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Efficacy of subcutaneous lidocaine injections in patients with painful total knee arthroplasty

Ağrılı total diz protezi olan hastalarda subkutan lidokain enjeksiyonunun etkinliği

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ABSTRACT

Objectives: This study aims to investigate the efficacy of injection of subcutaneous lidocaine in the management of pain that arises after total knee arthroplasty (TKA).

Patients and methods: Data of 56 patients who had postoperative pain related with TKA between December 2013 and April 2014 were retrospectively evaluated. All patients were given an exercise program and oral non-steroidal anti-inflammatory drugs. According to the treatment applied, the patients were divided into two groups: 33 patients given lidocaine injection to the painful knee sites by the same physiatrist constituted group 1, and the remaining 23 patients, who had been treated only with exercise program and oral non-steroidal anti-inflammatory drugs, constituted group 2. Demographic data, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and visual analog scale (VAS) scores were recorded. These data were taken into consideration for the first and third month evaluations.

Results: Both of the groups had higher initial scores for VAS and WOMAC (WOMAC total score group 1: 29.9, group 2: 34.2; VAS total score group 1: 8.3, group 2: 8.0). There were significant decreases in WOMAC and VAS scores ($p<0.001$) in both groups when the values before and after the treatment were compared. The decrease in the scores of group 1 was significantly higher than that of group 2.

Conclusion: Subcutaneous lidocaine injections had short-term positive effects in patients who had postoperative pain after TKA. Future studies with larger sample may make the long-term effects of this intervention explicit.

Keywords: Pain; subcutaneous lidocaine; total knee arthroplasty.

ÖZ

Amaç: Bu çalışmada total diz protezi (TDP) sonrası ortaya çıkan ağrı tedavisinde subkutan lidokain ile yapılan enjeksiyonun etkinliği araştırıldı.

Hastalar ve yöntemler: Aralık 2013 - Nisan 2014 tarihleri arasında TDP ilişkili ameliyat sonrası ağrısı olan 56 hastanın verileri geriye dönük olarak değerlendirildi. Tüm hastalara egzersiz programı ve oral nonsteroidal antiinflamatuar ilaç verildi. Hastalar uygulanan tedaviye göre iki gruba ayrıldı: ağrılı diz bölgelerine aynı doktor tarafından lidokain enjeksiyonu uygulanan 33 hasta grup 1'i, yalnız egzersiz ve oral nonsteroidal antiinflamatuar ilaç verilen 23 hasta ise grup 2'yi oluşturdu. Demografik veriler, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) ve görsel analog ölçeği (GAÖ) skorları kaydedildi. Birinci ve üçüncü ayda yapılan değerlendirmelerde bu veriler göz önünde bulunduruldu.

Bulgular: Her iki grubun GAÖ ve WOMAC için başlangıç skorları daha yüksekti (WOMAC total skoru grup 1: 29.9, grup 2: 34.2; GAÖ total skoru grup 1: 8.3, grup 2: 8.0). Tedavi öncesi ve sonrası değerler karşılaştırıldığında her iki grupta da WOMAC ve GAÖ skorlarında anlamlı derecede azalma vardı ($p<0.001$). Grup 1'deki skorlardaki azalma grup 2'ye kıyasla anlamlı derecede yüksekti.

Sonuç: Total diz protezi sonrası ağrısı olan hastalara yapılan subkutan enjeksiyonunun kısa dönemde olumlu etkileri oldu. İleride yapılacak daha kapsamlı çalışmalarla bu müdahalenin uzun dönemdeki etkilerine ışık tutulacağı kanaatindeyiz.

Anahtar sözcükler: Ağrı; subkutan lidokain; total diz protezi.

