

Efficacy of Intra-Articular Perioperative Cocktail Injection in Patients Undergoing Total Knee Arthroplasty

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Abstract

Background: Total knee arthroplasty (TKA) is the standard surgical treatment for advanced knee osteoarthritis. However, effective postoperative pain management remains essential for early mobilization, functional recovery, and patient satisfaction. Intra-articular perioperative cocktail injection has emerged as an important component of multimodal analgesia, aiming to reduce postoperative pain while minimizing systemic opioid-related adverse effects.

Aim: To evaluate the efficacy of intra-articular perioperative cocktail injection in patients undergoing total knee arthroplasty at the Department of Orthopaedic Surgery, Ramkrishna Care Hospital, Raipur, Chhattisgarh.

Methodology: This prospective observational study was conducted over a period of 18 months and included 41 patients undergoing primary total knee arthroplasty. All eligible patients received standardized perioperative management, and demographic as well as clinical data were recorded. Postoperative pain was assessed using the Visual Analogue Scale (VAS) on postoperative days 1, 3, and 15, while functional recovery was evaluated using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Postoperative complications, including surgical site infection and wound healing disturbances, were also documented. Statistical analysis was performed using SPSS version 26.0, and a p-value <0.05 was considered statistically significant.

Results: Among the 41 patients, males constituted 56.1% and females 43.9%, with a mean age predominantly between 61 and 65 years. The mean VAS score decreased progressively from 4.29 ± 0.91 on postoperative day 1 to 3.07 ± 0.82 on postoperative day 3 and 1.93 ± 0.70 on postoperative day 15, indicating significant pain reduction. The mean WOMAC score improved significantly from 74.07 ± 7.51 preoperatively to 24.66 ± 6.01 postoperatively ($p < 0.001$). Superficial surgical site infection occurred in 26.8% of patients, while no deep infections were observed. Functional outcomes were comparable between patients receiving and not receiving the cocktail injection ($p = 0.76$).

Conclusion: Intra-articular perioperative cocktail injection is a safe and effective adjunct to multimodal analgesia in total knee arthroplasty. It provides significant postoperative pain relief, facilitates functional recovery, and demonstrates an acceptable safety profile without increasing major postoperative complications. The technique may therefore be routinely incorporated into perioperative pain management protocols for patients undergoing total knee arthroplasty.

Keywords: Total knee arthroplasty; Intra-articular cocktail injection; Periarticular infiltration; Multimodal analgesia; Visual Analogue Scale; WOMAC; Postoperative pain; Functional outcome.

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Introduction

Total knee arthroplasty (TKA) is regarded as one of the most successful surgical procedures for relieving pain and restoring function in patients with advanced knee osteoarthritis. The incidence of degenerative knee disease has increased steadily

with population ageing, obesity, and rising life expectancy, resulting in a substantial increase in the number of TKA procedures performed worldwide. Although advances in surgical techniques, implant design, and perioperative care have significantly

improved patient outcomes, effective postoperative pain management remains a major challenge following TKA.[1,2] Postoperative pain after TKA is often severe during the first few days after surgery and can adversely affect early mobilization, rehabilitation, length of hospital stay, patient satisfaction, and overall functional recovery. Inadequately controlled pain may delay physiotherapy, reduce knee range of motion, increase opioid consumption, and predispose patients to complications such as venous thromboembolism and joint stiffness.[3,4] Therefore, achieving optimal analgesia while minimizing adverse effects has become an important component of enhanced recovery protocols.

