

## PERIARTICULAR COCKTAIL INJECTION FOR ANALGESIA AND POST-OPERATIVE KNEE MOTION FOLLOWING TOTAL KNEE ARTHROPLASTY — A STUDY ON EFFICACY AND SAFETY

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### Abstract

**Background:** Pain control after total knee replacement (TKR) is of primary importance to joint replacement surgeons to achieve good functional outcome and recovery post-surgery. Effective analgesia in the peri-operative period facilitates early rehabilitation, improves patient satisfaction, and reduces the hospital stay. A locally injected analgesic cocktail avoids adverse effects caused by epidural analgesia or parenteral opioids. Our study was to prospectively evaluate the benefits of a periarticular cocktail injection which was given in patients undergoing TKR with respect to pain and knee motion recovery.. **Material & Methods:** Forty two patients undergoing primary TKR were included in the study. These patients received periarticular intra-operative injection containing bupivacaine, ketorolac and epinephrine. The perioperative and post-operative analgesic regimens were standardized. All patients received the same standard analgesia protocol. Visual analog scores for pain and knee range of motion were recorded on the day of surgery, first post-operative day, second post-operative day, till the day of discharge. Complications and need for rescue analgesic were also noted during the study period. **Results:** All patients who received the periarticular cocktail fared better in terms of pain scores and functional recovery. Additional rescue agents used were significantly less at 6 h, at 12 h, and over the first 24 h after the surgery. No toxicity or complications were observed. **Conclusion:** Periarticular cocktail injection significantly reduces the requirements for post-operative analgesia and also improves patient satisfaction, with no apparent risks, following total knee arthroplasty.

## INTRODUCTION

Approximately 60% of patients experience severe postoperative pain, and 30% experience moderate pain following total knee arthroplasty.<sup>[1]</sup> Postoperative pain affects sleep as well as return to pre-surgery activity.<sup>[2]</sup> Early control of postoperative pain is paramount to reduce hospital stay, better rehabilitation and mobilisation, and most importantly improve patient satisfaction. This thereby reduces the potential for postoperative complications such as deep vein thrombosis or pneumonia.

Pain control can be achieved via multiple methods — epidural analgesia, regional nerve blocks,

systemic opioids and continuous intra-articular analgesic infusion. Each method has its own risks and benefits. Epidural analgesia provides effective pain relief, albeit hinders early mobilisation and risks hypotension, headache and spinal infection. Regional nerve blocks can rarely cause neurovascular injury, hematoma formation and infection. Systemic opioids administration in patient controlled analgesia can cause nausea, vomiting, respiratory depression, drowsiness, urinary retention and constipation. Intra-articular analgesic infusion may cause joint effusion and risks being a direct access for infection.

Controlling local pain pathways and blocking pain receptors within the knee has been the innovative

approach to pain control. This is achieved by local periarticular and/or intra-articular injection of analgesic drugs. This method is cost-effective, technically reproducible and simple, avoids motor blockade and is without the risk of systemic complications in other methods of analgesia.

Various combinations of drugs have been reported in the literature with promising results.

Effective analgesia from these cocktails reduced the need for parenteral analgesia, and patients had a narcotic-free course in the hospital. Our study aims to study if a cocktail containing a local anesthetic (bupivacaine), an NSAID (ketorolac) and epinephrine can provide multi-modal analgesia as a safer and cost-effective pain control measure following TKR. We also hypothesise that with effective analgesia, patients should achieve 90° of active knee flexion by day 3 post TKR.

## MATERIALS AND METHODS

Patients who underwent unilateral total knee arthroplasty between May 2023 and September 2023 were included in the study. All patients received spinal anaesthesia. Forty-two consecutive patients who fulfilled the inclusion criteria were enrolled and received periarticular analgesia intraoperatively. Patients with allergic reaction to any of the ingredients in the cocktail, uncontrolled diabetes, deranged liver and/or renal function tests were excluded from the study. All patients were operated at our centre specialised for hip and knee surgeries by the two authors AB and DK.

