Original Article

The effect of pre-incisional wound site infiltration with multimodal analgesia on postoperative pain in total knee arthroplasty

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Received – 14 July 2019 Initial Review – 22 July 2019 Accepted – 28 August 2019

ABSTRACT

Background: Though Total knee arthroplasty (TKA) is an effective treatment method for osteoarthritis, insuffient postoperative pain management affects paitents satisfaction and functional results. To an effective postoperative pain management, several methods are used for analgesia. Aim of this study was to evaluate the effect of the application of pre-incisional wound site infiltration on postoperative analgesia, additional to multi-modal analgesia methods for the provision of analgesia following Total Knee Arthroplasty. **Material and methods:** Total of 80 patients aged ≥55 years posted to undergo TKA were randomly separated into 2 groups. Pre-incisional injection was administered to the skin for the group I patients, wherreas patiemts of group II were not administered pre-incisional injection. For postoperative pain management additional multi-modal analgesia methods were applied in both groups. To evaluate the level of postoperative pain, a Visual Analog Scale (VAS) score at rest and dynamic VAS (DVAS) during activity were used. The time of requirement for first analgesia and the amount of analgesia required were recorded. The patients were monitored throughout the operation and in the postoperative period for side-effects. **Results:** Postoperative VAS scores of Group I were found to be statistically significantly lower than those of Group II ($p<0.05$). The DVAS scores which were evaluated together with mobilisation, determined to be statistically significantly lower in Group I ($p<0.05$). The time of requirement for analgesia was determined to be later in Group I and the total amount of analgesia administered in the postoperative period was lower in Group I. No statistically significant difference was determined between the two groups in side-effects. **Conclusion:** The application of pre-incisional infiltration can be considered to be a safe and effective method, which is easy to apply and has low potential for side-effects, while increasing the efficacy of multi-modal analgesia..

Key words: *Total knee arthroplasty, Pain management, Multimodal analgesia, Pre-incisional infiltration*

Total knee arthroplasty (TKA) is an effective treatment method for osteoarthritis [1]. However, the provision of insufficient postoperative pain control to patients applied with TKA increases patient dissatisfaction, prolongs length of stay in hospital and causes economic losses [2]. Early mobilisation, sufficient joint range of movement and the regaining of muscle strength are possible with an effective postoperative pain management method. Therefore, following TKA, several methods are used for postoperative analgesia, such as intravenous analgesia, epidural analgesia, peripheral nerve blocks, patient-controlled drug administration and multi-

modal analgesia [3]. Although these methods are widely used, each one has systemic or local side-effects. While epidural analgesia is associated with urinary retention, itching and spinal cord ischaemia, systemic opioid anaesthetics may cause nausea, vomiting, respiratory depression and urinary retention. With the use of peripheral nerve blocks, vascular punction and nerve damage may be seen [4,5]. Recent studies have focused on multi-modal analgesia methods, which can improve early postoperative pain control and reduce side-effects [6, 7].

This study was undertaken with an aim to evaluate the effect on postoperative analgesia with the application of pre-incisional wound site infiltration, additional to intraoperative peri-articular injection and intra-articular catheterisation as multi-modal analgesia methods for the provision of analgesia following TKA.

MATERIAL AND METHODS

This single-centre, prospective, randomised, controlled study was conducted between February 2016 and January 2017. Approval for the study was granted by the Local Ethics Committee (decision no:2016/02-14). The study included patients aged ≥ 55 years, evaluated as ASA I-III (American Society of Anesthesiologists), who underwent TKA under spinal anaesthesia for unilateral primary osteoarthritis in the defined study period. Informed consent was obtained from all the study participants. Patients with known allergy to the drugs to be used, previous history of knee surgery, cases with bilateral TKA, severe liver or kidney failure, a history of stroke, coronary artery disease, who were unable to cooperate, or had contraindications to regional anaesthesia were excluded from the study. A total of 80 patients who met the criteria were included in the study for prospective evaluation.

