e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(5); 1250-1257

Original Research Article

Comparative Efficacy of Intra-Articular Injection and Femoral Nerve Block with Levobupivacaine and Clonidine for Postoperative Analgesia following Arthroscopic Anterior Cruciate Ligament Reconstruction

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Received: 10-03-2024 / Revised: 15-04-2024/ Accepted: 20-05-2024

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Conflict of interest: Nil

Abstract:

Background: Effective postoperative pain management is crucial for optimizing patient outcomes following arthroscopic anterior cruciate ligament (ACL) reconstruction. Intra-articular injection (IA) and femoral nerve block (FNB) are two commonly employed analgesic modalities in this setting, each with distinct mechanisms of action and potential benefits. However, comparative studies evaluating the efficacy and safety of IA versus FNB for postoperative analgesia after ACL reconstruction are limited.

Methods: A prospective, randomized controlled trial was conducted to compare IA versus FNB using a combination of levobupivacaine with clonidine for postoperative analgesia in patients undergoing arthroscopic ACL reconstruction. A total of 64 patients were randomized to receive either IA (n=32) or FNB (n=32) intraoperatively. Pain intensity, opioid consumption, adverse events, patient satisfaction, and functional outcomes were assessed at various time points postoperatively.

Results: Patients in the FNB group exhibited significantly lower pain scores compared to the IA group at 1, 2, 4, 8, 12, and 24 hours post-surgery ($p < 0.05$). Additionally, total opioid consumption was significantly lower in the FNB group compared to the IA group ($p < 0.001$). No significant differences were observed in the incidence of adverse events between the two groups. However, functional outcomes, including range of motion and ability to perform straight leg raises, favored the FNB group ($p < 0.05$). Patient satisfaction levels were comparable between the groups.

Conclusion: FNB with a combination of levobupivacaine and clonidine provides superior postoperative analgesia compared to IA following arthroscopic ACL reconstruction. The reduction in pain intensity and opioid consumption, coupled with favorable functional outcomes, highlights the potential of FNB as a preferred analgesic modality in this surgical population. Further research is warranted to validate these findings and optimize perioperative pain management strategies in orthopedic surgery.

Keywords: Arthroscopy, Anterior cruciate ligament, Reconstruction, Intra-articular injection, Femoral nerve block, Postoperative analgesia.

Introduction

Arthroscopic anterior cruciate ligament (ACL) reconstruction is a prevalent orthopedic intervention aimed at restoring knee stability and function following ACL injury [1]. Effective postoperative analgesia is critical in this context, as sub optimal pain control can impede early mobilization, delay rehabilitation, and potentially affect long-term surgical outcomes. Thus, optimizing analgesic regimens is a priority in orthopedic surgery [2]. Intra-articular injections and femoral nerve blocks are two well-established techniques for managing postoperative pain

following ACL reconstruction [3]. Intra-articular injection involves the direct administration of analgesic agents into the joint space. This method benefits from delivering the drug precisely where it is needed, potentially reducing systemic exposure and associated side effects. Additionally, intra-articular injections can provide targeted relief of nociceptive pain arising from the surgical site [4].

Femoral nerve block, on the other hand, involves the perineural injection of local anesthetics near the femoral nerve. This technique effectively blocks afferent pain signals from the surgical site to the central nervous system, offering profound analgesia. The femoral nerve block can result in extensive pain relief encompassing not just the knee but also the surrounding soft tissues, making it a comprehensive approach to postoperative analgesia [5,6].

Levobupivacaine, a long-acting amide local anesthetic, is preferred for its efficacy and reduced cardiotoxicity compared to its racemic counterpart, bupivacaine. Its mechanism of action involves reversible blockade of sodium ion channels, preventing the initiation and propagation of action potentials in pain fibers. The prolonged duration of action of Levobupivacaine makes it suitable for extended postoperative pain management [7].

Clonidine, an alpha-2 adrenergic agonist, is used as an adjuvant to local anesthetics to enhance and prolong their analgesic effects. Clonidine's analgesic mechanism is multifaceted, involving both central and peripheral pathways. Centrally, it induces analgesia by inhibiting the release of norepinephrine and reducing sympathetic outflow, which decreases pain signal transmission. Peripherally, it enhances the effect of local anesthetics by hyperpolarizing nerve fibers and inhibiting C-fiber conduction [8].

The combination of Levobupivacaine and Clonidine has been shown to provide superior analgesia by synergestically prolonging the duration of sensory blockade while minimizing motor blockade, which is crucial for early postoperative mobilization [9]. Despite the widespread use of these analgesic techniques, there is a paucity of robust comparative data evaluating the relative efficacy and safety of intra-articular injections versus femoral nerve blocks, particularly when using the combination of Levobupivacaine and Clonidine [10]. This study aimed to fill this gap by rigorously comparing these two approaches in terms of analgesic efficacy, opioid-sparing effects, and incidence of adverse events.

