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Efficacy of local infiltration analgesia in post-operative pain management following total knee replacement

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ABSTRACT

Background: Post-operative pain and prosthetic joint infections are two crucial impediments in providing a good quality of life after surgery. **Aims and Objectives:** In this study, we evaluated the efficacy of local infiltrative anesthesia (LIA) in total knee arthroplasty (TKA) and to study associated complications. **Materials and Methods:** The present study was conducted over 2 years. All patients who underwent total knee replacement for degenerative arthritis of the knee were considered for the study. Questionnaire consisted of three sections, first section: Demographic profile, second one: Laterality of knee, duration of surgery, final section: Consisted of pain evaluation by visual analog score. Pain assessment in post-operative period was done for 3 days (72 h) and was estimated using visual analogue score (0–10). Assessment was done at 6 h, 24 h, 48 h, and 72 h after surgery during rest and movement. Data collected were entered and analyzed using SPSS. Association between different variables was done using Chi-square test/Fishers exact test. **Results:** Visual analog score was 3.4 ± 1.31 in first 6 h. Visual analog scale scoring was significantly less 48 h of post-surgery. There were no postoperative surgical wound problems in any of the cases and no clinical signs of infection were identified at the end of 3-month post-surgery. **Conclusion:** LIA can be considered a safe and effective modality for pain control in knee arthroplasties.

Key words: Local infiltrative anesthesia; Pain; Arthroplasty; Rehabilitation; Infection

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INTRODUCTION

Total knee joint arthroplasty is frequently performed surgery to improve the quality of life in degenerative knee disease.[1,2] Post-operative pain and prosthetic joint infections are two crucial impediments in providing a good quality of life after surgery.[3,4] Pain free post-operative period can help in early rehabilitation and faster functional recovery.[5,6] Conventionally, post-operative morphine, epidural anesthesia, and peripheral nerve blocks have been tried with varying results. Systemic complications of morphine, hypotension in epidural anesthesia, and motor blockade of peripheral nerve blocks have compelled to explore more focused periarticular anesthetic techniques.[7,8]

The initial experience reporting effective analgesia along with early rehabilitation and short hospital stay has led to widespread use of the local infiltrative anaesthesia (LIA) technique in recent years. Simplicity of the technique and limited time required for the procedure is the major advantages for adapting the procedure of LIA.[9] In this study, we would like to evaluate the efficacy of LIA in total knee arthroplasty (TKA) and study associated complications. A skeptical arthroplasty surgeon is worried about seeding bacteria in the periprosthetic areas while delivering the drug. We would also like to discuss the method of maintaining sterility while acquiring the drug from its ampoules and delivering it into the periarticular soft tissue.

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Aims and objectives

To evaluate efficacy of local infiltrative anesthesia in TKA and to assess associated complications.

MATERIALS AND METHODS

Study design and participants

The present prospective and observational study was conducted in a tertiary care hospital over a span of 2 years (October 2018–September 2020). All patients who underwent total knee replacement for degenerative arthritis of the knee were considered for the study. Patients with major neurological deficit, history of stroke, or peripheral neuropathy were excluded from the study. Gross knee deformities which requires extensive surgical releases and additional implantation were not considered in the study.

Study instrument

A study questionnaire was developed after performing extensive review of literature and consulting experts in the field of study. Questionnaire consisted of three sections, first section consisted of demographic profile, second one consisted laterality of knee and duration of surgery, and the final section consisted of pain evaluation by visual analog score. Pain assessment in post-operative period was done for 3 days (72 h) and was estimated using visual analog score (0–10). Assessment was done at 6 h, 24 h, 48 h, and 72 h after surgery during rest and movement. Patient was followed up till 3-month post-surgery to look for clinical signs of infection and other complications.

Ethical consideration

The study was initiated after obtaining approval from the Institutional Ethics Committee. All measures were followed during the study to maintain the ethical standards of Helsinki declaration and manuscript was structured as guided by STROBE checklist for observational study. A written informed consent was taken from the patients when they were ready to enroll for the study. Confidentiality of patient details was maintained.

Statistics

Data collected were entered and analyzed using Statistical Package for the Social Sciences (SPSS version 11.5; SPSS Inc., 233 South Wacker drive, 11th floor, Chicago, IL 60606–6412). Categorical variables were presented as mean±SD and median. Normality of the data was tested by Kolmogorov–Smirnov test. If the normality was rejected, then non parametric test were used. Association between different variables was done using Chi-square test/Fishers exact test.