In the operating room pre-medication of 0.03 mg/kg midazolam (Zolamid®, Defarma, Ankara, Turkey) was administered intravenously (IV) to all patients. Preoperative hydration was provided with 15-20 ml/kg saline IV in 30 mins. With the patient in a sitting position, the appropriate area was cleaned then a 25G Quincke spinal needle (Egemen ®, Izmir, Turkey) was entered to the subarachnoid space from the L3-4 or L4-5 intervertebral space midline, and after the observation of free CSF flow, 10-15 mg 0.5% bupivacaine HCl (Buvasin ® 0.5% spinal heavy, VEM, Tekirdag, Turkey) was injected. After the administration of the spinal anaesthesia, the sensory block level was tested with the pinprick test and the motor block level with the Bromage score (0: no paralysis, 1: only the knee and foot can be moved, 2: able to flex the knee with free movement of the foot, 3: the foot and toes cannot be moved, total paralysis). When the sensory block reached T10 level and the Bromage score was 2, the surgery was started.

The patients were randomly separated into 2 groups. To Group I, at approximately 5 mins before surgery, a 10ml pre-incisional injection of 0.25% bupivacaine (Buvasin ® 0.5% VEM, Tekirdag, Turkey) was administered to the skin and below the skin along the incision line. No pre-incisional injection was applied to the patients in Group II. The age, gender, body mass index (BMI), ASA score and additional diseases were recorded for each patient. For postoperative pain management in both groups, a periarticular injection as intraopereative analgesia, and an infiltraton catheter as postoperative pain management method was applied. The periarticular injection consisted of 0.5% bupivacaine 20 ml (Bustesin®, Vem, Ankara, Turkey), 1 mg/ml adrenalin 0.6 ml (Adrenalin®, Oesel, Istanbul, Turkey), 100 mcg/ ml of dexmedetomidine 1 ml (Precedex®, Meditera, Izmir, Turkey), 8.4% magnesium sulphate 4 ml (Magnesium Sulphate®, Biofarma, Istanbul, Turkey), 10 mg/ml methylprednisolone 4 ml (Prednol-L®, Mustafa Nevzat, Istanbul, Turkey), 10 mg/ml morphine 5 ml (MorphineHCl®, Galen, Istanbul, Turkey) and 65.4 ml saline to form 100 ml solution prepared in two 50ml injectors. The injections were administered as recommended by Dye et al, taking into consideration the areas with increased neurosensorial and mechanoreceptors [8].

The multi-holed infiltration catheter applied for postoperative analgesia (On-q PainBuster®, I-Flow Corporation, Braunfels, Germany), was placed intracapsularly so that the distal end was at the midpoint of the surgical incision. The infusion of 0.25% bupivacaine was administered at the rate of 5ml/hour for 48 hours. The patients were monitored throughout the operation and in the postoperative period in respect of respiratory depression, nausea, vomiting, hypoxia(SpO_2 value <90% for 30 secs), hypertension (control systolic blood pressure [SBP] >20% or >150 mmHg), hypotension (control SBP <20% or <70 mmHg), tachycardia (control heart rate (HR) >20% or >110 bpm), bradycardia (control HR <20% or <40 bpm), and allergic reactions. To evaluate the level of postoperative pain, a Visual Analog Scale (VAS) score at rest and dynamic VAS (DVAS) during activity were used. The postoperative pain levels were evaluated at 2, 4, 8, 12, 24, 36 and 48 hours postoperatively by an anaesthetist trained on this subject. When the VAS score was >4, 50 mg dexketoprofen trometamol iv (Ketavel ®, DEVA,

Kocaeli, Turkey) was administered first as analgesia, and when VAS was >4 within 40 mins, tramadol HCl (Tramosel ®, Haver, Istanbul, Turkey) was administered iv in 100 ml saline. The time of requirement for first analgesia and the amount of analgesia required in 48 hours were recorded.

Data obtained in the study were analysed statistically using IBM SPSS vn 23.0 software. Descriptive statistics of the data were stated as mean ± standard deviation (SD) or median (minimum-maximum) values for quantitative variables and as number (n) and percentage (%) for qualitative variables. Conformity of the data to normal distribution was assessed with the Shapiro-Wilk test. In the comparisons of 2 groups, the t-test was used for data showing normal distribution and the Mann Whitney U-test was used for data not showing normal distribution. The Friedman test was applied to comparisons within the groups. In the examination of categorical data, the Pearson Chi-square test, Fisher's Exact Chi-square test and the Fisher-Freeman-Halton test were used and in the comparisons of dependent categorical data, the McNemar test was applied. The level of statistical significance in the evaluations was accepted as α=0.05.