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Symptomatic severe osteoarthritis of the knee and hip joints usually requires surgical treatment with total joint arthroplasty.[1] Total knee arthroplasty (TKA) is one of the most successful orthopedic operations,[2] and it is performed to reduce pain or functional disability[3] but persistent postoperative pain remains as a serious problem.[4] Inflammatory factors due to surgical trauma directly and indirectly may result in pain. Pain can also cause severe muscle spasm and this may eventually lead to the spasm-pain-spasm cycle.[5-7] Chronic postsurgical pain (CPSP) is defined as pain that occurs after a surgical procedure and lasts for at least two months.[8] However, the International Association for the Study of Pain (IASP) characterizes CPSP according to the type of surgery.[9] Pain severity generally draws plateau on the third month after TKA.[10] For this reason IASP has specifically defined persistent postsurgical pain as pain that developed after surgery, which has been present for at least three months.[11] Consequently, postoperative management plays a very important role during the post-acute phase of rehabilitation after TKA.[12,13] Patients often complain of the pain and weakness around their knees.[13] According to International Classification of Functioning, Disability and Health (ICF) there are several limits on these patients' body functions, activity and participation in daily life activities. So that it is important to measure the patients' functioning and disability and to give the appropriate intervention.[14,15] There are several techniques for management of the pain and functional status such as medications,[16-20] bisphosphonates,[1] acupuncture,[13] epidural analgesia,[21-24] femoral nerve block,[23,25] adductor canal block,[26] relaxation techniques,[8] kinesio taping,[27] and periarticular and intra-articular multimodal analgesia infiltration.[24] Although all of these methods are used commonly for pain relief and functional recovery, none of them have enough effects on pain, and most of the methods may cause side effects. Another method for pain relief is needed, which is easy to apply and has less side effects. Lidocaine is a peripheral nerve sodium channel blocker and it causes a selective and partial block of A-delta (Aδ) and C fibers, and lidocaine may be used as an analgesic method in neuropathic path.[28] Character of pain after TKA is usually neuropathic.[29,30] therefore lidocaine may be a useful agent for the pain relief for these patients but it is generally used in clinical practice as a medicated plaster for neuropathic pain.[31-33] There is no data about its being used as a subcutaneous injection in patients with painful knee prosthesis. Thus our study is the first one that investigates the effects of subcutaneous lidocaine injections in patients with painful TKA.

PATIENTS AND METHODS

Data were obtained from 56 patients who were operated for knee arthroplasty between December 2013 and April 2014. Patients who have persistent neuropathic pain for at least three months were chosen for the study. Radiographs of the sample knee were taken from all patients before the surgery. Anterior-posterior radiographs were taken from all patients to exclude the problems caused by the prosthesis. Patients who had bleeding disorders, infection and cancer were excluded from the study. All patients (n=56) had been treated with an exercise program and oral non-steroidal anti-inflammatory drug. Thirty-three of the patients (group 1: 2 males, 31 females; mean age 63.6±7.2 years), who gave consent for injection, had been treated by the same physiatrist with subcutaneous lidocaine injections as an additional therapy to the painful knee sites. Twenty-three female patients (group 2: mean age 63.6±5.2 years) had been treated only with exercise program and oral non-steroidal antiinflammatory drug. Exercise program and analgesic medication (NSAID) were applied to all patients. Subcutaneous lidocaine injection was performed to 33 patients (group 1). Exercise and oral medication were given to 23 patients (group 2). Informed consent was obtained from all the patients. Exercise program consists of a range of motion exercises especially for the knee flexor and extensor muscles, and knee flexor stretching three times a day. Injections were applied to patients once a week during a five-week period. Sterile lidocaine (2 mL) was mixed with 100 mL sterile saline and applied with a 2 mL sterile injector (29 gauge) to painful areas of prosthetic knees, application areas being about 1 cm apart from each other. Patients were regularly examined in the first and third months after the treatment was completed. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and visual analog scale (VAS) were used to evaluate the pain and functional status. The WOMAC questionnaire is one of the tools used for the evaluation of patients' functional status in rheumatic diseases especially knee osteoarthritis. Three domains of stiffness, pain, and functional limitation were measured with this questionnaire. Higher scores reveal worse patient status. Visual analog scale is a numeric scoring system, which evaluates the pain in a 10-base system and higher scores signify more severe pain. A local ethics committee and health authority approved the study protocol and it was conducted in accordance with the principles of the Declaration of Helsinki.