Surgical procedure

Anesthesia regimen was standardized. All patient received spinal anesthesia with 3 ml of 0.5% of bupivacaine heavy with preservative free fentanyl 25 mg. The surgery was performed by a single surgeon and common assistant by a standard technique. All surgeries were performed with midline incision made after the inflation of tourniquet. Standard medial parapatellar approach was utilized and cemented posterior stabilized knee replacement system belonging to same implant company (smith and nephew) was considered for standardization of surgical technique. Femoral and tibial cemented prosthesis was utilized with ultrahigh molecular weight polypropylene tibial insert. Patellar resurfacing was not done in any of the cases involved in the study.

Anesthetic procedure

Drugs and its dosages

10 mg Morphine 1 amp (10 mg/ml)
10 mg Ketorolac 1 amp. (30 mg/ml)
0.5 mg Adrenaline half amp (1 mg/ml)
200–280 mg of Ropivacaine prepared from
A. Ropivacaine 0.5% 2 amp.(20 ml)
B. Ropivacaine 0.2% 2 amp.(20 ml)
Injection Nacl 2 amp. (20 ml)

A high volume (120–130 ml) analgesic/anesthetic cocktail is prepared by mixing the above mentioned drugs. Dosages of morphine and ketorolac were adjusted based on cardiovascular and renal profile of the patient. 21 G green hypodermic needle was used for infiltration. Infiltration of the cocktail (40 ml) was performed after the pulse lavage wash of the cut femoral and tibial surfaces but before implantation.

First, with knee in flexed position, posterior capsule at both femoral and tibial end is infiltrated. Anterior and mediolateral corners are also infiltrated with the cocktail in the flexed position of the knee. Second, with knee in extended position. quadriceps retinacular tissues and collaterals are infiltrated (40 ml) with the cocktail. This is performed after implantation. Finally, 20 ml of mixture is infiltrated to skin and subcutaneous tissue during closure.

Tips and tricks of the technique

1. 1 ml BD syringe is used to load precise dosage of drug from 1 ml ampoules
2. It is ideal to use three different syringes while loading drugs which would reduce the possibility of needle contamination
3. First infiltration is given after performing pulsed saline lavage and before implantation
4. Second and third infiltration is performed after saline wash post-implantation of prosthesis, this reduces wash out of drugs
5. Dosages of analgesics can be adjusted based on cardiovascular or renal profile of the patient

6. 21G (green) hypodermic needle is less traumatic than 18G (pink) needle. Infiltrating collaterals with larger needles can lead to pie-crusting effect and thereby altering the balance of the knee joint
7. Sub-periosteal, capsular, and collateral infiltration should be done to create multiple pockets of ballooned soft tissues, which prevents the drug from getting washed out by blood or other fluids.

RESULTS

Majority of patients were aged more than 60 years and females as shown in Table 1. Mean age of study participants was 65.6 years.

Visual analog score was 3.4±1.31 in first 6 h as shown in Table 2.

Visual analog scale scoring (VAS) was significantly less 48 h of post-surgery as compared to 6 h post-surgery as shown in Table 3. There were no post-operative surgical wound problems in any of the cases and no clinical signs of infection were identified at the end of 3-month post-surgery.

Table 1: Sociodemographic and clinical characteristics of study participants (n=40)

Age	n (%)
<60	10 (25)
>60	30 (75)
Gender	
Male	12 (30)
Female	28 (70)
Laterality	
Right	18 (45)
Left	22 (55)

Table 2: Post-operative visual analog score (n=40)

Duration (hours)	VAS score (mean±SD)	Median (Range)	P-value
6	3.4±1.31	3 (2–7)	0.0001
24	3.25±1.27	3 (2–7)	
48	2.77±0.94	3 (2–6)	
72	2.62±0.97	2 (2–6)	

Table 3: Comparison of post-operative pain score at different time period (n=40)

Duration (hours)	P-value
6 and 24	>0.05
24 and 48	>0.05
48 and 72	>0.05
6 and 48	<0.001
6 and 72	<0.001

DISCUSSION

The LIA technique has increasingly become popular in the recent years for post-operative pain control in knee replacement arthroplasty.[10]

In this study, 40 patients who underwent total knee replacement were given LIA and evaluated for post-operative pain and complication.

