RESEARCH ARTICLE

Effectiveness of Pain Control Regimen with Local Infiltrative Analgesia for Total Knee Replacement: A Prospective, Double-blind, Randomized Controlled Trial

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Abstract

Introduction: Postoperative pain relief in total knee replacement remains a major determinant in the duration of the hospital stay and return to daily activities. Nowadays, a great attention has been given to pain management in the perioperative period focusing on faster recovery. Various analgesic regimens have been in use. The aim of this study is to evaluate the efficacy of our pain control regimen along with the use of local infiltration analgesia (LIA) in terms of postoperative pain control.

Materials and methods: A total of 50 patients were included in the study, and they were randomized into study group and control group by computerized randomization, and the study group was followed up with the multimodal pain relief protocol, while the control group was given a placebo; the results were measured with preoperative and postoperative visual analog score (VAS) and results were analyzed.

Results: Visual analog score showed a drastic fall of average 4.36 scale parameters compared with the preoperative in the study group and a significant difference of 1.88 on VAS scale compared with postoperative score of the control group. The mean postoperative score was 3.88 in a scale of 10 in the study group, while it remained 5.76 in the control group.

Conclusion: Our pain management protocol using effective LIA along with the pain control regimen has revolutionized postoperative recovery. Pain control and patient satisfaction were extremely high. The average length of hospital stay has been reduced to 2.12 days with the implementation of this regimen, with most of them discharged within 24 hours and all of them by second day.

Keywords: Early rehabilitation, Local infiltrative analgesia, Multimodal pain relief, Pain control, Total knee replacement.

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Introduction

Total knee replacement (TKR) has been a procedure with successful results which most of the time has lengthy hospital stays and painful recovery periods. Various measures have been made in the recent times to minimize the discomfort and hasten the recovery. Minimally invasive approaches, minimal handling of soft tissues, and comprehensive patient education programs with advanced implants have all contributed to reduce the morbidity due to the procedure.[1] Despite all these measures, pain management in the postoperative period plays a major role and determines the recovery and rehabilitation.

Postoperative pain management includes use of oral, epidural, and spinal anesthetics along with long-acting drugs like morphine and regional nerve blockade.[2,3] Although these modalities were widely used for pain management, side effects of intravenous opioids and motor blockade have been reported in various studies to delay rehabilitation.[4] Considering the above side effects in mind, a method of multimodal pain control regimen, along with preemptive analgesia, has been designed and is gaining wider acceptance for the management of pain in the postoperative period.

Most of such regimens use combinations of anti-inflammatories with limited use of narcotics. However, the major component of such regimens lies in the use of local infiltrative analgesia (LIA). The aim of this study is to evaluate the efficacy of our pain control regimen with the use of LIA in combination with other pain medications in terms of postoperative pain control.

Materials and Methods

A total of 50 patients who were electively posted for TKR surgery were included in the study during the period of January 2016 to January 2018. After obtaining proper consent from the patients, they were randomized into study group and control group by computerized randomization, and the study group was followed up with the multimodal pain relief protocol with LIA, while the control group was given a placebo instead of LIA while following up the same perioperative pain protocol as mentioned in Table 1. All the patients were operated under spinal anesthesia.

Although there are no published differences in the effect of LIA based on the method of injection, we always aim to maximum fluid into the soft tissues, which are the major pain generators. We used smaller needle size of 22 gauge along with control syringes to help in aspirating the site before injection to rule out intravascular injection especially in the posterior midline of knee. Moreover, the use of two syringes helps to speed up the process by allowing

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Table 1: Multimodal pain relief protocol followed in our study