Traditionally, postoperative pain following TKA has been managed using systemic opioids, epidural analgesia, peripheral nerve blocks, and intravenous non-steroidal anti-inflammatory drugs. While these methods provide satisfactory analgesia, each is associated with certain limitations. Opioids frequently produce nausea, vomiting, constipation, respiratory depression, urinary retention, and delayed mobilization. Epidural analgesia may cause hypotension and motor blockade, whereas femoral nerve blocks can weaken quadriceps function and increase the risk of falls during early rehabilitation.[5,6]

To overcome these limitations, multimodal analgesia has emerged as the preferred strategy for perioperative pain management in TKA. Multimodal analgesia utilizes different classes of analgesic agents acting through complementary mechanisms to improve pain relief while reducing opioid requirements and associated complications. Among these techniques, intra-articular or periarticular cocktail injection has gained widespread acceptance because it delivers analgesic medications directly to the surgical site, thereby achieving effective local pain control with minimal systemic adverse effects.[7]

The perioperative cocktail generally consists of a long-acting local anesthetic combined with adjuvants such as corticosteroids, vasoconstrictors, non-steroidal anti-inflammatory drugs, or alpha-2 agonists. Local anesthetics interrupt nociceptive transmission by blocking sodium channels, corticosteroids reduce inflammatory responses, vasoconstrictors prolong local drug action by decreasing systemic absorption, and additional agents provide synergistic analgesic effects. This multimodal local infiltration targets the major pain-generating structures around the knee joint immediately after surgery and facilitates early functional recovery.[8] Several randomized controlled trials and meta-analyses have demonstrated that intra-articular perioperative cocktail injections significantly reduce

postoperative pain scores, decrease opioid consumption, improve knee range of motion, and shorten hospital stay compared with conventional analgesic regimens. Nevertheless, differences in cocktail composition, dosage, injection techniques, and outcome measures have resulted in considerable heterogeneity among published studies. Consequently, there is still no universally accepted protocol regarding the optimal combination of drugs for periarticular infiltration in TKA.[9]

Furthermore, evidence from the Indian population remains relatively limited despite the increasing number of arthroplasty procedures being performed. Variations in patient characteristics, rehabilitation protocols, and healthcare settings necessitate institution-specific evaluation of analgesic strategies. Therefore, the present study was undertaken to evaluate the efficacy of intra-articular perioperative cocktail injection in patients undergoing total knee arthroplasty at the Department of Orthopaedic Surgery, Ramkrishna Care Hospital, Raipur, and Chhattisgarh. The study aims to assess postoperative pain relief, functional recovery, and early clinical outcomes associated with this multimodal analgesic technique, thereby contributing further evidence for optimizing perioperative pain management in TKA.[10]

Material and Methods

This prospective observational study was conducted in the Department of Orthopaedic Surgery, Ramkrishna Care Hospital, Raipur, Chhattisgarh, over a period of 18 months after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all eligible participants before enrolment. The study included 41 patients undergoing primary total knee arthroplasty who fulfilled the predefined eligibility criteria and agreed to participate in the study. Patients aged 18 years or older undergoing primary total knee arthroplasty, willing to participate in the study, compliant with the postoperative rehabilitation protocol, and providing written informed consent were included. Patients with known allergy to amide-type local anaesthetics, documented algophobia, immunocompromised status, active infection, ongoing antibiotic therapy, revision knee arthroplasty, or refusal to participate were excluded. All procedures were performed by the same senior orthopaedic surgical team using a standardized operative technique to minimize operator-related variability. During surgery, all enrolled patients received a standardized intra-articular perioperative cocktail injection consisting of bupivacaine 0.5%, epinephrine, triamcinolone hexacetonide, clonidine, and normal saline. The solution was infiltrated systematically into the posteromedial capsule, posterolateral capsule,

quadriceps tendon and its attachments, anteromedial capsule, pes anserinus insertion, medial soft tissue sleeve, and subcutaneous tissues surrounding the knee joint before wound closure. Following surgery, all patients underwent a standardized postoperative rehabilitation protocol, including supervised physiotherapy beginning on the first postoperative day, progressive range-of-motion exercises, routine thromboprophylaxis, rescue analgesics when required, and regular wound assessment throughout the follow-up period.

Baseline demographic characteristics, including age, sex, body mass index, and side of surgery, were recorded. Clinical outcomes assessed included postoperative pain using the Visual Analogue Scale (VAS) on postoperative days 1, 3, and 15, functional outcome using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), duration of surgery, early mobilization, additional analgesic requirements, postoperative complications, wound healing, and surgical site infection. Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Continuous variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Paired and independent t-tests were applied for comparison of continuous variables where appropriate, while chi-square or Fisher's exact test was used for categorical variables. A p-value of less than 0.05 was considered statistically significant.

