

Original Research Article

Posterior capsular infiltration with local anaesthetic cocktail during total knee arthroplasty: a prospective comparative study

Vikram I. Shah, Javahir A. Pachore*, Jayesh Patil, Darshan Rajani

Department of Orthopaedics, Shalby Hospital, Ahmedabad, Gujarat, India

Received: 21 July 2022

Revised: 16 August 2022

Accepted: 17 August 2022

*Correspondence:

Dr. Javahir A. Pachore,

E-mail: pachorejavahir@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: Total knee arthroplasty offers a stable joint with excellent long-term results in osteoarthritis knee patients. The procedure is also associated with post-operative pain which can lead to delayed functional recovery in few patients. This comparative study was aimed to evaluate the efficacy of a local anaesthetic cocktail injection with and without posterior capsular infiltration for post-operative pain control and early functional recovery in patients undergoing simultaneous bilateral TKA.

Methods: This was a prospective comparative study which involved 50 participants undergoing bilateral TKA where one knee, received LIA in anterior, medial and lateral structures of the knee as well as posterior capsule (group A) and contralateral knee received LIA in anterior, medial and lateral structures, identical to the former knee, but excluding posterior capsule region (group B). Pre-operative and post-operative parameters such as VAS, KSS and knee ROM in both knees of all the patients were noted and compared to evaluate the efficacy of PCI.

Results: Comparison of VAS scores, post-operatively showed that VAS on rest and on movement was lower in group A than group B at all the time frames (p value $<0.0001^*$). Post-operative knee ROM was higher in group A ($p<0.0001$). Knee society score was observed to be higher in group A than group B on 15th day and at 1 month ($p<0.0001$).

Conclusions: The study successfully demonstrates that posterior capsular infiltration when included in LIA technique provides a better pain control and also early functional recovery after TKA.

Keywords: Local infiltration analgesia, Total knee arthroplasty, Posterior capsular infiltration, Knee society score, Visual analogue scale, Straight leg raise, Range of motion

INTRODUCTION

One of the most prevalent disorders of arthritis of joints and leading cause of dysfunction and disability in India is Osteoarthritis. Though TKA (total knee arthroplasty) offers a stable joint with good long-term outcome, it is also associated with post-operative pain which can lead to delay in patient mobilization, longer hospital stays, patient dissatisfaction and hinderance in rehabilitation

protocols. APA (American Pain Society) in 1996 proclaimed, pain was the fifth vital sign.¹ In order to resolve this issue, various approaches have been designed, such pre-emptive analgesia, opioids medications, COX-2 inhibitor drugs, epidural anaesthesia, peripheral nerve blockade, local infiltration analgesia, PCA and multimodal analgesia.² All the above techniques carry their own set of complications. Kerr et al from Sydney, Australia developed a wound infiltration

procedure for tackling post-op pain after TKA/THA known as local infiltration analgesia (LIA).³ Principle of this technique is using multiple agents which target the pain pathway and receptors within the knee. But there is still shortage of literature depicting the importance of inclusion of posterior capsule during infiltration procedure and additional benefits of posterior capsular infiltration. The surgeon has to be careful during posterior capsular infiltration with local anaesthetic injection because of the chances of possible neurovascular complications due to proximity of neurovascular structures in relation to posterior capsule of the knee.⁴ The cocktail mixture considered for our study comprises of 0.5% bupivacaine, 40 mg methyl prednisolone, 1.5 gm cefuroxime and 0.9% normal saline. The main action of local anaesthetics is reversible block of voltage gated Na channels in nociceptors, thus resulting to decreased transmission of pain signals to the brain.⁵ Intermediate acting corticosteroid like methyl prednisolone has been used by many surgeons due to its anti-inflammatory properties.⁶ The prophylactic use of antibiotic drug cefuroxime in the anaesthetic cocktail was to aid in the prevention of deep wound infections.

Objectives

The objective of this prospective comparative study, involving 50 adult patients (100 knees) undergoing simultaneous bilateral total knee arthroplasty was to assess the role of posterior capsular infiltration as a component of local infiltration analgesia technique. The factors noted and compared post-operatively were, VAS score for pain control, knee flexion range of motion, extensor lag, time taken to perform active SLR and knee society score.