RESULTS:

No statistically significant difference was determined between the patient groups in respect of demographic data (Table 1). At postoperative 0 hour, no difference was observed between the two groups in the VAS scores at rest. At postoperative 2, 4, 24 and 36 hours, the VAS scores at rest of Group I were found to be statistically significantly lower than those of Group II ($p<0.05$). When the DVAS results were examined, which were evaluated together with mobilisation after the postoperative 24th hour, The DVAS scores at 24, 36 and 48 hours were determined to be statistically significantly lower in Group I than in Group II ($p<0.05$) (Table 2).

Table 1: Demographic data of the patients

	Group I (n=40)	Group II (n=40)	p
Age (years) [#]	67.35±6.03	66±8.17	0.403
Gender (F) [α] **(M)** [α]	32(80%) 8(20%)	35(87.5%) 5(13.5%)	0.363
Weight (kg) [#]	74.18±8.88	71.33±8.59	0.149
Height (cm) [€]	165 (150-175)	165 (150-175)	0.587
BMI (kg/m^2) [#]	27.43±2.97	26.69±2.77	0.252
Presence of comorbid diseases [α]	38(95%)	40(100%)	0.494
ASA [α]			
I	2(5%)	0(0%)	
II	37(92.5%)	37(92.5%)	0.362
III	1(2.5%)	3(7.5%)	
Preoperative Deformity (Degree)	8.30±5.01	8.75±4.31	0.668

BMI: Body Mass Index, **ASA:** American Society of Anesthesiology, [#]: mean ± standard deviation (SD), [€]: median (minimum-maximum), [α]: n(%)

Table 2: Postoperative resting and dynamic pain scores

	VAS			DVAS		
	Group I	**Group II**	**p**	**Group I**	**Group II**	**p**
0 hour [€]	0 (0-0)	0 (0-0)	1.000	-	-	-
2 hours [€]	0 (0-3)	2 (0-5)	**<0.001***	-	-	-
4 hours [€]	2 (0-5)	4 (0-6)	**<0.001***	-	-	-
8 hours [€]	4 (2-5)	4 (2-6)	0.563	-	-	-
12 hours [€]	4 (2-5)	4 (2-5)	0.714	-	-	-
24 hours [€]	3 (2-5)	4 (2-5)	**0.006***	4 (2-5)	5 (4-6)	**<0.001***
36 hours [€,**]	2 (0-4)	2 (0-4)	**0.011***	2 (0-4)	3 (2-4)	**0.001***
48 hours [€]	2 (0-4)	2 (0-4)	0.400	2 (0-3)	2 (0-4)	**0.017**

*p <0.05 [€]: median (minimum-maximum) ****:** At 36 hours, although the change in the VAS scores was the same, a statistically significant difference was determined. The mean row points were 46.62 in Group II, and lower at 34.38 in Group I.

In the evaluation of the requirement for and amount of analgesia in the postoperative period, the time of requirement for analgesia was determined to be later in Group I and the total amount of analgesia administered in the postoperative period was lower in Group I than in Group II ($p<0.001$) (Table 3). No statistically significant difference was determined between the two groups in respect of respiratory depression, nausea, vomiting, hypoxia, hypertension, hypotension, tachycardia, bradycardia or allergic reactions ($p>0.05$) (Table 4).

Table 3: The time of first analgesia requirement postoperatively and the total amount of analgesia administered.

	Group I	Group II	P
Time of first analgesia requirement (post-op hour) [€]	8 (4-12)	4 (2-24)	**<0.001**
Dexketoprofen consumtion (mg) [#]	72.50 ± 27.619	123.75 ± 40.80	**<0.001**
Tramadol consumption (mg) [#]	145 ± 55.23	247.50 ± 81.61	**<0.001**

[€] : median (minimum-maximum) [#]: mean ± standard deviation

Table 4: Postoperative side-effects

	Group I	Group II	p
Vomiting	0 (0%)	2(5%)	0.494
Nausea	3(7.5%)	8(20%)	0.105
Tachycardia	2(5%)	0(0%)	0.494
Hypotension	4(10%)	4(10%)	1.00
Bradycardia	1(2.5%)	4(10%)	0.359

