ORIGINAL ARTICLE

Postoperative Pain in Total Knee Arthoplasty Patients: The Effectiveness of Local Anaesthetic and Analgesic Agents

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ABSTRACT

Objective: To determine the efficacy of a periarticular injection of multimodal drugs, consisting of bupivacaine (a long acting local anesthetic), ketorolac (Nonsteroidal anti-inflammatory) and epinephrine in providing effective postoperative pain relief following total knee arthroplasty.

Methods: This randomized comparative study was conducted in the department of orthopaedics and Traumatology CMH Rawalpindi. Sixty patients undergoing unilateral total knee replacement were randomized for the study. All the patients received 30 mg ketorolac IV three times a day postoperatively. Thirty patients were given an intraoperative periarticular injection of analgesic and anaesthetic drugs, and thirty were. Visual analog scale was used to assess pain (range from 0 to 100mm in 10-mm increments) at zero, first and second postoperative day. Zero (0) mm indicated no pain whereas 100 mm indicated extreme pain.

Results: Patients who had received the multimodal drug infiltration had significantly lower mean visual analog scores for post operative pain ($p < 0.001$) and had significantly reduced need for analgesia over the first forty-eight hours after the operation ($p < 0.001$).

Conclusion: Periarticular infiltration of the knee during arthroplasty is an effective way of postoperative analgesia. It is simple, practical and safe.

Key Words: Postoperative Pain, Total Knee Arthoplasty, local anaesthetic and analgesic agents

INTRODUCTION

To alleviate patient's discomfort and enhance postoperative recovery, primary total knee replacement surgery requires appropriate anesthesia and analgesia.[1] In this regard; many methods of pain relief have been used. [2] These include preoperative, perioperative, and postoperative analgesia used in patients undergoing total knee arthroplasty.[2] The treatment regimens used comprise of a combination of analgesics like nonsteroidal anti-inflammatory drugs (NSAIDs), opioids and/or regional anesthetics, such as femoral nerve and epidurals blocks.[3] These pain-management-medications can be administered through a number of different modalities such as oral, local, or epidural injections. [3,4] One such modality of pain management is Local infiltration analgesia (LIA). [3]It is administered as a "cocktail" of a combination of many pain medications into the intra-articular space of the joints or other tissues at the site of the joint.[5] The cocktail may be administered through a catheter or directly. [5] Whether LIA provides superior pain management compared with other pain management strategies still remains uncertain.[6]

The use of epidural analgesia established benefits. [5,6] Nonetheless, it has many undesirable effects for example hypotension, cardiac decompensation, respiratory depression, neurogenic bladder, pulmonary hypertension and danger of spinal infection.[6,7] Postoperative continuous infusion of combination of local anaesthetics and other analgesics into the knee has provided sufficient pain relief but has the risk of wound drainage and infection.[8] The administration of opioid drugs through patient-controlled-analgesia or other means, controls pain after the operation effectively but carry unfavorable effects such as urinary retention, nausea and vomiting, reduced gut motility, respiratory depression, pruritus and drowsiness.[8,9]

Administration of local analgesia, with less systemic side effects, at the surgical site is an excellent choice.[9] What remain uncertain are whether LIA provides superior pain management and can it reduce requirements for postoperative analgesia and reduce stay of the patients in the hospital?[10]

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This study aims to determine the efficacy of a periarticular injection of combination of drugs containing ketorolac (a nonsteroidal anti-inflammatory agent), bupivacaine (a local anesthetic) and epinephrine in providing effective postoperative pain relief following total knee replacement.

METHODS

After the approval of local ethics committee, sixty patients undergoing unilateral total knee replacement were randomized. Thirty patients were given a periarticular injection of combination analgesic and local anaesthetic drugs, and were not. The inclusion criteria were kept as: a weight of 48 kg to 110 kg, age of less than eighty-five years, provision of informed consent and cooperation for the study. Patients with allergies to any of the drug in the injection, previous dependency on drugs, kidney failure, psychological diseases, abnormal liver function tests, uncontrolled angina, prolonged QT intervals, bifascicular blocks, history of stroke and major neurological deficits and those patients who were kept on epidural analgesia after the noperation were excluded from the study. A standard medial parapatellar approach was used to perform the operation. The cocktail injection was made from 50 mg of buipivacaine, 30 mg of ketorolac (Toradol) and 0.5 mL of 1:1000 epinephrine. All these were added to a sterile solution of normal saline to make up a total volume of 100 mL in the operation theater. Taking care of peroneal nerve the first aliquot of 20 mL of mixture was injected into the posterior capsule and the medial and lateral collateral ligaments just before the placement of component. An additional 20 mL of the mixture was injected into the quadriceps mechanism and the retinacular tissues. Finally, the subcutaneous tissue and fat were saturated with the remaining 60 mL of the solution. The anesthetic regimen was standardized. Operative anesthesia used was spinal in all cases. No long-acting analgesics were given, and spinal anesthesia was given with 10 to 15 mg of bupivacaine. All patients received IV ketorolac 30mg tid for three days after the operation. Visual analog scale (VAS) was used to score patients pain at zero, first and second day after the operation. The VAS ranged from 0 mm to 100 mm in 10-mm increments. Zero indicated no pain and 100 extreme pains. Complications regarding the cardiac, central nervous system and wound were specifically noted. The data was analyzed with SPSS (version 10). Kolmogorov-Smirnov test ($p < 0.05$) was used for normality and subsequently a normal t test.

