Original Research Paper

Volume - 12 | Issue - 01 | January - 2022 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anaesthesiology

COMPARISON BETWEEN ULTRASOUND GUIDED ADDUCTOR CANAL BLOCK VERSUS FEMORAL NERVE BLOCK FOR ORTHOPEDIC KNEE SURGERY (TOTAL KNEE ARTHROPLASTY): A Randomized Prospective Double Blind Study

Dr. Deepa Jadav*	(M.D. Anesthesia) Assistant Professor, Department of Anesthesiology, GCS Medical College, Hospital & Research Centre Nr. Chamunda Bridge, Naroda Road, Ahmedabad 380025 Gujarat. *Corresponding Author
Dr. Heena Chhanwal	(M.D. Anesthesia) HOD and Professor, Department of Anesthesiology, GCS Medical College, Hospital & Research Centre Nr. Chamunda Bridge, Naroda Road, Ahmedabad 380025 Gujarat.
Dr. Devendra Makwana	3rd year Resident, Department of Anesthesiology, GCS Medical College, Hospital & Research Centre Nr. Chamunda Bridge, Naroda Road, Ahmedabad 380025 Gujarat.

ABSTRACT Management of postoperative pain after total knee arthroplasty (TKA) remains challenging. Patient suffers from moderate to severe postoperative pain following TKA, leading to immobility related complications and prolonged hospitalization. Adductor canal block (ACB) is now a widely used as an arm of multimodal analgesia for knee replacement surgery and is slowly replacing femoral nerve block (FNB). **Objectives:** To compare the efficacy of postoperative pain control and quadriceps muscle strength in USG guided ACB with USG guided FNB in patient following TKA. **Method:** 100 patients posted for elective unilateral knee surgery were included in this prospective double blind study and were randomly divided into two groups; Group ACB and Group FNB (50 patients each).All patients received spinal anesthesia and ultrasounds guided blocks were given at the end of surgery. Postoperatively, analgesic efficacy determined by Visual Analogue Scale and total opioid requirement while quadriceps muscle strength assessed by Straight Leg Raise and Time up and go (TUG) test. **Result:** There were no significant differences among VAS score and total opioid consumption in both groups. Patients received ACB had significantly less quadriceps muscle weakness and time up and go test($P<0.05$) was significantly shorter compared to FNB. **Conclusion:** ACB provides postoperative analgesia that is as effective as that of FNB while maintaining the quadriceps muscle strength better than FNB.

KEYWORDS : Ultrasound, Adductor canal block, Femoral nerve block, Total knee arthroplasty

INTRODUCTION

Total knee arthroplasty is regarded as an effective treatment for end stage knee osteoarthritis[1]. As TKA involves extensive bone resection and soft tissue manipulation, patient can experience moderate to severe pain during the early postoperative period[2,3,4]. The incidence of moderate to severe pain after TKA can contribute to immobility related complications, delayed in hospital discharge and may interfere with functional outcome[1]. Hence, optimal pain relief while maintaining the motor function remains the mainstay in postoperative pain management after TKA.

Although there are multimodal analgesic protocols accepted but no gold standard pain management protocol has been established. In addition to NSAIDs, analgesia after knee surgery can be provided by multiple nonsystemic methods such as continuous epidural analgesia, periarticular injection and peripheral nerve block(PNB) which is commonly used to relieve postoperative pain and decrease opioid requirement and its adverse effects[5] and also significantly lower hospital length of stay.

The aim of this study was to compare two different nerve blocks, FNB and ACB in patients following TKA regarding early postoperative ambulation and analgesic efficacy. Primary outcome of the study was to compare the quality of postoperative analgesia and total opioid consumption (Tramadol in this study). The secondary outcomes included quadriceps muscle weakness, success of early ambulation and any adverse effects following the study intervention.