Medication by time point	*Dose*	*Route*	*Frequency*	*Notes*
Preoperative				
Gabapentin	300 mg	Oral	One dose at previous night of surgery	Avoided if patient has comorbidities like DM, HT, and CAD
1 hour preoperative				
Gabapentin	600 mg	Oral	One dose	Taken with sips of water
Paracetamol	1000 mg			
Etoricoxib	90 mg			
Intraoperative				
Dexamethasone	8 mg	Intravenous	8th hourly	Restricted to single dose for DM
Tranexamic acid	100 mg/mL (10 mL)	Intravenous	Two doses	First at the start of incision and next during closure
Ropivacaine	5 mg/mL (45 mL)	Intra-articular	One dose	Local infiltrative analgesia; normal saline added to medications to total 100 mL; delivered with 22-gauge needle into periosteum of femur and tibia as well as posterior capsule and arthrotomy; minimal injection needed in skin incision
Adrenaline	1 mg/mL (0.5 mL)			
Ketorolac	30 mg/mL (1 mL)			
Dexmedetomidine	100 µg/mL (1 mL)			
Postoperative				
Paracetamol	1000 mg	Intravenous	12th hourly	1 day
Pantoprazole	40 mg	Intravenous	12th hourly	3 days
Ondansetron	4 mg	Intravenous	12th hourly	As needed for nausea
Etoricoxib	90 mg	Oral	12th hourly	3 days
Gabapentin	300 mg	Oral	Daily night dose	3 days

DM, diabetes mellitus; HT, hypertension; CAD, coronary artery disease

the assistant to fill up the syringe while the surgeon to inject with the other.

Injections are made in multiple locations in low volume and in a slow fashion. Our aim is to deliver the drugs to the local pain-sensitive areas such as periosteum, joint capsule, and anterior fat pad. Care must be taken to note the elevation of periosteum from the femur to ensure adequate drug has been injected. We aimed to cover all over the surgical site with least volume of 10–15 mL to skin.

We used a LIA which consists of a 100-mL mixture of ropivacaine 0.5% (45 mL), ketorolac 30 mg (1 mL), dexmedetomidine 100 µg (1 mL), epinephrine 0.5 mg (0.5 mL), and sterile water (52.5 mL). In the control group, 100 mL of sterile water is injected. To make the study double blind, the person giving the infiltration is blinded and the observer interpreting the VAS scores is also blinded, and the final interpretation is done by the author. Tramadol was used as a rescue analgesic at a dose of 100 mg, twice daily when reported VAS was more than 4 on evaluation.

Despite various regimens being available for the use of tranexamic acid, we used 1 g intravenously at skin incision and 1 g at skin closure for all patients, without regard to weight, unless it is contraindicated. Intravenous dexamethasone was used to control nausea and vomiting along with ondansetron as and when needed.

The outcome of regimen was assessed based on the VAS in the preoperative period before the initiation of the regimen and postoperative period at 12 and 24 hours period, and the secondary outcome measures like length of the hospital stay were also analyzed.

Results

A total of 50 patients were included in the study, out of which 28 were male patients and 22 were female patients. The VAS showed a drastic fall of average 4.36 scale parameters compared with the preoperative in the study group and a significant difference of 1.88 on VAS scale compared with postoperative score of the placebo group. The mean postoperative score amounted to 3.88 in a scale of 10 in the study group, while it remained to 5.76 in the control group. Of the 25 patients, 6 used rescue pain medication, while none of the study group was in need of any additional pain control other than the perioperative multimodal pain protocol. In the postoperative period, the study group had no reluctance to early mobilization. Full weight-bearing was initiated the next day of surgery, and the patient did not experience any discomfort during the rehabilitation period.

The statistical analysis between the two groups showed that the control and study groups belonged to the same population without a significant change in the preoperative values, and there was a significant difference between the control and study groups on the outcome scores [t (7.408) = 24, $p < 0.001$]. On average, the study group scores were 1.87 points higher than the control group scores [95% confidence interval (CI): 1.356, 2.403]. There was a significant reduction in the length of the hospital stay [t (15.92) = 24, $p < 0.001$). On average, the study group patients got discharged 2.11 days earlier than the control group patients (95% CI: 1.845, 2.394) as shown in Table 2. There was also a significant difference in the need for rescue pain medication when LIA was not used in the pain protocol. Neither nerve palsies nor any cases

