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Comparison Of Epidural Versus 3 In 1 Femoral Nerve Block With Bupivacaine Hydrochloride And Fentanyl Citrate For Post-Operative Analgesia After Total Knee Replacement.

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Abstract
Introduction*: Total Knee Replacement (TKR) Is A Highly Painful Procedure Requiring Profound Postoperative Analgesia And Early Mobilization And Physiotherapy In The Postoperative Period. Immobilization Due To Pain Decreases Pulmonary Function And Increases The Risk Of Thrombus Formation.*
Aim*: In This Randomized, Open-Label Study, We Aimed To Compare The Efficacy And Safety Of Epidural And Femoral Nerve Block With Bupivacaine Hydrochloride And Fentanyl Citrate For Postoperative Analgesia After TKR.*
Materials And Methods*: Sixty Patients Of Either Sex, Aged 18-60 Years, With ASA Grade I Or II, Were Randomly Divided Into Two Groups Of 30 Patients Each. Group A Received 10ml Of 0.25% Bupivacaine + 25mcg Fentanyl Epidurally, While Group B Received 30ml Of 0.25% Bupivacaine + 25mcg Fentanyl Via Femoral Catheter In The Postoperative Period. Postoperatively, We Recorded VAS Score At Rest And During Movement, Heart Rate, Systolic And Diastolic Blood Pressure, Rescue Analgesia Requirement, And Adverse Effects For 48 Hours.*
Observations And Results*: We Found No Significant Difference In VAS Score At Rest (1 Hour: Group A- 2.33±0.77, Group B- 2.53±0.61; 6 Hours: Group A- 0.90±0.66, Group B- 1.10±0.65) Or During Movement (1 Hour: Group A- 2.90±0.99, Group B- 3.20±0.60; 6 Hours: Group A- 1.40±0.73, Group B- 1.60±0.87) Between The Two Groups (P>0.05). The Duration Of Analgesia Was (443.06±51.86) Minutes In Group A And (439.93±67.02) Minutes In Group B, With No Significant Difference In Rescue Analgesia Requirement, Hemodynamic Stability, Degree Of Motor Block, Or Side Effects Between The Two Groups During The 48-Hour Study Period (P>0.05).*
Conclusion*: Our Study Demonstrates That Femoral 3-In-1 Nerve Block Provides Analgesia Equivalent To Epidural Analgesia During The Postoperative Period After Total Knee Replacement Surgery, With Similar Efficacy And Safety Outcomes.*

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I. Introduction

Total knee arthroplasty (TKA), a popular operation for treating advanced osteoarthritis and other incapacitating knee problems with an aim to improve mobility and quality of life, is anticipated to see a global increase in demand of more than 1 million surgeries by the year 2030. (1) The last ten years have seen a continuous decline in hospital length of stay (LOS) and a shift towards outpatient surgery due to the rise in the use of TKA and ongoing practice modifications. One of the facets that continues to require improvement is the relatively high prevalence of postoperative severe pain ranging from 10 to 36% that necessitates intense intraoperative analgesia and motor block. (2)

Despite improvements in surgical methods and after care, TKA pain management is still a major obstacle. Inflammation, tissue edema, and nerve hypersensitivity are present throughout the postoperative period, which might result in chronic pain. The surgery itself is linked to tissue trauma that can induce acute pain. (3) In order to reduce pain and discomfort after surgery, postoperative pain management is a crucial part of patient care. To effectively treat postoperative pain, a number of evidence-based anesthesia modalities have been employed to provide intraoperative and postoperative pain control. (4) It has been demonstrated that multimodal analgesia, which combines several painkillers such opioids, nonsteroidal anti-inflammatory medicines (NSAIDs), and local anesthetics, offers better pain relief than single-agent therapy. (5) Techniques for regional anesthesia, such as nerve blocks or epidural analgesia, can be utilised to target particular body parts and block pain signals. By enabling patients to self-administer a pre-programmed dose of pain medicine, patient-controlled analgesia (PCA)