MATERIALS AND METHODS

After obtaining approval from institutional research ethical committee and the patient's written informed consents, this prospective randomized double blind study included total of 100 patients. Patients were randomly allocated into two groups (50 patients each); Group ACB and Group FNB by computer generated randomization list. All patients were evaluated at preoperative anesthesia clinic. Inclusion criteria included the patients who were posted for elective unilateral primary TKA under spinal anesthesia, able to interpret the VAS score with an American Society of Anesthesiology (ASA) physical status 1-3, aged 50-75 years of either gender with body mass index (BMI) 18-30 kg m^{-2} and duration of surgery up to two hours. Patients with refusal to consent for regional anaesthesia, bleeding diathesis, local infection or sepsis, allergy or C/I to study drugs, BMI >30 kg m^{-2} or compromised systemic illness were excluded from study. At the end of surgery, the patients received Femoral Nerve Block in Group FNB while Adductor Canal Block in Group ACB under ultrasound guidance. All patients were informed about Visual Analogue scale (VAS 0-10, 0 = no pain and 10 = worst pain) for pain assessment as well as trained for Straight Leg Raise (SLR) and Time up & go (TUG) test.

In the operative room, standard monitors were applied and an intravenous line was secured with 18G intracath. All patients of both groups received spinal anesthesia with Bupivacaine 0.5% (heavy) 12-15 mg injected through a 25 G Quincke needle at L2-L3 interspace. Intraoperative sedation was obtained using Inj. Midazolam 1 mg and Inj. Fentanyl 25 mcg IV. After completion of surgery nerve blocks were performed under aseptic technique with Ultrasound guidance using a high frequency linear transducer (6-13MHz M-Turbo, sonosite). In the ACB group, saphenous nerve was localized at medial side of the mid-thigh just deep to the Sartorius muscle, usually lateral to the femoral artery, as a hyper echoic structure. The femoral nerve in the FNB group was visualized just under the fascia iliac and lateral to the femoral artery. For both groups, Inj. Bupivacaine 0.25% 15 ml was injected through a 23 G Quincke spinal needle using in-plane technique from lateral to medial side and after negative aspiration of blood, 2ml of saline was injected to verify the correct needle position observing hydro dissection. Ultra sound picture was captured to ensure LA distribution by showing an inverted U shaped distribution of LA.

VAS score was assessed at 0 min, 30 min, 1hour, 3hour, 6hour, 12hour, 18hour and 24 hours. Time to first rescue analgesia and total tramadol consumption were also noted. Rescue analgesia with Inj. Tramadol 100 mg was used only if VAS for pain score assessment is more than 4. Any adverse events like nausea, vomiting, giddiness, or signs of local anesthetic systemic toxicity were noted.

To assess the quadriceps muscle power, patients (in supine position) were asked to perform a Straight Leg Raise. The motor strength was assessed as Grade 0: normal muscle power, Grade I: motor weakness, Grade II: complete motor paralysis. On postoperative day 1 (POD1), a standard regimen of physiotherapy was applied twice daily in our institution until discharge. Quadriceps muscle strength Mobilization ability was assessed with Time Up and Go test. TUG test measures the time taken by the patient to stand up from a chair, walk 3 m, turn walk back to the chair and sit down. The tests were only performed if patient feels that it is possible to rise and walk without the risk of falling.

The sample size was calculated by using surveysystem/sscalc.htm software with confidence level 95%, confidence interval 7%. Total sample size was calculated as 100 i.e. 50 in each group. However, 210 cases were assessed to compensate for any dropouts.

Statistical Analysis

Statistical analysis was conducted using Graph Pad prism/QuickCalcs. The unpaired t-test and Chi-square test were used to analyze the continuous and non-parametric data respectively. P<0.05 was considered statistically significant.

RESULTS

Both groups were similar with respect to the patient demographic variables and duration of surgery (Table I)

Table I: Demographic variables

Variables	Group ACB (n=50)	Group FNB (n=50)	P value
Age(year)	62.88±8.02	62.84±7.77	0.97
Gender (male/female)	18/32	16/34	NA
Weight (kg)	66.16±5.79	66.26±3.85	0.91
BMI (kg m^{-2})	27.25±2.21	27.70±1.55	0.24
ASA(1/2/3)	11/33/6	12/30/8	NA
Duration of surgery(min)	118.7±19.63	118.3±19.81	0.91

Data expressed as Mean±SD

The difference between both the groups regarding VAS (Table II) and total dose of opioid consumption (Table III) was statistically not significant (P>0.05). In both groups, all patients were pain free within the first 6h after block. Difference between heart rate and blood pressure in both groups was statistically not significant (P>0.05).