The mean age of the patients in our study was 65.62±8.67 years. The majority of patients were aged between 61 and 70 years, followed by those aged between 71 and 80 years. In our study, there were pre-dominatly females as compared to males in the ratio of 2.3:1. A meta-analysis performed by Xiao-Qiang Peng, involving eleven studies with a total of 707 patients showed similar results with a mean age of 65 and 71 years in patients undergoing TKR and an increase number of female patients relative to male patients. The increased incidence of TKR in women is primarily due to an increased incidence of osteoarthritis in elderly women, presumably due to menopause, which interferes with the levels of female hormones.[11]

The average duration taken for the surgery in our study was 93.25±4.77 min. Population-based cohort study, which analyzed TKA conducted between 2009 and 2016 in Ontario, Canada, to correlate the duration of surgery with associated complication, highlighted the increased duration of surgery of more than 100 min is associated with increased risk of post-operative complication, especially deep infection.[12] Prolonged duration of surgery is also correlated with increased post-operative pain and infection.[13,14]

In our study, post-operative pain was estimated using VAS of 0 to 10 at 6 h, 24 h, 48 h, and 72 h. The use of LIA reported significant reduction in the intensity of pain among enrolled patients. The average VAS score at 6th h was 3.4±1.31, which decreased significantly to 2.77±0.94 at the end of 48th h and to 2.62±0.97 at the end of 72 h. This reduced the use of opioid analgesia and aided in early mobilization of the joint. Post-operative pain is maximum in the 1st post-operative day and reduces by 3rd post-operative day.[15] Achieving post-operative VAS score between three and four without any additional opioid analgesia has significantly aided in early rehabilitation in our study. Meta-analysis study analyzing 38 RCTs reported LIA groups had lower pain scores, opioid consumption, and post-operative nausea and vomiting, higher range of motion at 24 h and shorter length of hospital stay than no injection or placebo and concluded LIA is effective for acute pain management after TKA.[6] Several RCT's and meta-analyses commented

specifically on reduced narcotic consumption as a benefit of LIA compared to patient-controlled intravenous or epidural analgesia protocols. A specific benefit noted was less nausea and vomiting in the LIA groups.[7,8] In general, the benefit of the LIA approach was most apparent in the first 48 h after surgery. A randomized and placebo-controlled trial, by Titman et al., reported positive effect of LIA on pain scores within the 1st h postoperatively in patients undergoing elective primary THA under general anesthesia.[16] In our study, we were able to achieve low VAS scores after 48 h of surgery, due to the rehabilitative measures started early in post-operative period. Vaishya et al., investigated the analgesic effect of a locally injected mixture of drugs, in a double blinded RCT in 80 primary TKR, it reported intraoperative periarticular injection with multimodal drugs following TKR significantly reduced the post-operative pain and hence the requirements for patient controlled analgesia and hospital stay, with no apparent risks.[17] Rizk et al., compare the pain control after total knee replacement using a single-shot femoral nerve block (FNB) against local infiltration analgesia, the group that received LIA showed significantly less pain at 4 h postoperatively, on the 1st post-operative day, and after physical therapy. The LIA group also showed significantly better rehabilitation and less hospital stay. Patients who received FNB used significantly more opiate compared with the LIA group.[18]

Thus, the result of our study and similar other studies highlighted the advantage of local infiltration analgesia in post-operative pain management. The advantage of LIA is the ability to provide pain control without interfering with the lower extremity motor strength, thereby allowing early mobilization of patients.

There were two major concerns while delivering the drugs around a sterile prosthesis. Infiltrating the knee with mixture of local anesthetics and analgesics could increase the risk of infection during the procedure. Vasoconstrictor action of epinephrine could possibly lead to skin necrosis and wound healing problems. One recent study on LIA had wound leaking problems in first 3 post-operative days and was attributed to higher dose of epinephrine (1.6 mg) used. They recommended to avoid epinephrine use for skin and subcutaneous tissue.[19] In our study, we used epinephrine of 0.5 mg of epinephrine, there were no problems with wound healing. Since we utilized a meticulous aseptic technique of loading the drugs from ampoules, there were no incidence of infection as followed up to 3-month post-surgery.

Limitations of the study

LIA has improved the surgical outcomes in terms of early rehabilitation, lesser wound complication, and decreased hospital stay. Surgical technique, duration of surgery, technique of delivering LIA, and also dosages of drugs used in LIA are few of the confounding variables that has to be taken into consideration for the effectiveness in achieving post-operative analgesia and reducing complications. This study has to be done on a larger sample for findings to be generalized. Associated comorbidities can alter the outcomes and hence does not allow us to design a multimodal analgesia protocol for post-operative pain management.

CONCLUSION

LIA using a cocktail of analgesics and long acting local anesthetics can effectively reduce post-operative pain and aid in faster rehabilitation after TKA. A meticulous and aseptic technique utilized during loading of drugs and infiltration, removes a major concern of surgical site infection and wound complication. Hence, LIA can be considered a safe and effective modality for pain control in knee arthroplasties.

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