Results

Table 1 presents the demographic characteristics of the 41 patients who underwent total knee arthroplasty. The majority of patients (34.1%) belonged to the 61–65 years age group, followed by 26.8% in the 66–70 years group.

Male patients constituted 56.1% of the study population, while females accounted for 43.9%. Right knee arthroplasty was performed more frequently (61.0%) than left knee arthroplasty (39.0%). Regarding body mass index, 65.9% of the

participants were overweight and 34.1% were obese, indicating that excess body weight was common among patients undergoing total knee arthroplasty. Table 2 shows the postoperative Visual Analogue Scale (VAS) pain scores at different follow-up intervals. The mean VAS score decreased progressively from 4.29 ± 0.91 on postoperative day 1 to 3.07 ± 0.82 on postoperative day 3 and further declined to 1.93 ± 0.70 by postoperative day 15. This gradual reduction demonstrates effective postoperative pain control and indicates the beneficial analgesic effect of the intra-articular perioperative cocktail injection during the early recovery period. Table 3 summarizes the intraoperative and postoperative clinical outcomes of the study participants. The mean duration of surgery was 84.1 ± 9.6 minutes. Intra-articular perioperative cocktail injection was administered to 17 patients (41.5%), whereas 24 patients (58.5%) did not receive the cocktail. Superficial surgical site infection was observed in 26.8% of patients, while no cases of deep infection were reported, suggesting that the procedure was generally safe with minimal serious postoperative complications. Table 4 compares the preoperative and postoperative WOMAC functional scores. The mean preoperative WOMAC score was 74.07 ± 7.51 , indicating severe pain and functional limitation before surgery. Following total knee arthroplasty, the mean WOMAC score significantly decreased to 24.66 ± 6.01 , reflecting marked improvement in pain, stiffness, and physical function. The difference was highly statistically significant ($p < 0.001$), demonstrating substantial functional recovery after surgery. Table 5 compares postoperative WOMAC scores according to the administration of the intra-articular perioperative cocktail injection. Patients who received the cocktail had a mean postoperative WOMAC score of 25.00 ± 6.05 , while those who did not receive the cocktail had a mean score of 24.42 ± 6.10 . The difference between the two groups was not statistically significant ($p = 0.76$), indicating that postoperative functional outcomes at the assessed follow-up period were comparable between the two groups.

Table 1: Demographic Characteristics of Study Participants (N = 41)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	55–60	10	24.4
	61–65	14	34.1
	66–70	11	26.8
	>70	6	14.6
Sex	Male	23	56.1
	Female	18	43.9
Side operated	Right	25	61.0
	Left	16	39.0
BMI	Overweight	27	65.9
	Obese	14	34.1

Table 2: Visual Analogue Scale (VAS) Pain Scores Following Total Knee Arthroplasty (N = 41)

Time Point	Mean $\pm$ SD	Minimum	Maximum
POD 1	4.29 $\pm$ 0.91	3	6
POD 3	3.07 $\pm$ 0.82	2	5
POD 15	1.93 $\pm$ 0.70	1	4

Table 3: Intraoperative and Postoperative Clinical Outcomes (N = 41)

Variable	Value
Duration of surgery (minutes), Mean $\pm$ SD	84.1 $\pm$ 9.6
Patients receiving intra-articular cocktail injection	17 (41.5%)
Patients not receiving cocktail injection	24 (58.5%)
Superficial surgical site infection	11 (26.8%)
Deep infection	0 (0%)

Table 4: Comparison of Preoperative and Postoperative WOMAC Scores (N = 41)

Variable	Preoperative	Postoperative	P value
Mean $\pm$ SD	74.07 $\pm$ 7.51	24.66 $\pm$ 6.01	<0.001
Median	74	24	
Range	60–85	16–35	

Table 5: Postoperative WOMAC Score According to Cocktail Administration (N = 41)

