EVALUATION OF POST-OPERATIVE ANALGESIC EFFICACY OF LOCAL INFILTRATION ANALGESIA IN PATIENTS UNDERGOING TOTAL KNEE ARTHROPLASTY -A PROSPECTIVE RANDOMIZED STUDY

Orthopaedics

Dr S P Garg (MBBS, DIPLOMA ORTHOPEDICS)-DNB Senior Resident.

Dr Sandeep Chouhan (MBBS, DIPLOMA ORTHOPEDICS)- Senior Resident.

Dr Prashant Pandey (MBBS, MS ORTHOPEDICS)-Senior Resident.

Dr Nandini Bhatt* (MBBS, MD ANESTHESIOLOGY)- Final Year Resident. *Corresponding Author

ABSTRACT

Introduction – Total knee arthroplasty is considered as one of the most painful procedures in field of orthopedic surgery. In this study we intended to evaluate the analgesic efficacy of Local Infiltration Analgesia (LIA) with post-surgical single shot of adductor canal block in terms of good post-operative analgesia and early post-operative mobilization thus allowing faster rehabilitation and recovery and thereby improving the final outcome of TKA in long term.

Material And Method- A total of 60 patients were enrolled, 30 in each group. Group A received Standard General anesthesia & postoperative analgesia with a single shot of adductor canal block with 20cc of 0.25% ropivacaine along with intraoperative local infiltration analgesia. Group B also received Standard General anesthesia & postoperative analgesia with a single shot of adductor canal block with 20cc of 0.25% ropivacaine but intraoperative local infiltration analgesia was not administered in group B.

Result- Group B patients required a greater number of rescue analgesic doses in comparison to Group A patients. The majority of the patients in Group A had early postoperative mobilization in comparison to Group B ($p=0.003$). Mean preoperative and 6-week postoperative WOMAC scores showed that difference was statistically significant ($p=0.034$), showing a significantly lower 6-week postoperative WOMAC score in Group A in comparison to Group B.

Conclusion – Our study gives us a conclusion that intraoperative Local Infiltration Analgesia along with single shot of adductor canal block provides better post-operative pain relief & allows early mobilization of the patient thus enhancing the rehabilitation thereby improving the final outcome of the Total Knee Arthroplasty.

KEYWORDS

Total knee arthroplasty, Adductor canal block, Local infiltration analgesia

INTRODUCTION

Primary total knee joint arthroplasty (TKA) is among the most frequent procedures performed by orthopedic surgeons & it is often cited as the most effective treatment for end-stage knee arthritis^{[1][2][3]}. It is often cited as one of the most painful procedures^{[1][2][3]}.

After knee surgery, pain inhibits early rehabilitation & mobilization of the knee joint.^[1] This acute post-surgical pain is also a known predictor of chronic post total knee arthroplasty pain^[24]. Thus, adequate postoperative pain control remains as a key factor for early rehabilitation and recovery of the patient. Thus, there was a need to find out analgesic modality which aims to reduce morbidity and enhance functional recovery as well as provide efficient analgesia with minimal side effects and minimal or no motor involvement.

Traditionally continuous epidural analgesia remained the major option for the postoperative pain management of total knee arthroplasty but it has some associated undesirable systemic side effects such as hypotension & post-operative urinary retention and motor blockade which delays the rehabilitation.^[7]

Another option for postoperative pain management is intravenous (IV) opioids administration after surgery, but IV opioids are often associated with serious systemic side effects.^{[3][4]} Femoral nerve block (FNB) can be a good substitute to opioid analgesia for postoperative pain control measures but it also carries a disadvantage of the motor blockade which actually delays early mobilization and rehabilitation of patients.

