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Original Research Article

Comparison between the effects of femoral 3-in-1 nerve block versus obturator nerve block added to the femoral 3-in-1 nerve block for postoperative analgesia after total knee replacement surgeries

[1]Dr. Mulumudi Yashaswee Reddy, [2]Dr. P. Kousalya, [3]Dr. Suresh Janapati, [4]Dr. Kiran Kumar Suggala

[1]PG Final Year, Mamata Medical College, Khammam, Telangana, India
[2,3]Assistant Professor, Mamata Medical College, Khammam, Telangana, India
[4]Professor and HOD, Mamata Medical College, Khammam, Telangana, India

Corresponding Author:
Dr. Mulumudi Yashaswee Reddy

Abstract

Background: Femoral 3-in-1 nerve block (FNB) alone is frequently used for pain control after total knee replacement (TKR), as the following nerves are inconsistently anesthetized during a Femoral three-in-one block i.e., the Lateral cutaneous nerve (LCN) of the thigh, the Femoral nerve (FN) and the anterior branch of the Obturator nerve (ON). But does not provide complete postoperative analgesia as the posterior branch of the Obturator nerve (ON) and femoral branch of the genitofemoral nerve are not blocked. The intact sensation in the back of the knee after an FNB alone could be attributable to either the obturator or the sciatic nerve, which also supplies the knee joint [2, 5].

Objective: The study aims to compare the quality of postoperative analgesia and the need for opioids postoperatively between femoral 3-in-1 nerve block and obturator nerve block added to the femoral 3-in-1 nerve block in patients undergoing elective total knee replacement surgeries.

Materials and Methods: After obtaining the institutional ethics committee approval and patient consent, a Comparative study was conducted on 60 patients aged between 40 and 60 years of ASA I & II scheduled for elective total knee replacement surgeries in MAMATA GENERAL HOSPITAL for 1 year. Patients are randomized into Group 1 (30 patients) which receives a Femoral 3-in-1 nerve block & Group 2 (30 patients) which receives an Obturator nerve block plus a Femoral 3-in-1 nerve block. Patients' baseline vitals were recorded, after giving the block & the extent of both blocks was evaluated 30 min after injection of the anesthetic solution. Both groups recorded postoperative analgesia efficacy and need for opioids and compared in the first 8 hours after surgery.

Statistical analysis: Categorical data will be compared using the Chi-Square test. Continuous variables will be compared using a student t-test. A P-value of <0.05 will be considered statistically significant.

Results: The mean no. of fentanyl boluses given in Group 1 was 3.03±0.72 and in Group 2 was 1.66±0.66 which is statistically significant (P<0.05). The mean total consumption of fentanyl in mcg in Group 1 was 75.83±17.96 and in Group 2 was 41.66±16.52 which is statistically significant (P<0.05).

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Conclusion: We conclude that adding an obturator nerve block to the femoral block results in a significant reduction in total requirements for opioids in the first 8 hrs after TKR.

Keywords: Postoperative analgesia, TKR, Femoral 3-in-1 nerve block, Obturator nerve block

Introduction

Continuous passive motion after TKR optimizes the functional prognosis but causes severe pain [1]. Hence, Effective pain control has become a major concern in the post-operative management of TKR [2].
The major objectives of post-operative analgesic treatment are to reduce opioid requirements, postoperative pain, and adverse events related to opioid intake [3].
Peripheral nerve blocks can be used as analgesic adjuncts for TKR, but the efficacy of femoral nerve blocks alone is controversial [4].
The following nerves are inconsistently anesthetized during a Femoral three-in-one block: the Lateral cutaneous nerve (LCN) of the thigh, the Femoral nerve (FN), and the anterior branch of the Obturator nerve (ON). However, the posterior branch of the Obturator nerve (ON) and femoral branch of the genitofemoral nerve are not blocked [5].
The intact sensation in the back of the knee after an FNB alone could be attributable to either the obturator or the sciatic nerve, which also supplies the knee joint [2].
The present study was designed to evaluate whether the addition of an obturator nerve block to FNB improves the quality of postoperative analgesia after TKR as the sciatic innervation of the posterior knee provides a relatively minor contribution to postoperative pain after TKR.