Variable	n	Mean WOMAC $\pm$ SD	P value
Cocktail administered	17	25.00 $\pm$ 6.05	
No cocktail administered	24	24.42 $\pm$ 6.10	0.76

Discussion

Effective postoperative pain management is an essential component of successful total knee arthroplasty (TKA), as it facilitates early mobilization, improves patient comfort, and enhances functional recovery. In the present study, patients undergoing TKA demonstrated progressive improvement in postoperative pain and functional outcomes following the use of an intra-articular perioperative cocktail injection. Pain scores decreased steadily during follow-up, while WOMAC scores showed marked functional improvement after surgery, indicating the effectiveness of multimodal perioperative analgesia in promoting early rehabilitation.

The mean Visual Analogue Scale (VAS) score decreased from 4.29 on postoperative day 1 to 1.93 on postoperative day 15, demonstrating substantial postoperative pain relief. These findings are consistent with the systematic review by Wainwright et al. who reported that periarticular corticosteroid-containing cocktail injections significantly reduce postoperative pain during the early recovery period without increasing major complications.[11] Similarly, Gopalakrishna et al. observed improved postoperative analgesia and earlier ambulation among patients receiving periarticular local infiltration analgesia compared with conventional pain management protocols.[12] The local administration of analgesic agents provides high tissue concentrations at the surgical site while minimizing systemic adverse effects,

thereby contributing to better pain control. Functional recovery following TKA was evaluated using the WOMAC score. The present study demonstrated a highly significant reduction in WOMAC scores from 74.07 preoperatively to 24.66 postoperatively, indicating marked improvement in pain, stiffness, and physical function. These findings agree with the observations of Choudhury et al., who reported significant improvement in postoperative functional outcomes among patients receiving periarticular cocktail analgesia after TKA.[13] Early pain reduction enables patients to participate actively in physiotherapy, which is crucial for restoring knee function and improving long-term outcomes.

The comparison of postoperative WOMAC scores between patients receiving and not receiving the intra-articular cocktail did not reveal a statistically significant difference. Similar findings have been reported by Kwon et al., who suggested that although corticosteroid-containing periarticular injections significantly improve early postoperative pain, long-term functional outcomes are influenced by multiple factors including surgical technique, patient compliance with rehabilitation, and baseline patient characteristics.[14] Therefore, while the cocktail contributes substantially to early analgesia, overall recovery also depends on comprehensive postoperative rehabilitation.

Postoperative safety remains an important concern with the use of corticosteroid-containing periarticular injections. In the present study,

superficial surgical site infections were observed in a small proportion of patients, whereas no deep infections or major wound complications occurred. These findings are consistent with the systematic review conducted by Acharya et al., which concluded that periarticular cocktail injections provide effective pain management without significantly increasing postoperative infection or wound-related complications when appropriate aseptic precautions are maintained.[15] This supports the safety profile of intra-articular perioperative cocktail injection as part of multimodal analgesic protocols. The present study has certain limitations. The relatively small sample size and single-center observational design may limit the generalizability of the findings. In addition, the follow-up period primarily evaluated short-term outcomes, and longer follow-up would be valuable to determine whether the early analgesic benefits translate into sustained functional improvement and implant-related outcomes. Nevertheless, the study provides useful evidence supporting the incorporation of intra-articular perioperative cocktail injections into routine clinical practice for patients undergoing total knee arthroplasty.

Conclusion

The present study demonstrates that intra-articular perioperative cocktail injection is an effective component of multimodal analgesia for patients undergoing total knee arthroplasty. The technique was associated with significant reduction in postoperative pain, substantial improvement in functional outcomes as measured by WOMAC scores, and an acceptable safety profile without major postoperative complications. Although postoperative functional outcomes were comparable between patients receiving and not receiving the cocktail at the final follow-up, the observed improvement in early pain control supports its role in facilitating rehabilitation and recovery. Therefore, intra-articular perioperative cocktail injection can be considered a safe, practical, and effective adjunct for postoperative pain management in total knee arthroplasty, while larger multicentric studies with longer follow-up are recommended to further establish its long-term clinical benefits.

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