Table II: Comparison of Visual Analogue Scale for pain

Time	Group ACB (MEAN±SD)	Group FNB (MEAN±SD)	P value
0 min	0	0	NA
30 min	0.08±0.27	0.04±0.19	0.39
1 hour	0.48±0.81	0.34±0.87	0.40
3 hour	1.64±0.82	1.5±0.67	0.35
6 hour	2.52±0.61	2.38±0.63	0.26
12 hour	3.42±0.73	3.22±0.58	0.13
18 hour	3.92±0.37	3.8±0.49	0.17
24 hour	5.12±1.23	5.08±1.10	0.86

VAS 0-no pain; 10- worst pain

Table III: Total opioid (Tramadol in mg) consumption

Time (hours)	Group ACB (MEAN±SD)	Group FNB (MEAN±SD)	P value
6-12 hours	20±40.40	12±32.82	0.27(NS)
12-18 hours	52±50.46	48±50.46	0.69(NS)
18-24 hours	64±48.48	58±49.85	0.54(NS)

Quadriceps muscle weakness was assessed by SLR test and it was found that patients in ACB compared to FNB group had less quadriceps muscle weakness and the difference was statistically significant (Figure 1). Difference was not significant at 0 and 30 min but extremely statistically significant up to 24 hours. During postoperative day1 when patients were asked to perform TUG test, all patients in Group ACB were able to perform it, whereas in FNB group, two patients experienced near fall (knee buckling). Risk of postoperative fall and near fall was found significantly higher in Group FNB.

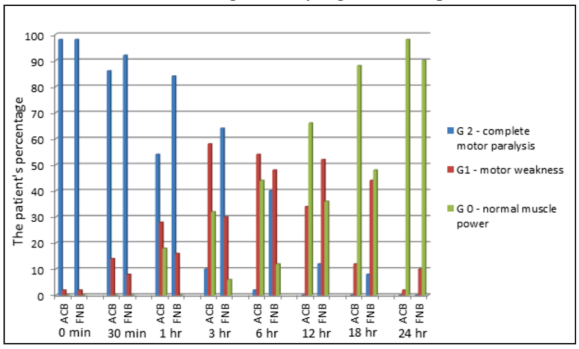

Figure 1: Quadriceps muscle weakness in both groups

TUG test (measured in seconds) in ACB group was 17.06±3.20 while in FNB group 18.52±2.68. The difference was statistically significant. (P value 0.015)

There wasn't any reported case of local anesthetic toxicity or postoperative neuropathy.

DISCUSSION

In TKA, effective analgesic modalities are essential as postoperative pain can be moderate to severe, yet patients are expected to begin physical therapy and ambulate as soon as possible after surgery because early rehabilitation may translate into long term functional achievements[6].

We conducted this study to evaluate analgesia and the motor sparing effect of ACB versus FNB post TKA. Our results suggest that ACB is an effective analgesic modality when compared with FNB after TKA surgery. The requirement for opioids for pain management on the 24 hours postoperatively was found to be comparable in both groups. Only one study, by Thacher et al [7] suggested a decreased opioids requirement within the FNB group.

FNB has remained the mainstay for postoperative analgesia for knee surgeries with good pain control and patient satisfaction [8,5,9,10] but because it causes weakness of quadriceps muscle, patient fall risk increases impairing early rehabilitation.[11,12] Unlike FNB, in ACB, the saphenous branch is blocked, making it a predominantly sensory block and free availability of ultrasound guidance also led to the more frequent use of ACB.