RESULTS

The study group (who received infiltration analgesia in addition to regular postoperative analgesia) and control group (who received only regular analgesia) each comprised of 30 patients. Mean age was 59.93 in the study group and 60.3 in the control group. There were 24 Females and 6 males in the study group with a mean BMI of 30.20 kg/m^2 (Table 1).

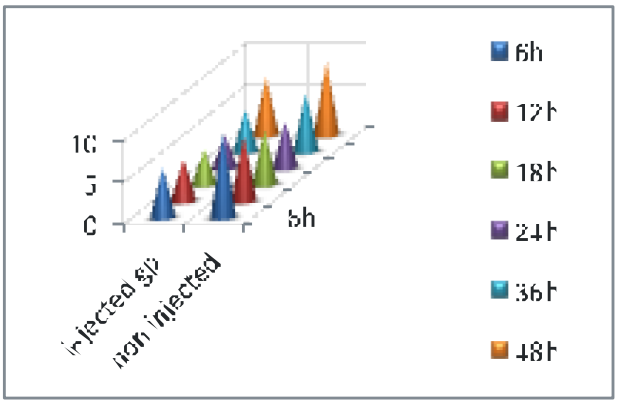
Table 1: Demographic Data for Patients in the Study

	Infiltrated gp	Non infiltrated gp
Average age (range) *(yr)*	59.93 (38-77)	60.37
Gender	24F, 6M	21F, 9F
Average body mass index (and stand. dev.)	30.20	29.67
Average hospital stay (hr)	127.3	128.1
Fat/ pulmonary embolism	1	0
Wound complications	1	1
Average Knee Society Clinical Score (Preop.)	55.14	52.59
Average Knee Society Clinical Score (Postop 3 months)	84.41	73.82
Average Knee Society Functional rating (Preop)	33.79	36.11
Average Knee Society Functional rating (points) Postop (3 months)	80.21	71.32

The use of postoperative Intravenous analgesia was found to be significantly less at six hours ($p < 0.01$), twelve hours ($p = 0.016$), eighteen hours ($p=0.013$) and twenty-four hours (0.011) in the patients who had received the multimodal drug infiltration. The same (injected) group had significantly lower overall

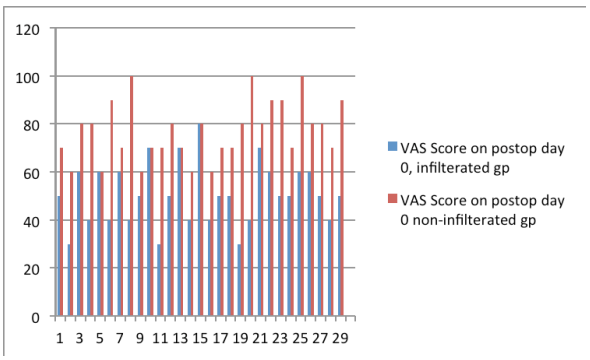
requirement for analgesia over the first forty eight hours after surgery ($p < 0.001$), as compared to the patients who had received no periarticular injection (fig. 1).

Figure 1: 0 to 10 shows postop percentage (%) analgesia (ketorolac) requirements



The group that received the local analgesic and anaesthetic agents had significantly lower mean VAS for pain on postoperative day 0, 1 and 2 ($p = 0.016$) as demonstrated in figures 1, 2 and 3.

Figure 2: visual analog scores for pain on postoperative day 0. Numerics: 1 to 30 show number of patients where as 0 to 100 show increment in Visual Analogue Scale (VAS).



