limit is 400 mg [17]. In this study, we used 300 mg bupivacaine in a continuous infusion of 5 cc/hour. We did not observe any skin complications or systematic bupivacaine side effects. We obtained a clear benefit for VAS scores on eight and forty-eight hours.

The main limitation of this study is the small number of patients but with our knowledge in the literature, there is no study that assesses the effect of continuous intraarticular pain pump in the single knee on patients with bilateral total knee arthroplasty. All the other studies were designed with a placebo. The biggest advantage of this study is; the control group of the continuous intraarticular pain pump usage is the other knees of the same patients. Therefore, we think that the evaluation of the efficacy of the continuous intraarticular pain pump in this study provides more accurate results.

Conclusion: Pain management with a continuous intraarticular pump is an effective method for eight and forty-eight hours after total knee arthroplasty. This treatment does not provide beneficial effects for postoperative functional recovery.

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

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