Objective

The study aims to compare the quality of postoperative analgesia and the need for opioids postoperatively between femoral 3-in-1 nerve block and obturator nerve block added to the femoral 3-in-1 nerve block in patients undergoing elective total knee replacement surgeries.

Materials and Methods

After obtaining the institutional ethics committee approval and patient consent, a Comparative study was conducted on 60 patients aged between 40 and 60 years of ASA I & II scheduled for elective total knee replacement surgeries in MAMATA GENERAL HOSPITAL for one year.
Patients are divided into Group 1 (30 patients) which receives a Femoral 3-in-1 nerve block & Group 2 (30 patients) which receives an Obturator nerve block plus a Femoral 3-in-1 nerve block.
The extent of both blocks was evaluated 30 min after injection of the anesthetic solution. Both groups recorded postoperative analgesia efficacy and need for opioids and compared in the first 8 hours after surgery.

Inclusion criteria

- Patient willing for study and who has given informed and written consent.
- Patients with ASA class 1 and 2 between the age of 40 and 60 years.
- No local infection.
- No neurological deficit.

Exclusion criteria

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- Patient's refusal.
- Patients on anti-coagulants or with any coagulopathies.
- Patient's baseline heart rate < 60 bpm and baseline BP < 100/60 mmHg.
- ASA grade III and IV.
- Allergy to protocol drug.
- Emergency surgeries.
- Patients with cardiorespiratory, hepatic, and renal problems.

Methodology

The day before surgery, a pre-anesthetic examination was performed. Patients were educated about the goal of the study, the benefits, and the drawbacks of the treatment, and were trained to measure the level of pain using the visual analog scale (VAS). They were also advised to seek analgesia if needed and informed written consent was acquired. All patients were premedicated with oral alprazolam 0.5mg and oral pan top 40mg the night before surgery, and the morning of surgery, and appropriate fasting was suggested according to ASA recommendations.

After shifting to the operating room, ASA standard monitors such as pulse oximetry, ECG, and non-invasive blood pressure monitoring were connected. The baseline values were documented and recorded. Also, a baseline measurement of adductor muscle strength was performed. The nerve blocks were performed before induction of general anesthesia.

With all aseptic measures, the patient was in a supine position, we used a nerve stimulator, a 50-mm 22-gauge insulated needle for the FNB, and the obturator nerve block. A mixture of 0.5% bupivacaine and 2% lidocaine with 1:200 000 epinephrine was given. Successful location was indicated by contraction of the quadriceps muscle (dancing patella sign) with cessation of contraction ≤ 0.3 mA, and 20 mL of the local anesthetic solution was injected.

Obturator nerve block was performed as follows: with the patient in the supine position, legs slightly abducted, the needle was inserted with an angle of 30 degrees to the skin, 2 cm caudal and 2 cm lateral to the pubic tubercle. The needle was advanced until it contacted the inferior border of the superior pubic ramus bone before it was redirected posteriorly and slightly laterally to walk off the inferior margin of the superior pubic ramus. Successful location was indicated by contraction of thigh adductors with cessation of contraction ≤0.3 mA, and 7 mL of local anesthetic solution was injected.

The extent of both blocks was evaluated 30 min after injection of the anesthetic solution. The sensation was assessed by loss of cold sensation and light touch. The strength of adduction was measured before and after the block with the help of a mercury sphygmomanometer. The patients were asked to extend their knees and hips. They were then asked to squeeze a blood pressure cuff previously inflated to 40 mm Hg between their knees. The maximal sustained pressure generated on the mercury sphygmomanometer was recorded as an index of adductor strength.

Patients with complete sensory abolition in the distribution of the femoral nerve and complete femoral motor block (inability to flex the knee) were considered to have a successful FNB and were included in Groups 1 and 2. Only the motor function was evaluated to assess the obturator nerve block.