**The following medications were given as standard protocol for all patients**

**Pre-emptive analgesia:** night before surgery

- Tab. Celecoxib 100 mg HS @ 10 pm
- Tab. Alprazolam 0.25 mg HS @ 10 pm

**Anesthesia and intraoperative analgesia**

- Spinal anaesthesia
- Periarticular injection

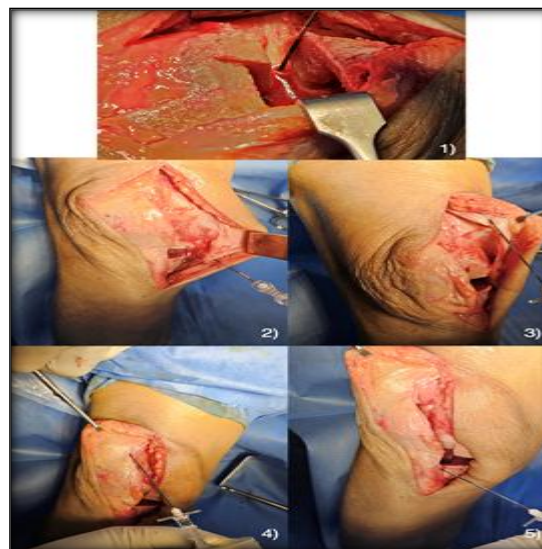
**Post-operative analgesia**

- Inj. Paracetamol 1 g intravenous 12 hourly
- Inj. Ketorolac 1-amp intramuscular IV SOS - as rescue medication

All patients underwent TKRs under spinal anaesthesia and anaesthetic regimen was standardised across all patients. All TKRs were performed via anterior vertical median incision with medial parapatellar arthrotomy. Standard medial release was done in addition to the standard bone cuts and flexion-extension gaps were balanced. Peri-articular cocktail injection was infiltrated after confirming balancing with trial implants and before implanting definitive implants.

The cocktail included the following

- Bupivacaine 0.5 % - 15 ml
- Ketorolac 15 mg/ml - 1 ml
- Epinephrine 1 in 1000 (1 mg / ml) - 0.5 ml.
- Normal saline - to dilute solution to total of 50 ml



**Figure 1: Sites of infiltration of analgesic cocktail. 1) Posterior capsule, 2) medial capsule and deep MCL, 3) and 4) quadriceps tendon and VMO and 5) patellar tendon**

The injection was administered in the posterior capsule (20 ml), medial capsule, deep MCL and patellar tendon (10 ml), quadriceps tendon and VMO (20 ml). (Figure 1) Tourniquet was deflated once implantation was complete. Suction drain was used in all cases. Implants varied between DePuy PFC Sigma, Smith & Nephew Genesis II and Meril Freedom knees — both cruciate retaining and posterior sacrificing designs were used based on the intra-operative scenario.

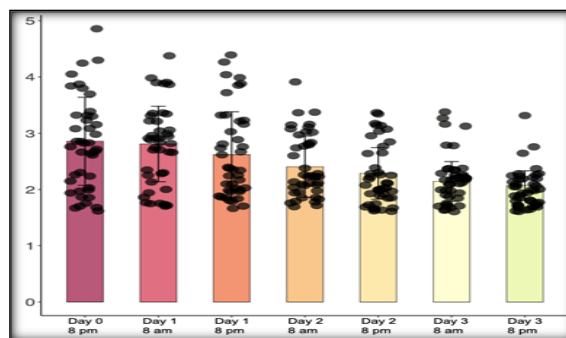
Standard antibiotic protocol included Intravenous Cefuroxime 1.5 g and Amikacin 500 mg — pre-operatively and every 12 hours till 48 hours after surgery. For thromboprophylaxis, a single dose of Inj. Clexane (Enoxaparin) 40 mg was given subcutaneously 12 hours after surgery followed by oral Aspirin 75 mg once daily for four weeks. Patients were often discharged 4 days' post operatively.

Outcomes measured: Patients were educated about the VAS scale before surgery, where they were asked to mark their pain levels on a linear scale from 1 to 10. Post-operative pain in the form of VAS score was recorded around 12 hours after surgery, and at 12 hour intervals till third post-operative day. Patients were mobilised full-weight bearing with walker frame and knee ROM exercises initiated the day after surgery. Post-operative ROM was measured at 3 days. Any complications that occurred during the study period were recorded — especially for surgical site infections, issues with wound healing and medical issues (if any).

## RESULTS

42 patients satisfied the inclusion criteria and were selected for periarticular cocktail injection. Mean age of the study group was 55.7 ( $\pm 5.92$ ) years. All patients had varus knee deformity preoperatively. 8

patients had fixed flexion deformity in addition to varus, while no patient had extensor lag pre-operatively. Mean VAS score on the times measured are listed in Table 1 and represented in Figure 2.