A number of different nerves traverse the adductor canal (Hunter's canal), including the saphenous nerve, the nerve to the vastus medialis, the posterior branch of the obturator nerve, and in some cases, the medial cutaneous nerve and the anterior branch of the obturator nerve.^[14] Except for the nerve to the vastus medialis, these branches have a sole sensory function. Thus continuous Adductor Canal block (ACB) can be a good alternative and effective treatment to reduce pain, as it blocks the sensory input from the anterior side of the knee with minimal effect on motor supply but with continuous adductor canal block chances of proximal extension of the blockade are high resulting

in motor involvement, also drug delivery catheter hampers the mobilization of the patient. Thus, an ultrasound-guided post-surgical single shot of the adductor canal block can be a good option but posterior knee pain control, which is under the innervation of the sciatic nerve cannot be achieved neither with femoral nor with adductor Canal Block.

Thus, infiltration of Local anesthetics through arthrotomy along with Adductor canal block is probably a good Pain control measure because it carries an advantage of neutralizing pain at the site of origin, least motor blockade as seen with Femoral Nerve Block and have minimal side effects.^[6]

Hence, in this study we intended to evaluate the analgesic efficacy of local infiltration analgesia along with single shot of adductor canal block in terms of good post-operative analgesia and early post-operative mobilization thus allowing faster rehabilitation and recovery and thereby improving the final outcome of TKR in long term.

MATERIAL AND METHODS

PROTOCOL- This study was conducted at Max Super-specialty Hospital F-50, C & D Block, Shalimar Bagh, New Delhi, 110088 & we enrolled all the diagnosed cases of osteoarthritis knee in adult, who are ready to undergo primary total knee replacement & who qualified our inclusion criteria. Our study design was a Prospective randomized study & it's a two-group study with a dichotomous variable.

PATIENTS – A total of 60 patients (30 in each group) who were planned for total knee replacement and who qualified inclusion criteria were enrolled with block randomization technique. Patients not willing to be the part of study, contraindications to spinal or regional anesthesia, ASA Grade 3 and above, patient with hypersensitivity to anesthetic drugs, revision arthroplasty, major peripheral vascular disease of the lower extremity, a cerebrovascular disease with history of CVA, patient with significant cardiac comorbidity, morbid obesity – BMI more than 35 were excluded from the study. Written informed consent was obtained from all patients who were enrolled in the study.

All patients in our study received pre-emptive analgesia in the form of

a combination of -Tablet Pregabalin 75mg with tablet diclofenac 75 mg per orally.

The Adductor canal is approximately halfway between the anterior superior iliac spine and the patella, at the mid-thigh level.^[9] To administer the adductor canal block an ultrasound transducer is placed transverse to the longitudinal axis of the extremity to identify the adductor canal underneath the sartorius muscle. The femoral artery is first identified as visible pulsations, with the vein just inferior and the saphenous nerve just lateral to the artery. The nerve is blocked at the location is so identified. (Fig 1.1)

In both Group A and B, Standard general anesthesia was administered & midline surgical approach was used & knee joint exposed through medial parapatellar arthrotomy following which patella was everted and retracted laterally then after soft tissue balancing proximal tibial cut & distal femoral were taken with the help of zig and sizing was done with posterior referencing then anterior-posterior and chamfers cuts were made following which joint space was checked in flexion and extension with spacer following which tibial plate and femoral component were positioned into place with antibiotic palacos cement and then spacer of adequate size placed then thorough wash was given and closure done in layers and the aseptic dressing was done. After the completion of the surgery, an ultrasound-guided single shot of an adductor canal block was administered in which anesthesiologist located the femoral nerve precisely within the adductor canal & 20cc of 0.25% ropivacaine injected into the adductor canal around the femoral nerve.

Additionally Intraoperatively 50 ml of local infiltrative anesthesia for each knee was administered (Fig 1.2) in **Group-A** in form of a mixture of 50mg ropivacaine, 1mg adrenaline, 15 mg morphine & 30 mg of triamcinolone diluted in normal saline and is injected 20 ml in the posterior capsule of the knee, 15 ml in suprapatellar part of quadriceps muscle & 15 ml in the medial compartment just before the cementation of the arthroplasty components.

Postoperative Protocol- Ankle flexion & extension exercises were started in bed immediately postoperatively. The patient was encouraged to sit on a recliner on the day of surgery. Day 0 was defined as the day of surgery. The first postoperative day was defined as the period between 6 am on the next day of surgery to 6 am of day next to it. The second postoperative day was defined as the period from termination of 1st postoperative day to 6 am of day next to it.