lessens the need for frequent nurse-administered medication and enhances pain management. (6) In addition to pharmacological treatments, non-pharmacological methods such as guided imagery, acupuncture, and relaxation techniques can also be used to lessen postoperative pain. In order to prevent pain pathways from being opened up during surgery and to lessen postoperative discomfort, pre-emptive analgesia entails giving painkillers beforehand. It has also been demonstrated that early mobilisation and ambulation after surgery minimise pain and enhance patient outcomes generally. (7) Compared to general anesthesia, regional anaesthesia techniques such peripheral nerve blocks, spinal anaesthetic, and epidural anaesthesia are promising modalities that potentially provide better pain management, less opioid use, and a lower incidence of postoperative problems. In TKA, the femoral nerve block, adductor canal block, and sciatic nerve block are recently utilised peripheral nerve blocks with promising results. (8)

Two more modern pain management methods utilised in knee arthroplasty include femoral nerve block and epidural anaesthesia. Local anaesthetics and/or opioids are injected into the epidural area surrounding the spinal cord during an epidural anaesthesia. Due to its capacity to deliver efficient pain relief and lower opioid usage, this approach has been applied in knee arthroplasty. (9) The risk of epidural hematoma, which can result in neurological damage that cannot be repaired, is one potential downside of epidural anaesthesia. Hypotension, urine retention, and infection are some additional potential side effects. In comparison to patient-controlled analgesia with morphine and spinal anesthesia, peripheral nerve block, which is an alternative to epidural analgesia, has been proven to offer improved analgesia with less morphine consumption. (10) In a comparison of three methods for managing pain following total knee replacement, Singelyn et al. discovered that both regional anaesthetic approaches were superior to patient-controlled morphine analgesia and that the femoral nerve block group experienced fewer side effects than the epidural group. (11) There is still no universal agreement regarding the superiority of femoral nerve block despite several additional trials having contradictory results to those reported here. We compared continuous femoral and sciatic nerve blocks with continuous epidural infusion in this prospective, randomised research. The main goals of the research were to assess the effectiveness and length of pain relief, while secondary objectives involved examining the differences in the patient's hemodynamic stability, any complications that occurred during the procedure, as well as the frequency and severity of any side effects.

II. Material and method

This study was a prospective controlled, open-labeled, randomised experiment. The study involved 60 patients having complete knee replacement surgery. Patients between the ages of 18 and 60, with ASA physical status I or II, and a normal coagulation profile met the inclusion criteria. Patients with a history of hypertension, diabetes mellitus, renal and hepatic insufficiency, cardiac diseases, neurological disorders, or anomalies of the spine were excluded from the study. The patients were randomly assigned to two groups, Group A and Group B, using a computer-generated randomization sequence. Group A patients received 10ml 0.25% bupivacaine with 25 mcg fentanyl via epidural catheter, while Group B patients received 30 ml 0.25% bupivacaine with 25 mcg fentanyl via femoral catheter.

Prior to surgery, all patients received intravenous injection of glycopyrrolate at a dose of 0.004mg/kg as premedication, along with prophylactic antibiotics to reduce the risk of infection. In addition, either an epidural catheter or femoral nerve catheter was inserted to provide post-operative analgesia, or this was done prior to the induction of general anesthesia.

For Group A patients, the epidural space was located using a sterile disposable Touhy needle (16 G) with a midline approach and the hanging drop technique. Once the epidural space was identified, an 18 G epidural catheter was inserted 5 cm through the needle and into the epidural space. The needle was then removed, and negative aspiration was used to confirm that the catheter was properly placed without being intravascular or intradural. The catheter was secured to the patient's back using adhesive tape. In Group B, the patients were placed in a supine position with slight abduction at the hip joint and flexion at the knee joint. The inguinal area, anterior superior iliac spine (ASIS), and pubic tubercle were prepared and draped. The femoral nerve and artery were located, and an 18G intracath (jelco) with a locally made 2-inch, 20G needle was inserted at a marked point. Stimulation of 2mA was applied, and the position of the needle was optimized at a current output of <0.5mA. The catheter was passed through jelco to about 5cm beyond the cannula, and adhesive tape was placed over the catheter insertion site.