METHODS

This was a prospective comparative study including 50 patients undergoing simultaneous bilateral TKA. The study took place between December 2020 to August 2021 at department of arthroplasty, Shalby Hospital, Ahmedabad.

Inclusion criteria

The inclusion criteria were patients diagnosed with bilateral knee primary osteoarthritis undergoing simultaneous bilateral total knee arthroplasty, patients with ASA grade 1 and 2 and patients undergoing surgery with spinal anaesthesia being given.

Exclusion criteria

The exclusion criteria were patients with known h/o allergy to the drugs used in the study, \geq ASA grade 3, poorly controlled diabetes mellitus or h/o recent cardiac disorders and arrhythmia, rheumatoid arthritis/neuromuscular deficits, h/o previous trauma or previous surgical intervention in the same sided knee,

treated previously with high tibial osteotomy and patients admitted for revision TKR.

Procedure

In all the study participants, one knee, received LIA in anterior, medial and lateral structures of the knee as well as posterior capsule (group A) and contralateral knee received LIA in anterior, medial and lateral structures, identical to the former knee, but excluding posterior capsule region (group B). To determine the side of knee (right/left) to be infiltrated with LIA with PCI in all 50 patients, we used alternating allocation method based on the date of admission of the patients, where if the first patient received LIA with PCI in the right knee and LIA without PCI in left knee, the next patient admitted in the sequence received LIA with PCI in the left knee and LIA without PCI in right knee, thus alternation was used in the sequential sequence for all the subjects to determine the side of knee receiving posterior capsular infiltration (PCI). The intention of alternation process was to make the comparison between two groups with as many as similar characteristics as possible. Pre-operatively clinical history and relevant data such as pain scores, knee society score and knee range of motion in both knees of all the patients were collected as per the pre-designed proforma. It showed no statistically significant differences between both the groups. All patients received spinal anaesthesia with 0.5% bupivacaine and 0.5 ml (25 mg) fentanyl. The antibiotic prophylaxis was provided with 1.5 gm of cefuroxime, half an hour before the TKA incision. All TKAs were done by a single senior surgeon, and standard anterior midline incision with medial parapatellar arthrotomy was taken. Tourniquet was used in all the patients. Cemented posterior stabilized total knee components (Meril, Stryker, Depuy and Smith and nephew) were used in all the patients. The cocktail was infiltrated after giving a thorough wash before cementing and final implantation. Cocktail injection was prepared by the assistant which included 100 mg bupivacaine (0.5%, 20 ml), 40 mg methyl prednisolone acetate, and 1.5 gm cefuroxime. The contents were mixed with sterile normal saline 0.9% to a total mixture of 60 ml. We divided the posterior capsule into following zones for better understanding and to maintain identical protocol of injection in all the participants (Figure 1): zone 1: postero-medial capsular area on femoral aspect, zone 2: postero-lateral capsular area on femoral aspect, zone 3: postero-medial capsular area on tibial aspect and zone 4: postero-lateral capsular area on tibial aspect. We avoided infiltrating the central portion of the posterior capsular area to escape the damage to neuro-vascular structures as it has a well-established close proximity to the midline structures such as popliteal artery and tibial nerve. If damage occurs to these structures while injecting in the central area of the posterior capsule, it might result into dangerous complications intra-operatively. We also avoided injecting the cocktail mixture into Zone 4 (postero-lateral capsular area on tibial aspect) to avoid damage to the common peroneal nerve in that area. Thus,

we injected cocktail mixture to zone 1, zone 2 and zone 3 in all our patients.