Table 1. Sociodemographic data

	Group 1 (n=33)					Group 2 (n=23)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Age (years)			63.6±7.2	63	50-77			63.6±5.2	65	50-72	0.72
Gender											0.67
Female	31	93.9				23	100				
Male	2	6.1				0	0.0				

Group 1: Injection and exercise+medicatio; Group 2: Only exercise + medication; SD: Standard deviation; Min: Minimum; Max: Maximum.

Statistical analyses were calculated with the IBM SPSS version 20.0 software (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean, standard deviation, median and minimum-maximum. For categorical variables, data were expressed as numbers and percentages. The distribution of the continuous variables was evaluated for their assumption of normality with the Shapiro Wilk test in VAS and WOMAC values. Comparisons within the groups, VAS and WOMAC Total values for the beginning, first month and third month were performed by Friedman test, because the distributions were not normal and *p* values less than 0.05 were considered significant. Bonferroni corrected Wilcoxon test was used for pairwise comparisons (corrected significance threshold level was accepted as p<0.016). For categorical variables, Fisher's exact test was used to assess differences in the comparison of gender. Mann-Whitney U test was used to examine the differences between study groups, (because the percentage differences in time periods within groups were not distributed normally) and *p* values less than 0.05 were considered significant.

RESULTS

There was no statistically significant difference between age and gender in the two groups (Table 1).

Improvement in ratio of visual analog scale scores

The VAS score was 8.3±0.5, 3.6±2.0, 3.1±2.1 at the initial assessment, first month and third month in group 1, respectively. The VAS score was 8.1±0.3, 6.8±0.6, 6.4±0.7 at the initial assessment, first month and third month in group 2, respectively. The intragroup comparisons of VAS pain score decreased at the end of the first and third months in both groups (p=0.001). The intergroup comparison of the level of improvement was better in group 1 from initial assessment to first month and initial assessment to third month. But the level of improvement from first to third month was statistically similar (Table 2).

Improvement in ratio of WOMAC total scores

The WOMAC total scores were 29.9±0.0, 17.7±5.9, 17.7±5.9 at the initial assessment, first month and third month in group 1, respectively. The WOMAC total scores were 34.2±3.1, 3.0±1.3, 34.8±2.9 at the initial assessment, first month and third month in group 2, respectively. The intragroup comparisons of WOMAC total scores decreased at the end of the first and third month in both groups (p=0.001). The intergroup comparison of the amount of improvement was better in group 1 from initial assessment to first month and first month to third month. But the amount of improvement from initial assessment to third month was statistically similar (Table 3).

Improvement in ratio of WOMAC subscales

For both of the groups, WOMAC pain, stiffness, and physical function scores were high. At the end of the first month, there was significant decrease in WOMAC pain, stiffness and physical activity scores

Table 2. Visual analog scale scores

Amount of VAS improvement	Group 1 (n=33)	Group 2 (n=23)	
	Difference	Difference	
	Median	Median	**p*
First month-initial assessment	-5.003	- 4.310	0.001
Third month-initial assessment	-4.999	-4.310	0.001
Third month-first month	-3.638	-3.317	0.525
‡*P*	0.001	0.001	

VAS: Visual analog skala; Group 1: Injection and exercise + medication; Group 2: Only exercise + medication; * Mann-Whitney U; ‡ Wilcoxon signed ranks test.

Table 3. Western Ontario and McMaster Universities Osteoarthritis Index total scores

Amount of WOMAC improvement	Group 1 (n=33)	Group 2 (n=23)	
	Difference	Difference	
	Median	Median	*p
First month-initial assessment	-5.196	-3.873	0.001
Third month-initial assessment	-5.196	-1.414	0.157
Third month-first month	-3.638	-3.317	0.525
‡P	0.0001	0.001	

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index; Group 1: Injection and exercise + medication; Group 2: Only exercise + medication; * Mann-Whitney U; ‡ Wilcoxon signed ranks test.

in both groups but at the end of the third month, although there was significant decrease in group 1, there was no difference between the initial score and third month score in group 2.