Anesthesia

The patients were pre-oxygenated with 100% oxygen for 3 minutes using a face mask before inducing anesthesia with intravenous injections of fentanyl (2 mcg/kg), thiopentone (6 mg/kg), and vecuronium (0.1 mg/kg) to facilitate intubation. Oral tracheal intubation was done using a Macintosh laryngoscope and an appropriately sized Portex cuffed endotracheal tube. Anesthesia was maintained using a mixture of oxygen, nitrous oxide (50:50), sevoflurane, and intermittent bolus injections of vecuronium (0.01 mg/kg). Tidal volume was kept at 8-10 ml/kg and respiratory rate at 12-14 breaths per minute. Patients were monitored for ECG, heart rate, SpO2,

non-invasive blood pressure, end-tidal CO2, urine output, and blood loss. The study drug was administered at the time of skin suture, and patients were reversed with injections of glycopyrrolate (0.4 mg) and neostigmine (0.05 mg/kg) before extubation.

Post-operative Assessment

Various parameters such as heart rate, blood pressure, motor block, sedation, oxygen saturation, and respiratory rate were monitored after shifting the patients to post-operative ward. The intensity of pain was evaluated using the visual analog scale (VAS) immediately after the surgery, and then at regular intervals of 1 hour, 2 hours, 3 hours, 4 hours, and subsequently every 2 hours for 48 hours from the time of administering the study drug. If the VAS score increased to more than 4, a second dose of the study drug was repeated. If the patient complained of pain within 3-4 hours of the dose administration, then rescue analgesia was given in the form of tramadol injection. The duration of analgesia was calculated from the time of administering the study drug to the time of requiring the second dose. The modified bromage scale was used to assess motor block, and hemodynamic stability was monitored with a fall of 20% in mean blood pressure and pulse rate from baseline values considered as hypotension and bradycardia, respectively. Such events were treated with intravenous administration of Ringer lactate and atropine, respectively. Any complications observed were recorded and treated accordingly. Sedation was evaluated using the Ramsay sedation score which is scored on a scale from 1 to 6, with 1 being a patient who is anxious, agitated, or restless and 6 being a patient who is unresponsive to stimuli.

Statistical Analysis

Statistical analysis was performed using the SPSS software version 15. The results for continuous variables were presented as mean and standard deviation, while categorical variables were presented as numbers and percentages. Student's t-test (unpaired) was used to determine the significance of study parameters on continuous variables, and chi-square test was used to determine the significance of study parameters on categorical variables. A p-value of less than 0.05 was considered statistically significant.

III. Results:

The present study includes 60 adult patients aged 18-60 years belonging to ASA group 1 and 2 undergoing total knee replacement surgeries. They were randomly assigned into two groups of 30 patients each. Here Group A was considered as patients who were treated with epidural catheter and group B is considered as patients who were treated with femoral catheter.

Table 1 gives the demographic details about the patients. The mean age of the in group A was 33.93± 16.93 compared to 31.5± 11.68 in group B. The sex ratio male to female was 19:11 and 22:8 in group A and B respectively. The mean weight of the patient in group A was 54.5± 8.01 kg while 57.63±10.53 kg in group B. The duration of surgery was 194.5 ± 31.70 and 191.5±29.91 minutes respectively. The procedural time was 13.1±2.27 and 13.9±1.77 in group A and group b respectively. There was no significant difference in age, sex, weight, duration of surgery and procedural time was observed.

Table 1: Demographic details about the patients.