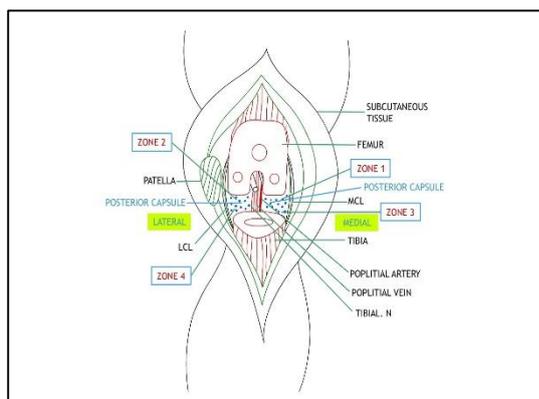


Figure 1: Picture showing knee anatomy and posterior capsular area, injection zones: - zone 1, zone 2, zone 3.

In one knee (Group A) LIA with posterior capsule area infiltration was administered, where after tibial and femoral cuts and before placement of implant, the 1st 20 ml of the cocktail preparation was injected into the posterior capsule in a flexed knee position, in equal proportions, into zones 1, 2 and 3 each, respectively (Figure 2).

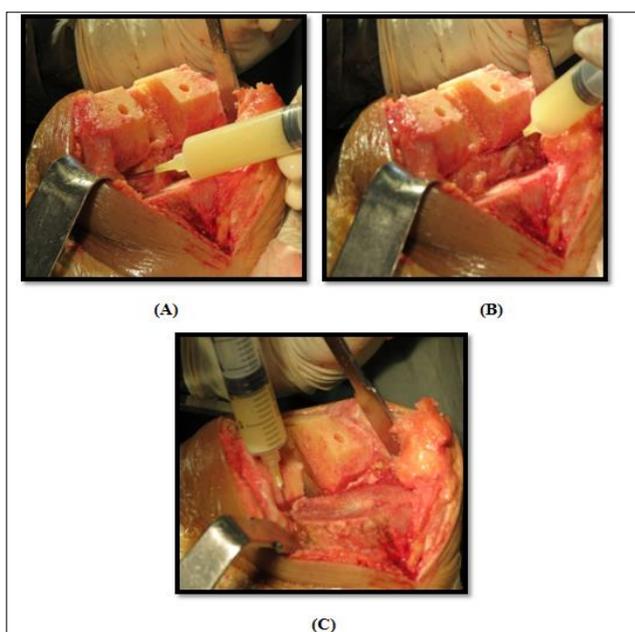


Figure 2: Intra-operative picture showing cocktail injection into; A) Zone 1 B) Zone 2 C) Zone 3.

Placement of the final implants was done and the next 20 ml were injected into quadriceps, patellar tendon, medial and lateral retinaculum and subcutaneous tissue (approx.4 ml each) sequentially with a 21-gauge needle and syringe. In the contralateral knee (Group B), 20 ml of cocktail preparation was injected identically as the first

knee and into the same sites as above, quadriceps, medial and lateral retinaculum, patellar tendon and subcutaneous tissue but without posterior capsular infiltration. Tourniquet was released and hemostasis was achieved. Thorough wash was given in all the surgeries followed by wound closure in layers and sterile dressing. Post-operatively, primary parameter VAS score for pain at rest and on movement was noted at 6, 12, 24, 48, 72 hours and on the discharge day. Knee flexion and extensor lag were recorded by goniometer and compared on both the sides at 6, 12, 24, 48, 72 hours and on the discharge day. Knee society score was assessed for both knees in all the study participants at 15 days and 1 month post-operatively. Time taken for active SLR was noted for both the knees post-operatively.

Statistical analysis

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of statistical package for social sciences (SPSS) software, IBM manufacturer, Chicago, USA, version 21.0. The presentation of the Categorical variables was done in the form of number and percentage (%). On the other hand, the quantitative data were presented as the means \pm SD and as median with 25th and 75th percentiles (interquartile range). The data normality was checked by using Kolmogorov-Smirnov test. The cases in which the data was not normal, we used non parametric tests. The comparison of the variables which were quantitative and not normally distributed in nature were analyzed using Wilcoxon signed rank test and variables which were quantitative and normally distributed in nature were analyzed using paired t test. For statistical significance, p value of less than 0.05 was considered statistically significant.