Postoperatively both the group received injection paracetamol 1 gm thrice and injection diclofenac sodium 75 mg twice a day for 3 days.

Patients were closely followed for 1st two days of surgery for
a. The requirement of rescue analgesia and its frequency post-operatively
b. Assessment of postoperative motor recovery and early mobilization of patient.

In both the Groups whenever patient complained of pain on and after day 1, VAS was assessed & single shot 20cc of 0.25% ropivacaine was injected into the adductor canal under ultrasound guidance as rescue analgesia & was administered only if VAS>3.

The short-term comparison of both study groups was done with the help of the above methodology but for long term comparison we evaluated the patient at 6 weeks after surgery with WOMAC functional outcome score.

Fig (1.1) Ultrasonic Image Of Adductor Canal

Fig (1.2) Local Infiltration Analgesia

Statistical Analysis-

The data was initially entered into the customized proforma and then transferred to Microsoft Excel for analysis. Statistical software Minitab Version 17.0 was used for calculating the P values. A comparison of means between the two groups was done using the Unpaired 't' test, the association between two non-parametric variables was done using Pearson Chi-square test, comparison of means within the groups at different time intervals was done using Paired 't' test. A p-value of <0.05 was taken as statistically significant. The final data was presented in the form of tables.

RESULTS

A total of 60 patients were enrolled. The mean age in Group A was 62.00 ± 7.51 years, and in Group B it was 61.43 ± 8.94 years. The difference was found to be statistically not significant ($p=0.791$), showing a comparable mean age between the two groups (**Table 1**). In Group A, there were 19 (63.3%) females and 11 (36.7%) males. In Group B, there were 22 (73.3%) females and 8 (26.7%) males. There was a female preponderance in both groups (**Table 2**). The mean weight in Group A was 75.40 ± 4.04 kg and in Group B it was 73.77 ± 4.55 kg. The difference was found to be statistically not significant ($p=0.147$), showing a comparable mean weight between the two groups (**Table 3**).

In Group A, 23 (76.7%) patients did not require any rescue analgesia and 7 (23.3%) patients required 1 rescue analgesia. In Group B, 4 (13.3%) patients did not require any rescue analgesia, 12 (40.0%) patients required 1 dose of rescue analgesia, 12 (40.0%) patients required 2 doses of rescue analgesia and 2 (6.7%) patients required 3 doses of rescue analgesia. Group B patients required a greater number of rescue analgesic doses in comparison to Group A patients (**Table 4**).

In Group A, 6 (20.0%) patients were mobilized on postoperative Day-1 and 24 (80.0%) patients were mobilized on postoperative Day-2. In Group B, 27 (90.0%) patients were mobilized on postoperative Day-2 and 3 (10.0%) patients were mobilized on postoperative Day-3. There was a statistically significant association seen between postoperative mobilization and the groups ($p=0.003$), showing that the groups are dependent on the postoperative mobilization. The majority of the patients in Group A had early postoperative mobilization in comparison to Group B which can be attributed to better analgesia achievement in group A patient (**Table 5**).

The mean preoperative WOMAC score in Group A was 72.40 ± 3.42 , while in Group B it was 71.50 ± 5.86 . The difference was found to be statistically not significant ($p=0.470$), showing a comparable mean preoperative WOMAC score between the two groups. The mean postoperative WOMAC score in Group A was 28.87 ± 3.04 , while in Group B it was 30.77 ± 3.72 . The difference was found to be statistically significant ($p=0.034$), showing a significantly lower postoperative WOMAC score in Group A in comparison to Group B (**Table 6**).