DISCUSSION

Total knee arthroplasty in patients with severe osteoarthritis is generally considered as a successful procedure with good clinical results.[34] This led increased amounts of TKA procedures with indications of knee arthroplasty to be extended to younger patients.[35] Due to increasing rates of arthroplasty, there is also an increase in complications. Bourne et al.[36] found that only 81% of patients expressed satisfaction with their primary TKA. A recent systematic review by Beswick et al.[37] suggested that between 19% and 31% of patients had an unfavorable pain outcome after TKA. Pain is one of the most common complaints in TKA.[23,38] As in many other disease managements of painful TKA, the first choice of the patients is medical treatment. Gong et al.[16] found that postoperative combined use of celecoxib and eperisone significantly reduced morphine consumption by 22.35% compared to patients who were only administrated with celecoxib. In our trial we used diclofenac potassium 50 mg, three times a day for each patient in both groups. Mikashima et al.[13] found that acupuncture provides effective treatment during the post-acute phase of rehabilitation after TKA with respect to pain relief and reduction of swelling around the knee. Singh et al.[39] found that a single intra-articular injection of botulinum neurotoxin type A (BoNT/A) improved pain and function in patients with chronic, refractory painful knee arthroplasty. But cost-effectiveness and health repayment problems are important factors for choosing this treatment option and there is a need for further research with large sample sizes. In a case presentation, a patient with postoperative TKA pain was successfully treated with genicular nerve radiofrequency (GN RF) ablation.[40] Although there was no other case about GN RF results of management of painful TKA, this case is important for building a different perspective of painful arthroplasty. Other treatment options include psychotherapy (i.e. cognitive-behavioral therapy), physiotherapy, relaxation training, occupational therapy, aerobic exercise, strength training, sensomotoric training, and creative or music therapy.[34] In our study, we created an exercise program for our patients including quadriceps isometrics, vastus medialis strengthening and hip abductor strengthening for both groups. Postoperative treatment with bisphosphonates revealed good results in pain management and they may have a role in prevention of periprosthetic bone loss after TKA, but further studies are needed.[41,42] Poor ligamentary and neuromuscular control may result in destructive mechanical stress and reduced control over anterior shear forces on the knee implant. Donec et al.[27] found that Kinesio Taping® technique appeared to be beneficial for reducing postoperative pain. Each of these analgesic models has a different efficacy mechanism with different features on clinical results, health payment rules, side effects, etc. There is no article that investigates the benefits of subcutaneous injection of lidocaine after TKA. Jørgensen et al.[43] found that intra-articular bolus injections of 10 mL lidocaine (10%) and 40 mg glucocorticosteroid (depomedrol) were effective on pain relief in both knee joint and surrounding muscles for at least two weeks after knee osteoarthritis. However, lidocaine given to the intraarticular space was not subcutaneous and since it was mixed with a glucocorticosteroid preparation, therefore it is not possible to say that this positive effect was due to lidocaine. In a prospective cohort study, Khanna et al.[44] found that concurrent use of lidocaine patch 5% in treating the postoperative pain of patients after TKA does not provide significant additional pain relief compared to the control subjects. But lidocaine was not directly injected into the painful area in this

study and it's not possible to compare the effects of lidocaine with ours. In a randomized, double-blinded comparative study, Loughnan et al.[45] found that N-saline was as effective as lidocaine in reducing knee pain when injected intradermally. But sample size was small and follow-up period was short.

In our study, lidocaine was given to the painful areas as subcutaneous injection. In this way, we aimed to decrease the stimuli of pain by blocking Aδ and C fibers with lidocaine.

In addition, we found a reduction in swelling and pain in the painful prosthetics area by the anti-inflammatory effects (reducing edema and swelling) of lidocaine. As lidocaine causes nerve block and this results in reducing pain, lidocaine has anti-inflammatory effects and this reduces both edema and pain. We believe that we broke the spasm-pain-spasm cycle in this way in patients with painful prosthesis.

This is the first study, which investigates the efficacy of subcutaneous lidocaine injection. We found significant improvement on pain relief and improvement in functional status in patients with painful knee arthroplasty for short-term follow-up (three months) and we reported no side effects.

In conclusion, subcutaneous lidocaine injections had short-term positive effects in patients who had postoperative pain after TKA. Future studies with larger sample should investigate long-term effects of this intervention.

Declaration of conflicting interests

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