RESULTS

Results of the study were analyzed in 50 patients (100 knees). Females were found to be more in number who were diagnosed with primary knee OA and underwent simultaneous bilateral TKA compared to males. Male to female ratio was 0.56:1, mean age at which the patients underwent the procedure was found to be 61.62 ± 7.7 years and mean BMI of the patients who underwent TKA was found to be 25.74 ± 3.01 kg/m² (Table 1).

Table 1: Age and BMI of the study subjects.

Parameters	
Age (years)	
Mean \pm SD	61.62 \pm 7.7
Median (25th-75th percentile)	61.5 (57.25-68)
Range	32-76
BMI-body mass index (kg/m²)	
Mean \pm SD	25.74 \pm 3.01
Median (25th-75th percentile)	25.8 (23.66-27.534)
Range	19.33-33.06

There were no significant differences in pre-operative parameters such as VAS scores, knee flexion, extensor lag and KSS between the two groups (Table 2).

Table 2: Pre-operative parameters of the study subjects.

Pre-operative parameters	Group A (N=50)	Group B (N=50)	P value
VAS († Wilcoxon Signed Ranks Test)			
Mean±SD	4.9±0.93	4.9±0.91	0.939
Median (25th-75th percentile)	5 (4-5.75)	5 (4-5)	
Range	4-7	3-7	
Knee flexion (paired t test)			
Mean±SD	97.3±8.22	98.5±9.22	0.274
Median (25th-75th percentile)	95 (90-105)	100 (90-110)	
Range	80-115	80-115	
Extensor lag (Wilcoxon Signed Ranks Test)			
Mean±SD	1.32±2.82	1.42±2.68	0.457
Median (25th-75th percentile)	0 (0-0)	0 (0-0)	
Range	0-10	0-10	
KSS (Wilcoxon Signed Ranks Test)			
Mean±SD	43.46±3.47	43.68±3.5	0.705
Median (25th-75th percentile)	43 (41-45)	44 (41-45)	
Range	39-52	39-52	

The VAS scores at rest were lower in Group A knees compared to contralateral knees (Group B) at 6, 12, 24, 48 and 72 hours with $p < 0.0001$ (Figure 3).

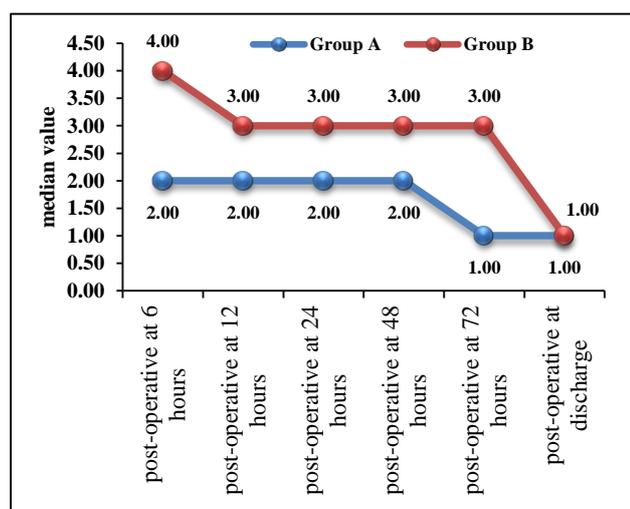


Figure 3: Comparison of trend of post-operative VAS at rest at different time intervals between group A and B.

The difference between VAS values at rest at the time of discharge was not found to be significant. The VAS scores on movement were significantly lower in knees where LIA included posterior capsular area (Group A) compared to contralateral knees (Group B), at all the given time frames (Figure 4).

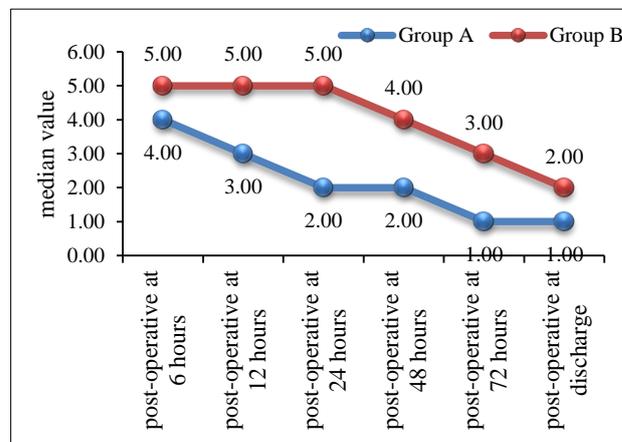


Figure 4: Comparison of trend of post-operative VAS on movement at different time intervals between group A and B.