Table No. 1 Distribution Of Patients According To Age

Age Group	Group A		Group B	
	No.	%	No.	%
44-54 years	5	16.7	8	26.7
55-64 years	12	40.0	13	43.3
65-74 years	12	40.0	7	23.3
75-84 years	1	3.3	2	6.7
Total	30	100.0	30	100.0
Mean age (years)	62.00 ± 7.51		61.43 ± 8.94	

't' value and df	0.266, df=58
P value	0.791, Not Significant

Unpaired 't' test applied. P value = 0.791, Not Significant

Table No. 2 Distribution Of Patients According To Sex

Sex	Group A		Group B	
	No.	%	No.	%
Female	19	63.3	22	73.3
Male	11	36.7	8	26.7
Total	30	100.0	30	100.0

Table No. 3 Comparison Of Mean Weight Between The Two Groups

Groups	No.	Mean $\pm$ SD	't' value	P value
Group A	30	75.40 $\pm$ 4.04	1.471, df=58	0.147, NS
Group B	30	73.77 $\pm$ 4.55		

Unpaired 't' test applied. P value = 0.055, Not Significant

Table No. 4 Distribution According To Number Of Times Rescue Analgesia Given

Frequency of Rescue Analgesia	Group A		Group B	
	No.	%	No.	%
None	23	76.7	4	13.3
1	7	23.3	12	40.0
2	0	0.0	12	40.0
3	0	0.0	2	6.7
Total	30	100.0	30	100.0

Pearson chi-square value = 2.455, df=1, P value = 0.117, Not Significant

Table No. 5 Distribution According To Postoperative Mobilization

Postoperative Mobilization	Group A		Group B	
	No.	%	No.	%
Day-1	6	20.0	0	0.0
Day-2	24	80.0	27	90.0
Day-3	0	0.0	3	10.0
Total	30	100.0	30	100.0

Pearson chi-square value = 9.176, df=2, P value = 0.010, Significant

Table No. 6 Comparison Of Mean Preoperative And 6 Weeks Postoperative Womac Score Between The Two Groups

	Group A [Mean $\pm$ SD] (n=30)	Group B [Mean $\pm$ SD] (n=30)	't' value	P value
Preoperative	72.40 $\pm$ 3.42	71.50 $\pm$ 5.86	0.727, df=58	0.470, NS
Postoperative	28.87 $\pm$ 3.04	30.77 $\pm$ 3.72	-2.167, df=58	0.034*

Paired 't' test applied. P value = <0.05 was taken as statistically significant

DISCUSSION

Total knee arthroplasty is considered as one of the most painful procedure^{[14][3]}. Pain control is essential for early mobilization, which reduces the risk of complications. Thus in this study intended to evaluate two analgesic efficacy of local infiltration analgesia in terms of good post-operative analgesia and early post-operative mobilization thus allowing faster rehabilitation and recovery and thereby improving the final outcome of TKA in long term.

The mean age difference of patients in our study in both groups was found to be statistically not significant with female preponderance in both the groups.

In our study we used WOMAC scoring for preoperative evaluation of knee osteoarthritis & 6 weeks postoperatively to assess the recovery & functional outcome of the procedure. It is a self-administered questionnaire consisting of 24 items divided into 3 subscales; pain, stiffness, physical function.^[18]

Higher scores on the WOMAC indicate worse pain, stiffness, and functional limitations.

The mean preoperative WOMAC score difference in our study was found to be statistically not significant (p=0.470), showing a

comparable mean preoperative WOMAC score between the two study groups.

For pain assessment in our study we have used pain Visual Analogue Scale (VAS), ranging from 0 to 10 where 0 represents no pain and 10 represents extreme pain.

In our study **Group B**, more frequently developed pain & required administration of rescue analgesia in the first 48 hours postoperatively. Andersen^[9] et al. in their systematic review found that intra-operative LIA may have an analgesic effect in the early postoperative period after TKA which may be equally effective (four trials) or provide superior analgesia (one trial) compared with FNB in TKA. Similarly, Axelson^[10] et al in their study also found that LIA technique provided better postoperative analgesia and earlier mobilization, resulting in shorter hospital stay, than did intrathecal morphine after TKA. Fatin Affas^[5] et al in their study found that both LIA and femoral block provide good analgesia after TKA but LIA may be considered to be superior to femoral block since it is cheaper and easier to perform and has no post operative motor blockade. Perlas et al^[15] in their retrospective study of 298 patients showed that LIA with the addition of ACB is associated with further increases in early ambulation, a more rapid transition to use of a standard low walker, and a higher incidence of discharge to home.