Akkaya et al. and Hanson et al[13] studied the effect of saphenous nerve block on postoperative analgesia post menisectomy compared to placebo. They concluded that the pain score decrease significantly at rest and activity by ACB. They also stated that the ACB improves patient comfort post-surgery. In these studies, opioid consumption was also significantly reduced than placebo with ACB. RK Singh, GV Krishna Prasad[14] in their study reported that ACB was significantly better as analgesic technique compared to epidural analgesia. In their study they compared continuous epidural with continuous ACB for postoperative pain management in TKA.

Chinsholm et al[9] compared the ACB with FNB post ACLR, stated that there have been no significant difference between two groups in pain score at rest and opioid consumption within postoperative 24 hours. However, they were in doubt about the causes of quadriceps muscle weakness in their study whether it attribute to the FNB or the original injury therefore, in another study they recommend assessing quadriceps muscle power over six or nine month follow up. In the other study El Ahl[8] compared the ACB with FNB post ACLR concluded that in spite of significant preservation to the quadriceps muscle power in ACB group than FNB group, the VAS and opioid consumption was significantly higher in the ACB group.

Grevstad et al[15] studied the effect of postoperative ACB in patients with severe pain, despite systemic analgesics, after TKA and concluded that ACB is an effective analgesic modality in such patients, although mild to moderate pain was still experienced by some patients. Our results demonstrated that ACB spares quadriceps muscle strength compared to FNB and reduces the risk of fall. FNB is commonly used to control postoperative pain in TKA. Nerve blocks involving the femoral nerve, however lead to quadriceps muscle weakness results in functional impairment and an increased risk of fall[11]. In this context, ideal PNB with an adequate analgesic effect and preserved muscle function is desirable. The introduction of ultrasonography for several nerve blocks was the key of inventing the adductor canal block, which is comparatively new block with high success rate[16]. ACB blocks the main sensory contributions from the femoral nerve to the knee, namely the Saphenous nerve and nerve to vastus medialis, which are the components of the adductor canal[17].

Khaireddine Raddaoui, Mohamed Radhouani, et al[18] in their study they compared the diffusion of two volumes of 0.375% ropivacaine to popliteal fossa resulting in high rate of sensory blockade of both popliteal and tibial nerves without significant motor block. Thacher al[7] reported a statistically significant difference in episodes of near fall (knee buckling) with FNB versus ACB (total of 17 (13%) patients experienced knee buckling in the FNB group during physiotherapy as compared to only 3 (2%) total patients in the ACB group). Others have

documented 6-8% incidence of near fall[19,20,21]. Some studies reported quadriceps weakness after FNB using dynamometer[22,23].

CONCLUSION:

We found that the ACB was introduced as effective method for postoperative pain control as FNB and most enticing in ACB block is sparing the motor fibers. This could explain the superiority of the ACB over the FNB in preserving the quadriceps muscle power necessary for patient's early rehabilitation and decreasing the risk of fall after unilateral Total Knee Arthroplasty.

There is no any conflict of interest.

REFERENCES:

1. Karkhur Y, Mahajan R, Kakralia A, Pandey AP, Kapoor MC. A comparative analysis of femoral nerve block with adductor canal block following total knee arthroplasty: A systematic literature review. J Anaesthesiol clin Pharmacol 2018;34:433-8
2. Korean Knee Society. Guidelines for the management of postoperative pain after total knee arthroplasty. Knee Surg Relat Res. 2012; 24:201-7
3. Koh IJ, Chang CB, Lee JH, Jeon Y, Kim TK. Preemptive low dose dexamethasone reduces postoperative emesis and pain after TKA: a randomized controlled study. Clin Orthop Relat Res: 2013;471:3010-20
4. Koh IJ, Kang YG, Chang CB, Do SH, Seong SC, Kim TK. Does periarticular injection have additional pain relieving effects during contemporary multimodal pain control protocols for TKA? A randomized controlled study. Knee.2012;19:253-9
5. Nasr A Hegazy, Sherif S Sultan. Comparison between effects of ACB and FNB on early postoperative course in TKA: a prospective double blind, Randomized controlled study: Ain-shams Journal of Ane. 2015;08:124-128
6. Munin MC, Rudy TE, Glynn NW, Crossett LS, Rubash HE. Early inpatient rehabilitation after elective hip and knee arthroplasty. JAMA 1998;279:847-52
7. Thacher RR, Hickernell TR, Grosso MJ, et al. Decreased risk of knee buckling with adductor canal block versus femoral nerve block in total knee arthroplasty: a retrospective cohort study. Arthroplast Today 2017;3:281-5
8. El Ahl MS. Femoral nerve block versus adductor canal block for postoperative pain control after ACLR: A randomized controlled double blind study. Saudi J Anaesth 2015;9:279-82
9. Chisholm MF, Bang H, Maalouf DB, et al. Postoperative analgesia with saphenous block appears equivalent to femoral nerve block in ACL Reconstruction. HSS J 2014;10:245-51
10. Abdallah FW, Whelan DB, Chan VW, et al. Adductor canal block provides noninferior analgesia and superior quadriceps strength compared with femoral nerve block in Anterior Cruciate Ligament Reconstruction. Anaesthesiology 2015;124:1053-64
11. IlFeld BM, Duke KB, Donohue MC. The association between lower extremity continuous peripheral nerve blocks and patients falls after knee and hip arthroplasty. Anesth Analg 2010;111:1552-4
12. Kandasami M, Kinninmonth AW, Sarungi M, Baines J, Scott NB. Femoral nerve block for total knee replacement –A word of caution. Knee 2009;16:98-100
13. Hanson NA, Derby RE, Auyong DB, et al. Ultrasound guided adductor canal block for arthroscopic medial menisectomy: a randomized double blind trial. Can J Anaesth 2013;60:874-80
14. RK Singh, GV Krishna Prasad. Continuous epidural versus continuous adductor canal block for postoperative pain management in total knee arthroplasty. Indian journal of pain 2020;34(2): 112-117
15. Grevstad U, Mathiesen O, Lind T, Dahl JB. Effect of adductor canal block on pain in patients with severe pain after total knee arthroplasty: a randomized study with individual patient analysis. Br J Anaesth 2014;112:912-9
16. Manickam B, Perlas A, Duggan E, Brull R, Chan VW, Ramlogan R. Feasibility and efficacy of ultrasound guided block of the sephenous nerve in adductor canal. Reg Anesth Pain Med 2009;34:578-80
17. Lund J, Jenstrup MT, Jaeger P, Sorensen AM, Dahl JB. Continuous adductor canal blockade for adjuvant postoperative analgesia after major knee surgery: Preliminary results. Acta Anaesthesiol Scand 2011;55:14-9
18. Raddaoui K, Radhouani M, Bargaoui A, et al. Adductor canal block: Effect of volume of injectate on sciatic extension. Saudi J Anaesth 2020;14:33-37
19. Shah NA, Jain NP. Is continuous adductor canal block better than continuous femoral nerve block after total knee arthroplasty? Effect on ambulation ability, early functional recovery and pain control: a randomized controlled trial. J. Arthroplasty 2014;29:2224-9
20. Mudumbai SC, Kim TE, Howard SK, et al. Continuous adductor canal blocks are superior to continuous femoral nerve blocks in promoting early ambulation after TKA. Clin orthop Relat Res 2014;472:1377-83
21. Thomazeau J, Rouquette A, Martinez V, et al. Predictive factors of chronic post-surgical pain at 6 months following knee replacement: Influence of post-operative pain trajectory and genetics. Pain Physician 2016;19:E729-41
22. Kim DH, Lin Y, Goytizolo EA, et al. Adductor canal block versus femoral nerve block for total knee arthroplsty: a prospective, randomized, controlled trial. Anesthesiology 2014;120:540-50
23. Memtsoudis SG, Yoo D, Stundner O, et al. Subsartorial adductor canal vs femoral nerve block for analgesia after total knee replacement. Int Orthop 2015;39:673-80