Post-operatively, comparison of mean values of knee flexion range between Group A and Group B at 6, 12, 24, 48, 72 hours and at the time of discharge, showed a significant difference, with Group A demonstrating higher knee flexion range of motion compared to Group B (Figure 5).

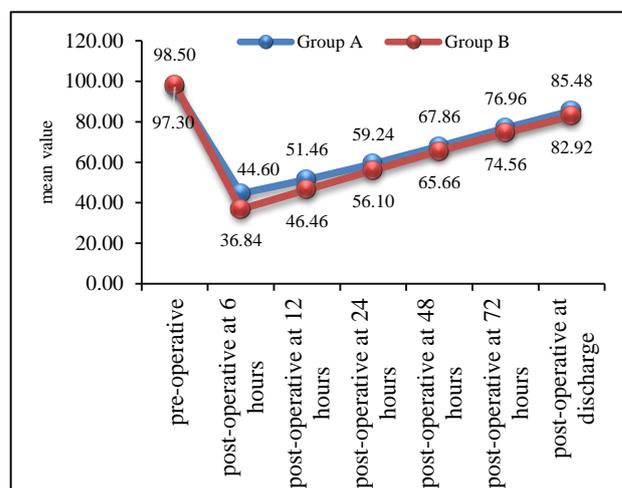


Figure 5: Comparison of trend of knee flexion at different time intervals between group A and B.

The extensor lag was significantly lesser in Group A when compared to Group B at 6, 12, 24, 48 and 72 hours. However, there was no significant difference between the two groups at the time of discharge (Figure 6). Mean knee society knee score in patients with and without infiltrated posterior capsule at 15 days was 69.4 ± 4.4 and 65 ± 6.1 respectively. Similarly, at one month mean KSS

in patients with infiltrated posterior capsule was 83.9 ± 4.6 and that of in patients without posterior capsular infiltration was 78.7 ± 4.8 .

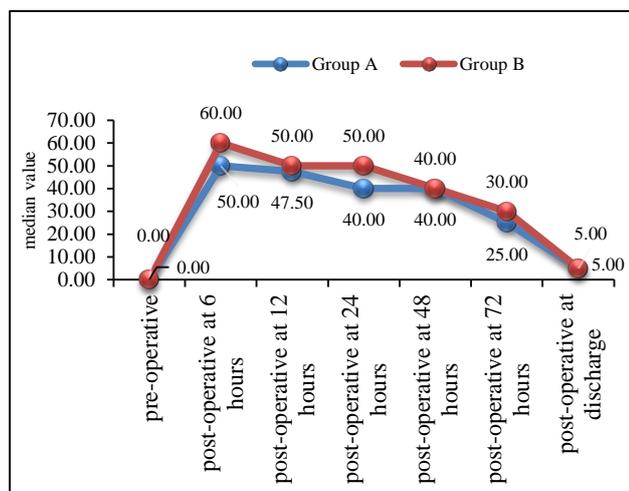


Figure 6: Comparison of trend of extensor lag at different time intervals between group A and B.

The difference between the KSS of the two groups was significant ($p < 0.0001$) and showed early improvement in Group A than Group B (Figure 7). The mean time taken to perform active SLR was lesser in the knee which received LIA with PCI (2.5 ± 0.79) than the contralateral knee (2.74 ± 0.75) (Figure 8).