DISCUSSION

The results of this study showed that the VAS values at 2, 4, 24 and 36 hours postoperatively and the DVAS values examined together with mobilization were statistically significantly lower in the group applied with pre-emptive analgesia. Correspondingly, the time of first requirement for analgesia was later in the patient group applied with pre-emptive analgesia, and the total analgesia requirement was lower than in the control group. Appropriate pain control improves the early functional results of TKA and increases patient satisfaction. However, although systemic opioids administered after TKA are the most effective pain control method, there may be several side effects on the circulatory, urinary, gastrointestinal and nervous systems [9, 10]. While multimodal analgesia provides effective pain control, opioids can decrease side effects. This technique aims to provide effective analgesia by affecting various stages of the pain pathways with methods such as central and peripheral nerve blocks, preventive analgesia, periarticular block, and postoperative oral or parenteral analgesia [4-7, 11].

In a randomised, controlled study by Tsukada et al, periarticular injection was compared with epidural analgesia. The postoperative VAS scores of the group applied with periarticular analgesia were reported to be lower and opioid-related side-effects were seen less in this group, and it was therefore concluded that periarticular injection was more effective than epidural analgesia [12]. In the current study, which was conducted to evaluate the efficacy of pre-incisional wound site infiltration, it was aimed to provide effective analgesia after TKA with multi-modal methods to avoid the side-effects of systemic opioids. In both groups, spinal anaesthesia, periarticular injection and catheter, and IV patient-controlled analgesia (PCA) were used. In another study that evaluated the costs and efficacy of peri-operative pain management, groups were compared of patients applied with femoral nerve block (FNB) +PCA, periarticular injection (PAI)+PCA, and PAI alone. It was reported that postoperative pain scores were lower in the patients in the PAI alone group, rehabilitation values, such as walking and going up stairs, were better, length of stay in hospital was shorter, and costs were lower [13].

Youm et al compared 3 groups applied with PAI, FNB, and PAI+FNB, and reported that patients in the PAI group experienced less pain in the first 8 hours postoperatively, but from postoperative 24 hours onwards, the VAS scores of the FNB group were lower. This was considered to be related to the postoperative rebound effect of PAI, and therefore, more effective analgesia was provided by the additional application of FNB reducing this rebound effect [14]. As quadriceps weakness and postoperative falls following FNB have been reported in literature [15], it was thought that this could affect postoperative rehabilitation, so in the current study, to avoid the rebound effect of PAI, instead of applying femoral block it was planned to increase the duration of analgesia by applying an intra-articular infiltration catheter at the rate of 5ml/hour infusion for 48 hours to both groups.

Wound site infiltration in the surgical area is applied with the aim of providing postoperative analgesia with a catheter preoperatively or postoperatively, delivering drug infiltration to the skin and subcutaneous tissues or proximal of the nerve sheaths. While wound site infiltration alone provides sufficient analgesia in minor surgical interventions (eg, cholecystectomy, tonsillectomy, inguinal hernia repair), its efficacy in major surgical interventions is debatable and opioid support may be required. The postoperative pain values of the patients applied with infiltration in the current study were better than those of the control group, and the need for analgesia

was reduced. Therefore, the application of pre-emptive infiltration can be considered to be a safe and effective method, which is easy to apply and has low potential for side-effects, while increasing the efficacy of multi-modal analgesia.

CONCLUSION

The postoperative pain values of the patients applied with infiltration in the current study were better than those of the control group, and the need for analgesia was reduced. Therefore, the application of pre-emptive infiltration can be considered to be a safe and effective method, which is easy to apply and has low potential for side-effects, while increasing the efficacy of multi-modal analgesia.

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Funding: None; Conflict of Interest: None Stated.

How to cite this article: Cansabuncu S , Yilmaz C , Cansabuncu G, Çağlayan U, Karasu D. The effect of pre-incisional wound site infiltration with multimodal analgesia on postoperative pain in total knee arthroplasty. East J Med Sci. 2019:4(4);144-148.

DOI: 10.32677/EJMS.2019.v04.i04.001