Table 2: Details of population under study and their outcome measures

Descriptive factors	*Control group*	*Study group*
Population	25	25
Male	13	15
Female	12	10
Age	Mean = 57.6 (SD ± 7.2)	Mean = 53.4 (SD ± 8.4)
Preoperative VAS	Mean = 8.12 (SD ± 0.78)	Mean = 8.24 (SD ± 0.66) ($p = 0.558$)
Postoperative VAS	Mean = 5.76 (SD ± 0.87)	Mean = 3.88 (SD ± 0.78) ($p < 0.001$)
POD of discharge	Mean = 3.68 (SD ± 0.47)	Mean = 1.56 (SD ± 0.50) ($p < 0.001$)

SD, standard deviation; POD, postoperative day

of intravascular injection have been identified, nor have any issues with skin healing, even with epinephrine in the mixture.

Discussion

Pain management in the current era was developed to reduce the surgical morbidity to the minimum and to improve patient recovery as early as possible after the procedure. Recently, the concept of preemptive analgesia and multimodal pain management protocols were commonly used to achieve the same. Local infiltration analgesia is an integral component of the regimens followed. After Kerr and Kohan[5] published their early reports on benefits of LIA in 2008, various authors supported their concept and developed their own regimen for LIA. Many drug regimens were developed which included preemptive analgesics[2,6] and showed a significant improvement in the recovery of the patient after the surgery.[7–9]

Local infiltration analgesia is advantageous over regional peripheral blocks, in the way that they can be administered by operating surgeon himself into the pain-sensitive tissues in the field of surgery without any specific skill set, and all the more, they do not block the motor power which hastens the recovery and rehabilitation. Avoiding or limiting the use of narcotics has been beneficial to the patient in many ways.

Many authors suggested their own combinations of drugs for LIA.[10] Majority of them has a long-acting local anesthetic in addition with epinephrine and other adjuvants like opioids, corticosteroids, and antibiotics in their composition.[11–13] Although identification of the most effective regimen has not yet been made out, we undertook a prospective study to evaluate the effectiveness of our regimen consisting of ropivacaine, epinephrine, ketorolac, and dexmedetomidine as a local infiltrative analgesic cocktail.[14] It has been very much evident from the study that control of pain and functional rehabilitation was enhanced with our combination of LIA. In addition to controlling pain and enhancing recovery, the ingredients in our composition of LIA were inexpensive and readily available, and hence, it remains a practical and applicable in all centers.

Despite the composition of LIA and delivery method, various other factors were also responsible for achieving a comprehensive pain management. Preemptive analgesia along with LIA is required to raise the threshold of pain perception along with control of nausea and vomiting and control of blood loss. Currently, the recommended preemptive analgesic combination used includes nonsteroidal anti-inflammatory drugs like acetaminophen, gabapentin, ketorolac, along with short-acting oral narcotics for synergistic action.

Tranexamic acid has been effective in reducing the blood loss and postoperative blood transfusions[15] in addition to being cost-effective.[16] Other than 18 patients (10 in control group and 8 in study group) who were diabetic, all others received eighth hourly dexamethasone starting from the intraoperative dose until the day of study, while we restricted to single-dose regimen for those 18 patients.

With this multimodal pain management protocol, the patient gets blocked in all the modalities of pain afferents and experiences a pain-free and shortened rehabilitative period and early return to function of day-to-day activities.

Conclusion

Our pain management protocol using effective LIA along with the pain control regimen has revolutionized postoperative recovery. Pain control and patient satisfaction were extremely high. The average length of hospital stay has been reduced to 2.12 days with the implementation of this regimen, with most of them discharged within 24 hours and all of them by second day.

Despite having numerous ways to achieve pain control and earlier rehabilitation in TKR surgery, our regimen has been found to be safe and extremely effective in achieving the desired goals and can be implemented in surgeries other than TKR to extend its spectrum of usage.

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