Patients then underwent TKR under general anesthesia, standardized for both study groups. Patients were induced with 1.5–2.5 mg/kg propofol and 1mcg/kg of Fentanyl, then intubated, and controlled ventilation was applied for the duration of the surgery. Patients were paralyzed with a loading dose of Inj.Vecuronium @ 0.1mg/kg. Anesthesia was maintained using 50% nitrous oxide in oxygen, 0.75%–1% isoflurane end-tidal concentration, and inj. vecuronium @ 0.04mg/kg. After the completion of the surgery, patients were extubated and shifted to the postoperative ward and monitored.

Postoperatively pain was evaluated during the study period using a VAS score ranging from 0 (no pain) to 10 (worst imaginable pain) on a scale. The pain levels were determined at the arrival in the postanesthesia care unit, as well as 30min., 1, 2, 3, 4, 5, 6, 7, and 8 hours after

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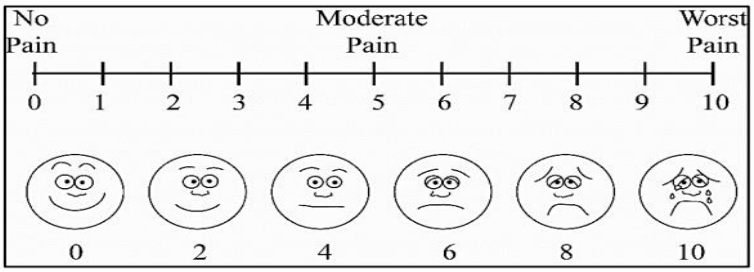
surgery. If the patient complains of pain and the VAS score was determined to be more than 5 at that time, Inj. Fentany l 25mcg IV with each bolus was given on demand for analgesia. The analgesic efficacy i.e., total fentanyl consumption in mcg, number of fentanyl boluses VAS pain scores were recorded in the first 8 hours after surgery for each group.



Results

Table 1: Demographic Characteristics of the study participants

Parameters	Group 1 (n=30)	Group 2 (n=30)	The P value
Age (in years)	51.37±4.61	51.4±5.85	0.94^{NS}
Gender (M: F)	16:14	17:13	0.79^{NS}
Weight (Kgs)	62.8±9.57	57.93±7.89	0.05^{NS}
Height (cm)	161.23±7.99	160.13±7.15	0.53^{NS}
BMI (Kg/m2)	24.07±2.60	23.54±2.33	0.05^{NS}
ASA (I/II)	11/19	8/22	0.50^{NS}
Mean duration of surgery	165.5±9.98	162.66±8.41	0.19^{NS}

There was no statistically significant difference in demographic characteristics across both groups ($p>0.05$). Table 1 displays the results.

Analgesia demand

There is a statistically significant difference between both groups regarding the requirement of no. of fentanyl boluses and total fentanyl consumption (mcg) with P value of 0.000. We further observed a significant decrease in the total requirement of fentanyl postoperatively for the first 24 hours. Table 2 displays the results.

Table 2: Comparison of analgesia demand across the groups.

Parameters	Group 1(n=30)	Group 2(n=30)	The P value
No. of fentanyl boluses given	3.03±0.72	1.66±0.66	0.000*
Total fentanyl consumption in mcg	75.83±17.96	41.66±16.52	0.000*

The information is represented as mean ± SD. * denotes p-value < 0.05 - significant and NS-Non-significant.