Parameters	**Group: A**	**Group: B**	**P Value**
Age (yrs)	33.93 ± 16.93	31.5± 11.68	0.52 (NS)
Sex ratio(M:F)	19:11	22:8	-
Weight(kg)	54.5 ± 8.01	57.63±10.53	0.20 (NS)
Duration of surgery(min)	194.5 ± 31.70	191.5±29.91	0.81 (NS)
Proceduretime (min)	13.1±2.27	13.9±1.77	0.13 (NS)

The table 2 represents the number and percentage of patients diagnosed with different types of bone tumors in Group A and Group B. In Group A, 13 out of 30 patients (44%) were diagnosed with osteosarcoma, 12 (40%) with giant cell tumor, 2 (7%) with aneurysmal bony cyst, 1 (3%) with chondrosarcoma, 1 (3%) with Ewing sarcoma, and 1 (3%) with chondroma. In Group B, 15 out of 30 patients (50%) were diagnosed with osteosarcoma, 11 (33%) with giant cell tumor, 1 (3%) with aneurysmal bony cyst, 1 (3%) with chondrosarcoma, and 2 (7%) with Ewing sarcoma.

Table 2: Distribution of patients according to diagnosis

Parameter	Group A	Group B
Osteosarcoma	13 (44)	15 (50)
Giant Cell Tumor	12 (40)	11 (33)
Aneurysmal Bony Cyst	2 (7)	1 (3)
Chondrosarcoma	1 (3)	1 (3)
Ewing sarcoma	1 (3)	2 (7)
Chondroma	1 (3)	--

Table 3 and Table 4 represents the mean heart rate and mean blood pressure in post –operative period. There is no significant difference between group A and Group B in heart rate and blood pressure (p value>0.05).

Table: 3 Mean heart rate in post-operative period

Time interval	Group: A Mean ± SD	Group: B Mean ± SD	P value	Result
At time of skin closure *	80.03 ± 10.78	81.00 ± 7.84	0.6917	NS
Immediate post op	84.77 ± 7.66	83.36 ± 9.36	0.5256	NS
1 hours	78.83 ± 8.59	77.10 ± 9.73	0.4683	NS
2 hours	74.53 ± 8.06	75.13 ± 12.00	0.8210	NS
4 hours	73.23 ± 8.25	73.90 ± 8.41	0.7565	NS
6 hours	71.40 ± 5.70	72.26 ± 7.23	0.6109	NS
8 hours	81.70 ± 10.06	80.13 ± 11.14	0.5689	NS
10 hours	76.93 ± 7.70	77.13 ± 9.10	0.9271	NS
12 hours	75.53 ± 7.89	76.53 ± 10.40	0.6763	NS
18 hours	74.60 ± 7.96	74.90 ± 6.08	0.8404	NS
24 hours	73.50 ± 8.57	70.60 ± 5.53	0.1248	NS
36 hours	71.86 ± 6.80	69.90 ± 6.39	0.2547	NS
48 hours	70.76 ± 5.29	68.63± 5.13	0.1188	NS

(Data expressed as Mean ± SD, p value <0.05 considered as significant)

***** Time of study drug given.

Table: 4 Mean blood pressure in post-operative period

Time interval	Group: A Mean ± SD	Group: B Mean ± SD	P value	Result
At time of skin closure *	92.47 ± 6.16	92.00 ± 9.01	0.8144	NS
Immediate post op	96.63 ± 7.62	95.16 ± 10.80	0.5448	NS
1 hours	93.63 ±10.03	92.20 ± 9.30	0.5691	NS
2 hours	89.80 ± 9.12	88.56 ±12.10	0.6556	NS
4 hours	87.20 ± 10.62	87.23 ± 7.83	0.9901	NS
6 hours	86.16 ± 5.91	86.50 ± 7.74	0.8490	NS
8 hours	94.70 ± 8.69	94.06 ± 9.83	0.7903	NS
10 hours	91.40 ± 9.00	90.60 ± 9.20	0.7347	NS
12 hours	89.93 ± 8.41	88.33 ± 6.95	0.4251	NS
18 hours	88.60 ± 10.30	86.63 ± 5.08	0.3514	NS
24 hours	87.16 ± 7.55	84.33 ± 7.19	0.1425	NS
36 hours	85.36 ± 5.92	83.60 ± 4.43	O.1975	NS
48 hours	84.00 ± 4.40	82.50 ± 3.91	0.1681	NS

(Data are expressed as mean ± SD, p< 0.05 considered as significant.)