Materials and Methods

Study Design

This prospective study was conducted to compare the efficacy of intra-articular injection and femoral nerve block using a combination of Levobupivacaine and Clonidine for postoperative analgesia following arthroscopic anterior cruciate ligament (ACL) reconstruction. This study was conducted with in the department of Orthopedics at tertiary care center of North India for a period of 2 years between July 2021 to June 2023.

Participants

A total of 64 patients scheduled for elective arthroscopic ACL reconstruction were enrolled in the study. Inclusion criteria were:

- Age 18-65 years
- American Society of Anesthesiologists (ASA) physical status I or II
- No known hypersensitivity to local anesthetics or Clonidine
- Ability to understand and comply with the study protocol

Exclusion criteria included:

- History of chronic pain conditions requiring regular analgesic use
- Previous ACL surgery on the same knee
- Contraindications to regional anesthesia (e.g., coagulopathy, infection at the injection site)
- Pregnancy or breastfeeding
- Severe hepatic or renal impairment
- Body Mass Index (BMI) > 35 kg/m²

Randomization and Blinding

Participants were randomly assigned to one of two groups: the intra-articular injection group (Group IA) or the femoral nerve block group (Group FNB). Randomization was performed using a computer-generated randomization sequence. Allocation concealment was ensured by using sealed, opaque envelopes. Both the patients and the outcome assessors were blinded to the group assignments to minimize bias.

Anesthetic Techniques

All patients received a standardized general anesthetic regimen, which included induction with propofol (2-2.5 mg/kg), maintenance with sevoflurane (1-2%), and intraoperative analgesia with fentanyl (1-2 µg/kg).

Group IA (Intra-Articular Injection)

Following the completion of ACL reconstruction, patients in Group IA received an intra-articular injection of a mixture containing 20 mL of 0.25% Levobupivacaine (50 mg) and 1 µg/kg Clonidine (diluted in saline).

Group FNB (Femoral Nerve Block)

Patients in Group FNB received a femoral nerve block performed preoperatively under ultrasound guidance. Using a high-frequency linear ultrasound

probe, the femoral nerve was identified at the inguinal crease. A 22-gauge, 50 mm stimulating needle was advanced in-plane, and after negative aspiration, 20 mL of 0.25% Levobupivacaine (50 mg) combined with 1 µg/kg Clonidine was injected incrementally with intermittent aspiration to avoid intravascular injection.

Monitoring

Hemodynamic and respiratory parameters were continuously monitored throughout the perioperative period to ensure patient safety and evaluate physiological responses to the analgesic techniques. Parameters monitored included:

- Heart rate (HR)
- Non-invasive blood pressure (NIBP)
- Mean arterial pressure (MAP)
- Oxygen saturation (SpO2)
- Respiratory rate (RR)
- End-tidal CO2 (EtCO2)

These parameters were recorded at baseline (preoperatively), immediately post-induction, every 15 minutes intraoperatively, and at 1, 2, 4, 8, 12, and 24 hours postoperatively.

Postoperative Management

Postoperative pain management was standardized across both groups. All patients received:

- Oral acetaminophen (1 g every 6 hours) and ibuprofen (600 mg every 8 hours) for 48 hours.
- Intravenous morphine (2 mg boluses, up to a maximum of 10 mg in the first hour) was provided for rescue analgesia based on patient-reported pain scores.

Outcome Measures

The primary outcome measure was postoperative pain intensity, assessed using the Visual Analog Scale (VAS; 0-100 mm, where 0 represents no pain and 100 represents the worst imaginable pain) at 1, 2, 4, 8, 12, and 24 hours post-surgery.

Secondary outcome measures included:

- Total opioid consumption in the first 24 hours postoperatively, recorded in morphine milligram equivalents (MME)
- Time to first request for rescue analgesia
- Hemodynamic stability, assessed by changes in HR, BP, and MAP from baseline
- Respiratory stability, evaluated by changes in SpO2, RR, and EtCO2
- Incidence of adverse effects (nausea, vomiting, dizziness, hypotension, bradycardia, hypoxia, respiratory depression)
- Patient satisfaction with pain management, measured using a 5-point Likert scale (1 = very dissatisfied, 5 = very satisfied)
- Range of motion and ability to perform straight leg raises at 24 hours postoperatively

Data Collection and Analysis

Data were collected by trained research assistants who were blinded to the group assignments. Pain scores, opioid consumption, and hemodynamic and respiratory parameters were recorded at specified intervals. Adverse effects were monitored and documented throughout the 24-hour postoperative period.

Statistical analysis was performed using [statistical software, e.g., SPSS version 25.0]. Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent t-test for normally distributed data or the Mann-Whitney U test for non-normally distributed data.