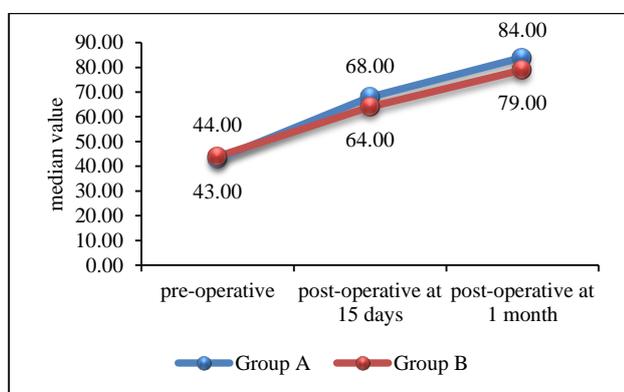


Figure 7: Comparison of trend of knee society score at different time intervals between group A and B.

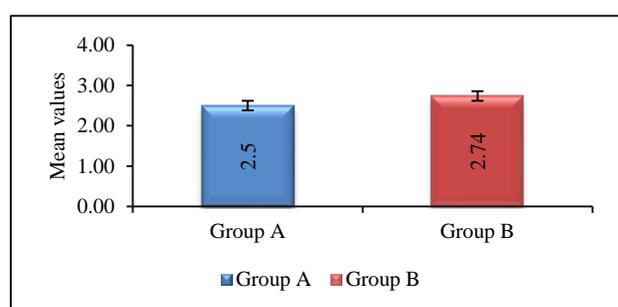


Figure 8: Comparison of time taken post-operatively for active SLR (days) between group A and B.

DISCUSSION

The prevalence of knee osteoarthritis in rural region of India has been shown to be 3.9% whereas in urban region of India to be 5.5%. According to a survey done by ISHKS joint registry in 2013, which included data of 34,478 TKAs, it was observed that OA knee was the indication for TKA in 33,444 patients, which makes around 95% of the study population considered.⁷ With regard to a survey conducted, the number of total knee joint replacement procedures in India are on a rise every year and estimated surgeries in 2020 were around 2,00,000.⁸

TKA might usually be accompanied with post-operative pain which affects the patients ability to mobilise, satisfaction ratio and rehabilitation program. Several methods have been devised to tackle the problem of post-operative pain after TKA such as pre-emptive analgesia, opioids, COX-2 inhibitors, peripheral nerve blockade, LIA and patient controlled analgesia. Each method carries its own benefits and side effects.^{9,10} LIA is one such method which has proven to be beneficial for post-operative pain but there is not much definitive literature that specifically isolates the advantages of the posterior capsular infiltration when included as a component of LIA. Diwakar et al conducted a prospective study to compare the effectiveness of a single posterior capsule versus multiple site injection in controlling post-operative pain. Authors concluded that a single posterior capsular injection is as satisfactory as multiple infiltration.¹¹ Garg et al did a study to assess the effectiveness of LIA (bupivacaine) given into the posterior capsule along with FNB and concluded that posterior capsular infiltration aided in relieving the post-operative pain after TKA.¹² In our study, it was observed that values of VAS were significantly lower in Group A when compared to Group B at rest and on movement, at different time frames. It depicts improved and better pain control with posterior capsular infiltration.

In a randomized, double-blind, placebo, research done by Fu et al 80 participants with OA knee who were posted for TKA were assigned to 2 groups: trial, who received intraarticular LIA including PCI, and Control, who received NS.¹³ The authors found out that Knee ROM at 15th post-op day, was better in trial group when compared to the control group. In our study, knee flexion range of motion was higher in Group A than Group B and the extensor lag was lesser in Group A than Group B at all the observed time frames, which shows improved functional range of movements in the posterior capsule infiltrated knees. In a study conducted by Esswing in authors evaluated the efficacy of LIA for post-operative pain in patients undergoing TKA and found LIA group had reduced morphine consumption when compared to the placebo group, though knee scores at 14 days and 3 months follow-up were not significantly different than the placebo group.¹⁴ In our study, comparison of KSS at 15th day and at 1 month showed significant difference and

was found to be higher in Group A compared to Group B. The difference shows the impact of PCI in patient satisfaction factors and early functional outcome in post-operative phase.