***** Time of study drug given.

As shown in Table: 5 there was no significant difference in mean VAS score at rest in both the groups. (p> 0.05). VAS score was high in immediate postoperative period and then it decreased. At 8hr 25 patients in group A and 22 patients in group B complained of pain at rest and are having VAS score of >4. Second dose of study drug was given via epidural or femoral catheter respectively after that study drug was administeredas and when required. VAS was remained ≤1 throughout study period after 18hrs.

Table: 5 Visual Analogue Score (VAS) at rest in postoperative period

Time interval	Group: A Mean± SD	Group: B Mean± SD	P value	Result
Immediate post op	4.33±0.80	4.56±0.61	0.2155	NS
1 hours	2.33 ± 0.77	2.53 ± 0.61	0.2694	NS
2 hours	1.50 ± 0.62	1.83 ± 0.68	0.0543	NS
4 hours	1.23 ± 0.67	1.40 ± 0.55	0.2875	NS
6 hours	0.90 ± 0.66	1.10 ± 0.65	0.2418	NS
8 hours	4.00 ± 0.69	3.80 ± 0.74	0.2834	NS
10 hours	1.96 ± 0.66	1.80 ± 0.68	0.3589	NS
12 hours	1.33 ± 0.66	1.20 ± 0.42	0.3665	NS
18 hours	1.00 ± 0.58	0.90 ± 0.47	0.4661	NS
24 hours	0.50 ± 0.50	0.70 ± 0.52	0.1343	NS
36 hours	0.40 ± 0.55	0.56 ± 0.61	0.2904	NS
48 hours	0.33 ± 0.53	0.43 ± 0.49	0.4510	NS

(Data expressed as mean ± SD, p< 0.05 considered as significant.)

As shown in Table: 6 there was no significant difference in mean VAS score at movement in both the groups. (P value > 0.05). VAS score was high in immediate postoperative period then it decreased.

Table: 6 Visual analogue score at movement in postoperative period

Time interval	Group: A Mean± SD	Group: B Mean± SD	P value	Result
Immediate post op	5.01 ± 0.75	4.80 ± 0.65	0.1032	NS
1 hours	2.90 ± 0.99	3.20 ± 0.60	0.1611	NS
2 hours	2.16 ± 0.69	2.26 ± 0.81	0.6087	NS
4 hours	1.93 ± 0.73	2.00 ± 0.77	0.7192	NS
6 hours	1.40 ± 0.67	1.60 ± 0.87	0.3226	NS
8 hours	4.56 ± 0.81	4.96 ± 1.05	0.1039	NS
10 hours	2.40 ± 0.71	2.10 ± 0.78	0.1247	NS
12 hours	1.77 ± 0.89	1.70 ± 0.68	0.7334	NS
18 hours	1.40 ± 0.67	1.30 ± 0.53	0.5240	NS
24 hours	0.93 ± 0.81	1.00 ± 0.57	0.7001	NS
36 hours	0.60 ± 0.66	0.76 ± 0.66	0.3517	NS
48 hours	0.43 ± 0.55	0.53 ±0.49	0.4601	NS

As shown in Table: 7 there was no significant difference in the duration of analgesia between two groups in postoperative period. (P Value >0.05) Average duration of analgesia was 443.06 ± 51.86 min in group A and 439.93 ± 67.02 min in group B.