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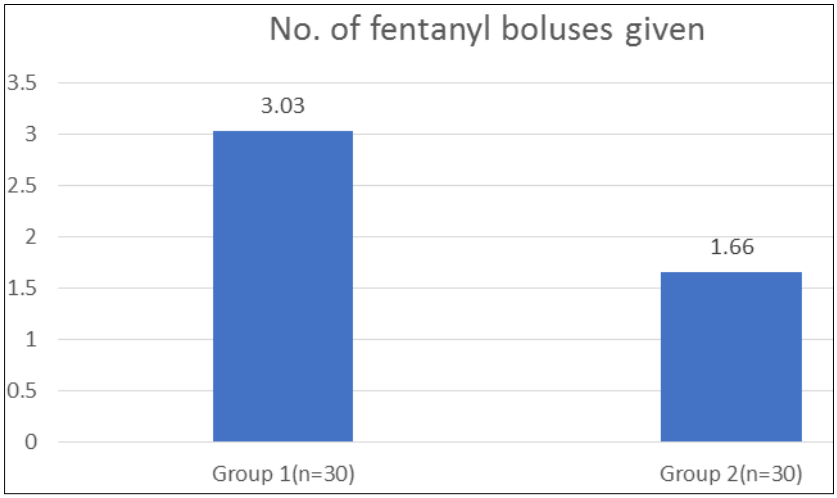

Fig 1: Comparison of analgesia demand across the groups

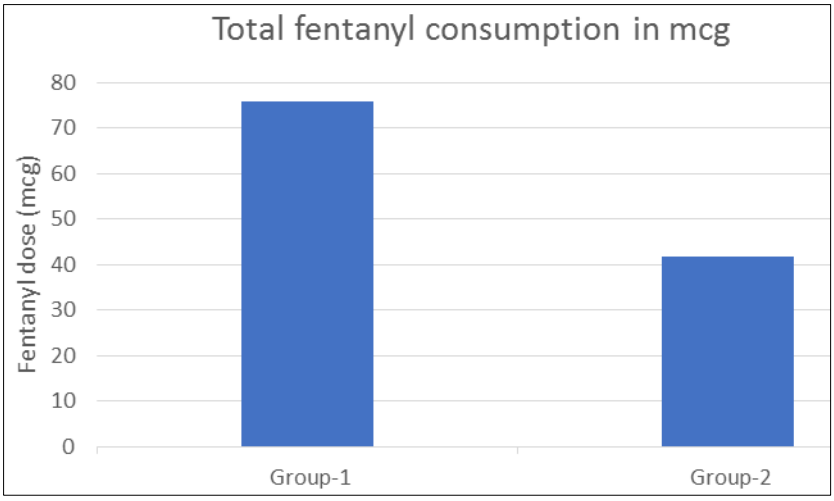

Fig 1: Comparison of analgesia demand across the groups

Visual analog scale

The difference in mean baseline VAS scores between groups 1 and 2 and at 2hrs, 4hrs, 5hrs, 6hrs, 7hrs, 8hrs was statistically significant. Meanwhile at 30min., 1hr and 3hrs there was no significant difference between the VAS scores of two groups($p>0.05$). We further observed a significant decrease in pain scores postoperatively for the first 24 hours. Table 3 displays the results.

Table 3: Comparison of Visual analog scale score across the groups

VAS Score	Group 1 (n=30)	Group 2 (n=30)	The P value
Baseline	3.46±1.31	2.56±0.63	0.01*
30min.	3.70±0.88	3.36±1.25	0.12^{NS}
1 hour	3.63±1.22	3.70±1.15	0.83^{NS}
2 hours	4.06±1.17	3.26±1.28	0.014*
3 hours	3.43±1.04	3.40±1.25	0.69^{NS}
4 hours	3.90±0.88	2.86±0.97	0.000*
5 hours	4.20±0.99	3.40±0.77	0.004*
6 hours	3.93±1.05	3.26±0.78	0.027*
7 hours	3.73±0.74	2.93±0.78	0.000*
8 hours	4.00±0.95	2.80±0.76	0.000*

The information is represented as mean ± SD. * denotes p-value < 0.05 - significant and NS- Non-

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significant.