In **Group A**, 6 (20.0%) patients were mobilized on postoperative Day-1 and 24 (80.0%) patients were mobilized on postoperative Day-2 while in **Group B**, 27 (90.0%) patients were mobilized on postoperative Day-2 and 3 (10.0%) patients were mobilized on postoperative Day-3 which indicates that majority of the patients in Group A had early postoperative mobilization in comparison Group B which can be attributed to better post-operative pain control in group A as compared to group B thus enhancing the early mobilization of the patient.

Patient in Group A showed a significantly lower 6 weeks postoperative WOMAC score comparison to Group B which indicates better recovery of patients in group A which again can be attributed to better postoperative pain control with Local Infiltration Analgesia (LIA) that made early mobilization of patient possible which led to faster recovery of the patient as indicated by lower 6 week post-operative WOMAC score.

CONCLUSION

Thus, our study gives us a conclusion that Local Infiltration Analgesia along with post-surgical Single Shot of adductor canal block is a better post-operative analgesic modality in terms of

- Better pain relief
- Early mobilization of the patient
- Higher patient acceptability

Thus, it allows faster rehabilitation & recovery of the patient & thereby increasing the functional outcome of the procedure in the long-term.

However further research with a larger study population is required to confirm the same.

REFERENCES

1. Singelyn FJ, Deyraert M, Joris D, Pendeveille E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. *Anesth Analg* 1998;87:88-92.
2. Ganapathy S, Wasserman RA, Watson JT, Bennett J, Armstrong KP, Stockall CA, et al. Modified continuous femoral three-in-one block for postoperative pain after total knee arthroplasty. *Anesth Analg* 1999;89:1197-202.
3. Badner NH, Bourne RB, Rorabeck CH, MacDonald SJ, Doyle JA. Intraarticular injection of bupivacaine in knee-replacement operations. Results of use for analgesia and for preemptive blockade. *J Bone Joint Surg Am*. J Bone Joint Surg Am 1996;78:734-8.
4. Allen HW, Liu SS, Ware PD, Nairn CS, Owens BD. Peripheral nerve blocks improve analgesia after total knee replacement surgery. *Anesth Analg* 1998;87:93-7.
5. Vendittoli PA, Makinen P, Drolet P, Lavigne M, Fallaha M, Guertin MC, et al. A multimodal analgesia protocol for total knee arthroplasty. A randomized, controlled study. *J Bone Joint Surg Am*. J Bone Joint Surg Am 2006;88:282-9.
6. Röstlund T, Kehlet H. High-dose local infiltration analgesia after hip and knee replacement – What is it, why does it work, and what are the future challenges? *Acta Orthop* 2007;78:159-61.
7. Hu S¹, Zhang ZY, Hua YQ, Li J, Cai ZD. A comparison of regional and general anaesthesia for total replacement of the hip or knee: a meta-analysis. *J of Bone and Joint surr* 2009;1(7)935-942.
8. Ottokar Stundner, Ya-Lin Chiu, Xuming Sun, Madhu Mazumda, Peter Fleischut, et al. Comparative Perioperative Outcomes Associated With Neuraxial Versus General Anesthesia for Simultaneous Bilateral Total Knee Arthroplasty. *Reg Anesth Pain Med* 2012;37(6):638-44.
9. Andersen, L. Ø., & Kehlet, H. (2014). Analgesic efficacy of local infiltration analgesia in hip and knee arthroplasty: a systematic review. *British Journal of Anaesthesia*, 113(3),