Table: 7 Duration of analgesia in postoperative period

Variable	Group :A Mean ± SD	Group: B Mean ± SD	P value	Result
Duration of analgesia (min)	443.06 ± 51.86	439.93 ± 67.02	0.8404	NS

As shown in Table: 8 there was no significant difference in motor block as per modified bromage scale between two groups in post-operative period (p>0.05).

Table: 7 Modified Bromage scale in post-operative period

Time interval	Group: A Mean ± SD	Group: B Mean ± SD	P value	Result
Immediately post op	1.90 ± 0.3	1.83 ± 0.37	0.4242	NS
1 hours	1.36 ± 0.54	1.43 ± 0.55	0.6208	NS
2 hours	1.03 ±0.31	0.80 ±0.79	0.1431	NS
4 hours	0.86 ± 0.33	0.70 ±0.69	0.2566	NS
6 hours	0.30 ± 0.45	0.26 ±0.24	0.6691	NS
8 hours	0.20 ± 0.10	0.16 ±0.17	0.2712	NS
10 hours	0.83 ±0.52	0.90 ± 0.50	0.5971	NS
12 hours	0.13 ± 0.10	0.10 ±0.10	0.2500	NS
18 hours	0.06 ± 0.20	0.06 ± 0.06	1	NS
24 hours	0.03 ± 0.10	0.03 ±0.03	1	NS
36 hours	0 ± 0	0 ± 0	1	NS
48 hours	0 ± 0	0 ± 0	1	NS

(Data express as Mean ± SD , $p<0.05$ is statistical significant)

As shown in Table : 8 there was no significant difference in Ramsay Sedation Score in Post-operative period between two groups (P value >0.05).

Table: 9 Ramsay sedation score in post operative period

Time interval	Group: A Mean ± SD	Group: B Mean ± SD	P value	Result
Immediate post op	2.93 ± 0.24	2.90 ±0.3	0.6705	NS
1 hours	2.70± 0.52	2.63 ± 0.60	0.6310	NS
2 hours	2.46 ± 0.49	2.33 ± 0.74	0.4257	NS
4 hours	1.90 ± 0.53	1.80 ± 0.54	0.4720	NS
6 hours	1.50 ± 0.61	1.43 ± 0.49	0.6260	NS
8 hours	1.20 ± 0.54	1.23 ± 0.49	0.8225	NS
10 hours	2.00 ± 0.63	1.80 ± 0.65	0.2311	NS
12 hours	1.43 ± 0.49	1.40 ± 0.55	0.8243	NS
18 hours	1.10 ± 0.30	1.06 ± 0.24	0.5707	NS
24 hours	1.00 ± 0.00	1.00 ± 0.00	1	NS
36 hours	0.56 ± 0.49	0.53 ± 0.49	0.8134	NS
48 hours	0.13 ± 0.33	0.10 ± 0.3	0.7139	NS

As shown in Table: 10 there was no significant difference in rescue analgesia requirement during 48 hour in both the groups. ($p>0.05$) 5 patients in group Aand 3 patients in group B required injection tramadol 50mg i.v. as rescue analgesia. Among these 3 patients 2 patient in group B required 2nd dose of rescue analgesia within 48 hrs. This suggests partial or inadequate effect of FNB.Total dose of tramadol requirement was similar between two groups.

Table: 10 Rescue analgesia requirement

Variable	Group: A(n=30)	Group: B(n=30)	P value	Result
No of Patients	5 (16.66%)	3(10%)	0.4475	NS
No of Patients required >1 dose	0	2(6.66%)	0.1498	NS
Total tramadol dose	250mg	250mg	_	_

As shown in Table: 11 there was no significant difference in adverse effects between two group. ($p>0.05$)Incidence of nausea, vomiting and pruritus was higher in group A than group B. Hypotension, Shivering, sedation, Respiratory depression was not seen in any patients. All Patients were catheterized so urinary retention was not observed.