Limitations

Limitations of current study were large number of data collection over a few years will provide a better and more detailed information about the advantages of inclusion of posterior capsular infiltration in local infiltration analgesia technique. One of the limitations of our study is that we didn't include patients with a particular knee deformity, varus/valgus. This factor can prove to be a limitation in the final outcome.

CONCLUSION

The results of the study and comparison of the post-operative parameters such as VAS, knee range of motion, KSS and time taken to perform active SLR between both groups successfully demonstrate that posterior capsular infiltration when included in local infiltration analgesia technique provides a better post-operative pain control and early functional recovery after TKA.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the institutional ethics committee

REFERENCES

- Gaffney CJ, Pelt CE, Gililand JM, Peters CL. Perioperative pain management in hip and knee arthroplasty. *Orthoped Clin*. 2017;48(4):407-19.
- Dimaculangan D, Chen JF, Borzio RB, Jauregui JJ, Rasquinha VJ, Maheshwari AV. Periarticular injection and continuous femoral nerve block versus continuous femoral nerve block alone on postoperative opioid consumption and pain control following total knee arthroplasty: Randomized controlled trial. *J Clin Orthoped Trauma*. 2019;10(1):81-6.
- Kerr DR, Kohan L. Local infiltration analgesia: a technique for the control of acute postoperative pain following knee and hip surgery: a case study of 325 patients. *Acta Orthopaed*. 2008;79(2):174-83.
- Ben-David B. Complications of regional anesthesia: an overview. *Anesthesiol Clin North Am*. 2002;20(3):665-7.
- Lirk P, Picardi S, Hollmann MW. Local anaesthetics: 10 essentials. *Eur J Anaesthesiol*. 2014;31(11):575-85.
- Mullaji A, Kanna R, Shetty GM, Chavda V, Singh D. Efficacy of periarticular injection of bupivacaine, fentanyl, and methylprednisolone in total knee arthroplasty: a prospective, randomized trial. *J Arthroplast*. 2010;25(6):851-7.
- Pachore JA, Vaidya SV, Thakkar CJ, Bhalodia HK, Wakankar HM. ISHKS joint registry: A preliminary report. *Indian J Orthop*. 2013;47(5):505-9.
- Vaidya SV, Jogani AD, Pachore JA, Armstrong R, Vaidya CS. India joining the world of hip and knee registries: present status-a leap forward. *Indian J Orthop*. 2020;55(1):46-55.
- Ilfeld A, Duke BM, Donohue KB, Michael C. The association between lower extremity continuous peripheral nerve blocks and patient falls after knee and hip arthroplasty. *Anesth Anal*. 2010;111(6):1552-4.
- Feibel RJ, Kim PR, Beaulé PE. Major complications associated with femoral nerve catheters for knee arthroplasty: a word of caution. *J Arthroplasty*. 2009;24:132-7.
- Diwakar MD. Periarticular regional analgesia in total knee arthroplasty efficacy and outcome of single posterior capsular vs. multiple site injections. *J Arthroscop Joint Surg*. 2019;6:171-4.
- Garg M, Gupta P, Kang K, Dukshstein A, Feierman D. Evaluation of the efficacy of liposomal bupivacaine infiltrated into the posterior capsule for postoperative analgesia after total knee arthroplasty a randomized double blind clinical trial. *J Anesthesiol*. 2017;7:45-9.
- Fu P, Wu Y, Wu H, Li X, Qian Q, Zhu Y. Efficacy of intra-articular cocktail analgesic injection in total knee arthroplasty a randomized controlled trial. *Knee*. 2009;16(4):280-4.
- Essving P, Axelsson K, Kjellberg J, Wallgren O, Gupta A, Lundin A. Reduced hospital stay, morphine consumption, and pain intensity with local infiltration analgesia after unicompartmental knee arthroplasty. *Acta Orthop*. 2009;80(2):213-9.

Cite this article as: Shah VI, Pachore JA, Patil J, Rajani D. Posterior capsular infiltration with local anaesthetic cocktail during total knee arthroplasty: a prospective comparative study. *Int J Res Orthop* 2022;8:587-92.