Spinal anesthesia was used in all patients whether they receive or did not receive the local infiltration. No significant difference was noted in the rate of wound complications or average hospital stay between the two groups. Of the patients who had received the injection, only one developed fat embolism postoperatively. There was no significant difference in the range of motion between the two groups at six weeks. No toxicity of either cardiac or central nervous system was observed (Table I).

Figure 3: visual analog scores for pain on postoperative day 1; Numerics: 1 to 30 show number of patients where as 0 to 100 show increment in Visual Analogue Scale (VAS).

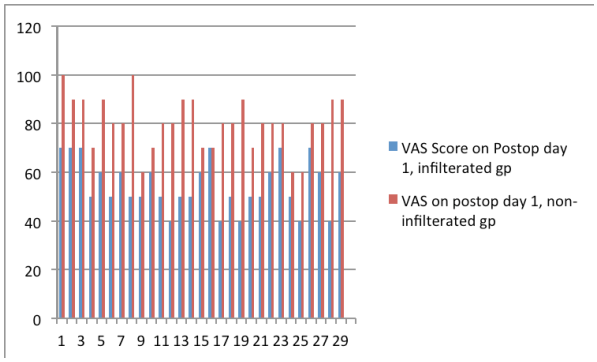
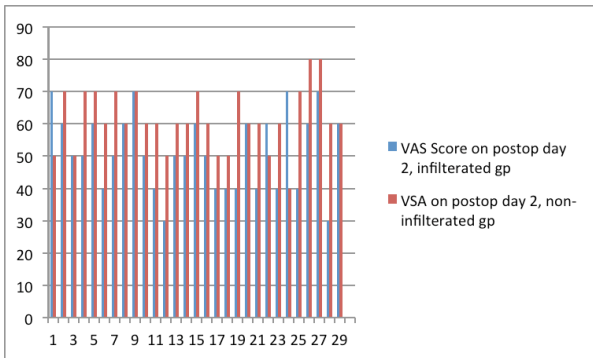


Figure 4: visual analog scores for pain on postoperative day 2; Numerics: 1 to 30 show number of patients where as 0 to 100 show increment in Visual Analogue Scale (VAS)



DISCUSSION

Post operative pain in total knee arthroplasty is a big problem.[11] It is mild in 10 percent, moderate in 30% and severe in approximately 60% of patients.[12] The pain can either be due to trauma to the soft tissues or bone or hyperperfusion following release of tourniquet.[11] To avoid the establishment of pain hypersensitivity pain-relieving-medications are administered preoperatively, perioperatively, and postoperatively.[12,13] The ideal analgesic regimen following TKA should offer a balance between adequate pain levels and sufficient lower motor function to allow for safe early ambulation.[13] Local infiltration of the knee joint following TKA reduce

postoperative analgesia requirements and permit earlier hospital disdcharge.[14]

The conjecture of administering deterrent analgesics directly at the site of operation, yet with less systemic adverse effects, is appealing.[14] Surgical trauma during TKA modifies the reaction of the nervous system in two ways.[15] Firstly, the threshold for afferent nociceptive neurons is reduced and thus peripheral sensitization occurs.[14,15] Secondly, the excitability of spinal neurons is increased and thus central sensitization occurs.[14,15] These two changes contribute to postoperative pain hypersensitivity. This in turn enhances the response to noxious stimuli. Thus the pain threshold at the site of tissue injury suffers a cut back. [15] The application of analgesia in a preemptive fashion prevents central sensitization and alleviates pain after operation.[16] Although, other authors had previously reported the use of intra-articular injections of local anesthetics, the first detailed description of this technique for TKA was by Kerr and Kohan.[17, 18]

The infiltration mixture that we used had three active ingredients i.e; ketorolac, bupivacaine, and epinephrine. Ketorolac, a nonsteroidal anti-inflammatory drug reduces peripheral sensitization and activation of nociceptors by inhibiting the eicosanoid cycle that yields inflammatory mediators.[19] Bupivacaine is a local long acting anaesthetic.[20, 21] Its maximum serum level is reached 20 to 30 minutes after being injected. [10, 22] Although the cheif function of bupivacaine is to halt afferent peripheral nociceptive activity in the body, it has also been shown to carry some anti-inflammatory action in the cells of human mucosa.[23, 24] Adding epinephrine helps keep the local anaesthetics localized to the area of injection thereby reducing its toxicity. [23,25] Thus, intraoperative periarticular injection of combination of analgesic and anaesthetics carries no obvious hazards and significantly curtails pain in immediate postoperative period after total knee replacement. [25]

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