Table : 11 Adverse effects in two groups in postoperative period

Complication	Group: A	Group: B	P value	Result
Nausea/vomiting	5(16.66%)	3(10%)	0.4472	NS
Headache	2(6.66%)	2(6.66%)	1	NS
Pruritus	2(6.6%)	1(3.33%)	0.2276	NS
Dizziness	2(6.66%)	1(3.33%)	0.2276	NS

IV. Discussion

Severe and prolonged pain after total knee replacement (TKR) can be a major obstacle in early postoperative recovery and rehabilitation. The use of oral painkillers alone may not be sufficient to manage this pain, and could potentially hinder patients' participation in important physiotherapy sessions. (12) Optimal pain control is crucial for promoting active and passive movement and reducing the risk of deep vein thrombosis. Delayed rehabilitation after TKR has been associated with an increased risk of knee arthrofibrosis, which can lead to restricted knee movement and stiffness. (13, 14) These factors emphasize the importance of effective pain management strategies following TKR, which may include the use of regional anesthesia techniques and/or multimodal analgesia. Such strategies can help to provide more effective pain relief and promote early participation in physiotherapy by reducing neuroendocrine stress responses, central sensitization, and muscle spasms in response to pain, which is crucial for successful postoperative rehabilitation and outcomes. (15, 16)

Epidural infusion of local anesthetics and opioids is a common regional anesthesia technique used for postoperative pain management after TKR. However, this technique may increase the risk of epidural hematoma, which can be a serious complication and interfere with the administration of anticoagulation therapy to prevent thromboembolic events. Several studies have reported an increased risk of epidural hematoma with the use of epidural analgesia in TKR patients, especially when combined with anticoagulant medications such as aspirin or heparin (17, 18). Furthermore, a systematic review and meta-analysis conducted earlier found that the use of epidural analgesia was associated with a significantly increased risk of epidural hematoma compared to other types of analgesia following TKR (19).

Infusion of local anesthetic into the femoral nerve sheath is a regional anesthesia technique that provides site-specific analgesia for patients undergoing total knee replacement (TKR) with a lower incidence of side effects compared to systemic analgesia. Earlier reported studies have demonstrated the efficacy of femoral nerve sheath block (FNSB) in terms of superior pain relief and decreased opioid consumption compared to systemic analgesia. (20) Also a metaanalysis reported earlier showed that FNSB resulted in significantly lower pain scores, decreased opioid consumption, and fewer side effects compared to systemic analgesia. (21) FNSB is also associated with early postoperative rehabilitation outcomes with improved postoperative quadriceps strength and knee range of motion compared to systemic analgesia, leading to earlier discharge from the hospital. (22)

Bupivacaine and fentanyl are a potent and long-lasting local anesthetic agent that selectively blocks nerve conduction and reduces pain sensation in the area of application. (23) Regional anesthesia techniques, such as femoral nerve sheath block (FNSB), allow for targeted delivery of bupivacaine to specific nerve fibers that innervate the surgical site, thereby providing effective site-specific analgesia. (24) The use of FNSB with bupivacaine has been shown to decrease the need for systemic opioids, which are known to have various adverse effects such as nausea, vomiting, sedation, and respiratory depression. (25, 26) By reducing opioid consumption, FNSB with bupivacaine can offer improved patient comfort and satisfaction while also minimizing the risk of opioid-related complications. This approach can be considered an important adjunct to multimodal analgesia for managing postoperative pain after total knee replacement.