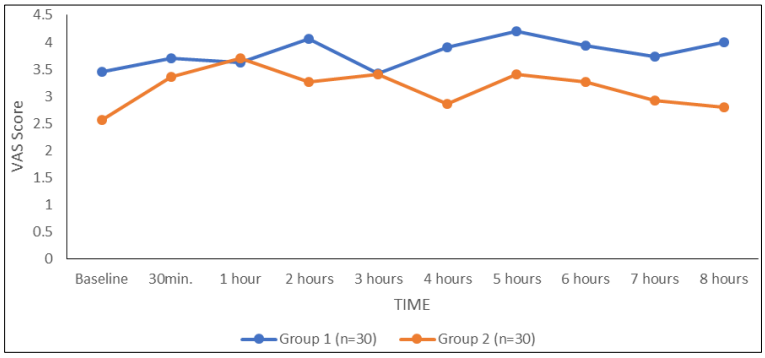

Fig 3: Comparison of Visual analog scale score across the groups.

Discussion

Continuous passive motion after TKR optimizes the functional prognosis but causes severe pain [1]. Hence, Effective pain control has become a major concern in the post-operative management of TKR [2].

The major objectives of post-operative analgesic treatment are to reduce opioid requirements, postoperative pain, and adverse events related to opioid intake [3].

Peripheral nerve blocks can be used as analgesic adjuncts for TKR, but the efficacy of femoral nerve blocks alone is controversial [4].

The following nerves are inconsistently anaesthetised during a Femoral three-in-one block: the Lateral cutaneous nerve (LCN) of the thigh, the Femoral nerve (FN) and the anterior branch of the Obturator nerve (ON).However, the posterior branch of the Obturator nerve (ON) and femoral branch of genitofemoral nerve are not blocked [5].

The obturator nerve has two divisions. Both carry motor fibers to the adductor muscles of the thigh, but only the anterior division provides any cutaneous innervation. The posterior division contributes to the innervation of the knee joint [6].

The intact sensation in the back of the knee after an FNB alone could be attributable to either the obturator or the sciatic nerve, which also supplies the knee joint [2].

The present study was designed to evaluate whether the addition of an obturator nerve block to FNB improves the quality of postoperative analgesia after TKR as the sciatic innervation of the posterior knee provides a relatively minor contribution to postoperative pain after TKR.

The demographic profile of our patients was comparable concerning mean age, body weight, ASA grade, and duration of surgery with no significant difference between the two groups.

The results in this study have shown that the addition of Obturator nerve block to Femoral 3-in-1 block promotes better postoperative analgesia after TKR compared to Femoral 3-in-1 block alone.

Group 2 showed visible superiority over group 1 in postoperative opioid demand and a lesser amount of total fentanyl used post-operatively [75.83±17.96 vs 41.66±16.52mcg; p=0.000].

VAS Scores were also significantly low in group 2 as compared to group 1 in our study [at 0min. (0.01), 2hrs (p=0.014), 4hrs(p=0.000), 5hrs(p=0.004), 6 hours (p=0.027), 7 hours (0.000), and 8 hours (0.000)].

In the present study, the motor function of the obturator nerve was measured by evaluating the adductor muscle strength with the help of a mercury sphygmomanometer as described by Lang *et al*. (4) in 1993.

Similar results in the decrease of adductor muscle strength have been observed in the present study (70%±19%) when the obturator nerve block was performed and assessed before the FNB (6). This suggests a high efficacy of obturator nerve blocks. However, the adductor strength decreased by only 18.7%± 11.2% in Group 1, proving no or little anesthesia of the obturator nerve.

We further observed a significant decrease in pain scores and the total requirement of

fentanyl postoperatively for the first 24 hours.
McNamee *et al*. [10] stated that the addition of an obturator nerve block to femoral and sciatic block results in a significant reduction in total requirements for morphine in the first 48 h after TKR, significantly between the 20–48 h. But in contrast to the present study, they failed to show significantly decreased pain scores.

Conclusion

We conclude that adding an obturator nerve block to femoral block results in a significant reduction in total requirements for fentanyl in the first 8 hrs after TKR.
Overall, the experience with the Femoral 3-in-1 block plus obturator nerve block is superior to the femoral 3-in-1 block alone in providing postoperative analgesia and lesser opioid demand after TKR.

Source of Funding
Nil.

Conflict of Interest
There is no conflict of interest.

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