**Figure 2: Scatter distribution of VAS score of the study group from Day 0 till 84 hours post TKR**

**Table 1: Mean VAS scores recorded at 12 hourly intervals from day 0 to day 3 following TKR**

Time	Mean VAS score	Standard deviation (SD)
Day 0	2.8571	0.7831
Day 1 - 8 am	2.8095	0.4506
Day 1 - 8 pm	2.6190	0.7544
Day 2 - 8 am	2.404	0.5436
Day 2 - 8 pm	2.2857	0.4572
Day 3 - 8 am	2.1428	0.3541
Day 3 - 8 pm	2.0714	0.2606

All patients regained at least 90 degrees' knee flexion post-operatively by day 3. There were no intra-operative or immediate post-operative complications in the study group.

## DISCUSSION

Pain soon after total knee arthroplasty may be from surgical trauma of soft tissues and/or bone, or from hyperperfusion after release of tourniquet. Pain following TKR is a major concern, which can be severe in approximately 60% of patients and moderate grade in approximately 30%. Currently most pain management protocols aim at preventing pain hypersensitivity by providing analgesia throughout the patient's hospital stay — preoperatively, intraoperatively and postoperatively. The concept of providing multimodal preemptive analgesia as a method to avoid central sensitisation to pain and improving post-operative pain control was first described by Busch et al. This multimodal approach not only reduced postoperative pain but also facilitated earlier rehabilitation and improved range of motion.

Epidural analgesia is the most commonly used modality for controlling pain, but it is fraught with adverse events like headache, hypotension, respiratory depression, cardiac decompensation.<sup>[3,4]</sup> Regional nerve block like femoral nerve adductor canal blocks are associated with 1-2.5% risk of nerve injury, muscle weakness and local infection.<sup>[5,6]</sup> These catheters risk bacterial colonisation within 48 hours (in 57% cases).<sup>[7]</sup>

One of the first reported studies on periarticular infiltration analgesia for total knee arthroplasty was from Busch et al., who noted that patients who received infiltration of a combination of drugs (ketorolac, ropivacaine, epimorphine, and epinephrine) used far less rescue analgesia and had a prolonged narcotic-free post-operative period.<sup>[8]</sup> Spreng et al., compared epidural analgesia against local infiltration analgesia and observed that

epidural group reported better pain relief in the immediate post-operative period, while local infiltration group experienced better pain relief after initial 24 hours.

Thorsell et al reported that post-operative pain relief and mobilisation were faster in patients who underwent local infiltration when compared to epidural analgesia.<sup>[9]</sup>

Nair et al., found that postoperative pain was significantly less in cocktail injected knee (normal saline, Bupivacaine, Ketorolac and Adrenaline) when compared to the control group i.e., who received the same amount of normal saline. They also reported that range of motion was significantly better in the cocktail group than control group.<sup>[10]</sup>

The addition of epinephrine helps to reduce the toxicity of the local anesthetic by keeping it localized to the area of injection.<sup>[11]</sup>

Our analgesic cocktail consisted of bupivacaine, ketorolac, epinephrine and normal saline. Bupivacaine is a well-established long acting local anesthetic agent, when mixed with epinephrine helps in reducing the systemic (cardiac) toxicity of bupivacaine by keeping it localised to the area of injection, thereby prolonging the time of action of bupivacaine. Epinephrine also causes contraction of smooth muscle fibres of arterioles and potentially minimise intraarticular bleeding. We did not consider including steroid in the cocktail as previous studies reported no significant improvement in pain relief and early post-operative ROM. Steroids also pose a risk for surgical site infection.<sup>[12]</sup>

Our study aimed to observe the efficacy of periarticular cocktail injection in controlling pain and early post-operative range of motion after primary total knee replacement. VAS score for pain progressively reduced from the 12 hours to 84 hours

post TKR. Functional recovery was evaluated in the form of knee flexion. All patients comfortably achieved 90 degrees of knee flexion by post-operative day 3. The need for rescue analgesia was significantly less during their hospital stay.

In addition to the aforementioned benefits, the ingredients of the cocktail are inexpensive and easily available, and thus is reproducible and affordable in most centres.

Based on this study, further work is necessary to refine the optimum contents and dosage of the analgesic combination to further improve the efficacy in pain relief and recovery from TKR, and to make the rehabilitation less arduous for the patient. Our study has few fallacies. Our study did not attempt at evaluating long-term clinical outcomes of the patients. Further effort is needed with larger sample size, with a comparative study design to comment on the superiority of one component over the other.

## CONCLUSION

An effective, periarticular cocktail injection has revolutionised the recovery of patients after total knee replacement. Patient satisfaction is extremely high with multimodal approach in pain management with low VAS scores and early active range of motion facilitating good rehabilitation. Periarticular analgesic infiltration reduces need for parenteral analgesia and prevents need for narcotics.

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