3-in-1 femoral nerve block (FNB) with bupivacaine increases the time for the first rescue analgesia in comparison to epidural anesthesia by inhibiting the influx of sodium ions into nerve cells, thereby blocking nerve impulses and reducing pain sensation in the affected area. When used for FNB, bupivacaine provides analgesia by targeting the femoral, obturator, and lateral femoral cutaneous nerves, which supply the hip and knee joint. (27) By blocking these nerves, bupivacaine can provide effective pain relief, reduce the need for systemic opioids, and potentially increase the time to the first rescue analgesia in comparison to epidural anesthesia. (28) Earlier studies have reported that 3-in-1 FNB with bupivacaine can provide comparable analgesia to epidural anesthesia, with some studies showing longer times to the first rescue analgesia in the FNB group compared to the epidural group. (29)

A prospective study reported earlier have investigated the efficacy of femoral nerve blocks (FNB) using different local anesthetics for postoperative pain relief after total knee arthroplasty (TKA) and found that there was no significant difference in pain scores between patients receiving FNB with either ropivacaine or bupivacaine (30). which is consistent with the findings of the our study. Both FNB and epidural anesthesia work by blocking

nerve impulses, leading to reduced pain sensation in the affected area. By providing effective local pain relief, FNB can reduce the need for systemic opioids, which is also the goal of epidural anesthesia. some studies have reported similar outcomes between FNB and epidural anesthesia in terms of postoperative pain relief, opioid consumption, and side effects indicating no significant difference among both the techniques. (31)

EA has been always considered as gold standard for postoperative pain management in TKA patients, FNB has emerged as a promising alternative due to its lower risk of adverse effects and its ability to provide effective pain relief with fewer systemic side effects. An earlier reported study compared the duration of motor block by modified Bromage scale between femoral nerve block (FNB) and epidural anesthesia (EA) in patients undergoing total knee arthroplasty (TKA) (32) and found no significant difference in the duration of motor block between the two groups. This findings are consistent with the results of our study aimed to compare the efficacy of FNB and EA for postoperative pain relief wherein FNB works by blocking the femoral nerve, which supplies sensation to the anterior aspect of the thigh and motor function to the quadriceps muscle while EA works by blocking the nerves that transmit pain and sensation from the lower extremities to the spinal cord, leading to reduced pain sensation and improved mobility.

In contrast to Epidural anesthesia which involves a larger area of the body and can cause sympathetic blockade, leading to a drop in blood pressure, heart rate, and cardiac output and other hemodynamic changes, Femoral nerve block (FNB) provides analgesia to the surgical site nerves without affecting sympathetic nerve fibers, resulting in minimal cardiovascular effects. (33) Studies have reported that FNB is associated with less hemodynamic instability compared to epidural anesthesia contributing to better hemodynamic stability and lower risk of adverse events such as hypotension and bradycardia consistent with findings of our study. (34). In present study the efficacy of femoral nerve block (FNB) and epidural anesthesia in terms of Ramsay Sedation Score (RSS) in patients undergoing total knee arthroplasty was evaluated which takes into account factors such as patient responsiveness to verbal stimuli, patient's ability to obey commands, and patient's level of awareness. Our findings are consistent with the results of previous studies that have compared the sedative effects of FNB and epidural anesthesia which found no significant differences in sedation levels between FNB and epidural anesthesia in patients undergoing arthroplasty. (35) Similarly, a study by Unlügenç et al. found that there was no significant difference in sedation scores between FNB and epidural anesthesia in patients undergoing knee arthroplasty. (36) The RSS allows clinicians to monitor the level of sedation in patients and adjust the dose of sedatives or analgesics as needed to achieve the desired level of sedation. In our study, we found that both FNB and epidural anesthesia were effective in achieving a similar level of sedation in patients undergoing total knee arthroplasty.

V. Conclusion

In conclusion, our study found that both epidural anesthesia and femoral nerve block with fentanyl provided effective postoperative analgesia for patients undergoing lower limb surgery. There were no significant differences in pain scores at rest and with movement, duration of analgesia, rescue analgesia requirement, hemodynamic stability, degree of motor block, or side effects between the two groups during the 48-hour study period. Therefore, the choice between epidural anesthesia and femoral nerve block should be based on factors such as patient preference, contraindications, and surgical considerations. Further studies with larger sample sizes and longer follow-up periods may be needed to confirm these findings.

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