- 360-374. doi:10.1093/bja/aeu155.
10. Essving, P., Axelsson, K., Åberg, E., Spännar, H., Gupta, A., & Lundin, A. (2011). Local Infiltration Analgesia Versus Intrathecal Morphine for Postoperative Pain Management After Total Knee Arthroplasty. *Anesthesia & Analgesia*, 113(4), 926-933. doi:10.1213/ane.0b013e3182288deb
 11. Aykut Sigirci. Pain management in total knee arthroplasty by intraoperative local anesthetic application and one-shot femoral block. *Indian Journal of Orthopaedics* 2017 ;51(3):280-285.
 12. Charous MT, Madison SJ, Suresh PJ, Sandhu NS, Loland VJ, et al Continuous femoral nerve blocks. Varying local anesthetic delivery method (bolus versus basal) to minimize quadriceps motor block while maintaining sensory block. *Anesthesiology* 2011; 115: 774-81.
 13. Shah NA, Jain NP, Panchal KA. Adductor canal blockade following total knee arthroplasty-continuous or single shot technique? Role in postoperative analgesia, ambulation ability and early functional recovery: a randomized controlled trial. *J Arthroplasty* 2015;30:1476-81.
 14. Turner JD, Dobson SW, Henshaw DS, Edwards CJ, Weller RS et al. Single-injection adductor canal block with multiple adjuvants provides equivalent analgesia when compared with continuous adductor canal blockade for primary total knee arthroplasty: a double-blinded, randomized, controlled, equivalency trial. *J Arthroplasty* 2018;33:160-6.e1.
 15. Perlas, A., Kirkham, K. R., Billing, R., Tse, C., Brull, R., Gandhi, R., & Chan, V. W. S. (2013). The Impact of Analgesic Modality on Early Ambulation Following Total Knee Arthroplasty. *Regional Anesthesia and Pain Medicine*, 38(4), 334-339.
 16. In Jun Koh, Young Jun Choi, Man Soo Kim, Hyun Jung Koh, Min Sung Kang et al. Femoral Nerve Block versus Adductor Canal Block for Analgesia after Total Knee Arthroplasty. *Knee Surg Relat Res.* 2017 Jun; 29(2): 87-95.
 17. Sorensen JK, Jaeger P, Dahl JB, Gottschau B, Stephensen SL, Grevstad U. The isolated effect of adductor canal block on quadriceps femoris muscle strength after total knee arthroplasty: a triple-blinded, randomized, placebocontrolled trial with individual patient analysis. *Anesth Analg* 2016;122:553-8.
 18. Burckett-St Laurant D, Peng P, Girón Arango L, Niazi AU, Chan VW, Agur A, *et al.* The nerves of the adductor canal and the innervation of the knee: An anatomic study. *Reg Anesth Pain Med* 2016;41:321-7.
 19. D. Gould. Visual Analogue Scale (VAS). *Journal of Clinical Nursing* 2001; 10:697-70
 20. Brouwer TA, Rosier PF, Moons KG, Zuithoff NP, van Roon EN, Kalkman CJ. Postoperative bladder catheterization based on individual bladder capacity: a randomized trial. *Anesthesiology*. 2015;122:46-54
 21. Lamonerie L, Marret E, Deleuze A, Lambert N, Dupont M, Bonnet F. Prevalence of postoperative bladder distension and urinary retention detected by ultrasound measurement. *Br J Anaesth*. 2004;92:544-546.
 22. Lau H, Lam B. Management of postoperative urinary retention: a randomized trial of in-out versus overnight catheterization. *ANZ J Surg*. 2004;74:658-661.
 23. Pavlin DJ, Pavlin EG, Gunn HC, Taraday JK, Koerschgen ME. Voiding in patients managed with or without ultrasound monitoring of bladder volume after outpatient surgery. *Anesth Analg*. 1999;89:90-97.
 24. Buvaendran, A., Della Valle, C. J., Kroin, J. S., Shah, M., Moric, M., Tuman, K. J., & McCarthy, R. J. (2019). Acute postoperative pain is an independent predictor of chronic postsurgical pain following total knee arthroplasty at 6 months: a prospective cohort study. *Regional Anesthesia & Pain Medicine*, rapm-2018-100036. doi:10.1136/rapm-2018-100036.
 25. Affas, F., Nygåards, E.-B., Stiller, C.-O., Wretenberg, P., & Olofsson, C. (2011). Pain control after total knee arthroplasty: a randomized trial comparing local infiltration anesthesia and continuous femoral block. *Acta Orthopaedica*, 82(4), 441-447. doi:10.3109/17453674.2011.581264