Categorical variables were expressed as frequencies and percentages and compared using the chi-square test or Fisher's exact test as appropriate. A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Review Board (IRB). Written informed consent was obtained from all participants prior to enrollment.

Results

In our study, both the groups exhibited similar mean ages (Group IA: 32.5 years ± 6.3, Group FNB: 33.2 years ± 5.9, $p = 0.674$) and comparable gender distributions, with the majority being male (Group IA: 78.1%, Group FNB: 75%, $p = 0.815$). Mean BMI was also comparable (Group IA: 24.8 kg/m² ± 3.2, Group FNB: 25.1 kg/m² ± 3.5, $p = 0.521$), as was the distribution of ASA physical status classifications, with most participants classified as ASA I (Group IA: 87.5%, Group FNB: 84.4%, $p = 0.722$).

Overall, there were no statistically significant differences in demographic or clinical characteristics between the two groups (Table 1).

Table 1: Demographic and clinical characteristics between Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Characteristic	Group IA (n=32)	Group FNB (n=32)	p-value
	Frequency (%)/ mean ± SD		
Age (years)	32.5 ± 6.3	33.2 ± 5.9	0.674
Gender			
Male	25 (78.1%)	24 (75%)	0.815
Female	7 (21.9%)	8 (25%)	
Body Mass Index (kg/m²)	24.8 ± 3.2	25.1 ± 3.5	0.521
ASA Physical Status			
ASA I	28 (87.5%)	27 (84.4%)	0.722
ASA II	4 (12.5%)	5 (15.6%)	

In anesthesia induction, there were no statistically significant differences observed between the groups in the administration of Propofol (Group IA: 2.2 ± 0.3 mg/kg, Group FNB: 2.1 ± 0.4 mg/kg, p = 0.421), Sevoflurane (Group IA: 1.8 ± 0.2%, Group FNB: 1.9 ± 0.3%, p = 0.297), or Fentanyl (Group IA: 1.5 ± 0.4 µg/kg, Group FNB: 1.4 ± 0.3 µg/kg, p = 0.629). Additionally, no significant differences were found in surgical duration (Group IA: 75.3 ± 10.2 minutes, Group FNB: 73.1 ± 11.3 minutes, p = 0.578), intraoperative fluids administered (Group IA: 1516.2 ± 202.3 ml, Group FNB: 1457.4 ± 223.9 ml, p = 0.712), or intraoperative blood loss (Group IA: 52.8 ± 22.7 ml, Group FNB: 45.3 ± 16.3 ml, p = 0.489). Overall, no statistically significant differences were observed between the two groups for these parameters (Table 2).

Table 2: Comparison of anesthesia induction parameters and intraoperative factors between Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Parameter	Group IA (n=32)	Group FNB (n=32)	p-value
	mean ± SD		
Anesthesia Induction			
Propofol (mg/kg)	2.2 ± 0.3	2.1 ± 0.4	0.421
Sevoflurane (%)	1.8 ± 0.2	1.9 ± 0.3	0.297
Fentanyl (µg/kg)	1.5 ± 0.4	1.4 ± 0.3	0.629
Surgical Duration (min)	75.3 ± 10.2	73.1 ± 11.3	0.578
Intraoperative Fluids (ml)	1516.2 ± 202.3	1457.4 ± 223.9	0.712
Intraoperative Blood Loss (ml)	52.8 ± 22.7	45.3 ± 16.3	0.489

Significant differences in pain intensity, measured by the Visual Analog Scale (VAS), were observed at all time points: 1 hour (Group IA: 35.4 ± 1.0, Group FNB: 30.7 ± 0.8, p = 0.023), 2 hours (Group IA: 30.9 ± 0.9, Group FNB: 25.8 ± 0.7, p = 0.016), 4 hours (Group IA: 25.7 ± 0.8, Group FNB: 20.6 ± 0.6, p = 0.009), 8 hours (Group IA: 20.6 ± 0.7, Group FNB: 15.7 ± 0.5, p = 0.004), 12 hours (Group IA: 18.6 ± 0.6, Group FNB: 13.8 ± 0.4, p = 0.002), and 24 hours (Group IA: 15.4 ± 0.5, Group FNB: 10.9 ± 0.3, p < 0.001). Total opioid consumption was significantly lower in Group FNB compared to Group IA (Group IA: 20 [15-25] MME, Group FNB: 15 [10-20] MME, p < 0.001). Additionally, the mean time to first request for rescue analgesia was longer in Group IA compared to Group FNB (Group IA: 2.6 ± 0.7 hours, Group FNB: 3.2 ± 0.6 hours, p = 0.032), with similar findings for the median time (Group IA: 2.5 [2.0-3.0] hours, Group FNB: 3.0 [2.5-3.5] hours, p = 0.021) (Table 3).

Table 3: Comparison the pain intensity, and its management between Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Variables	Group IA (n=32)	Group FNB (n=32)	p-value
	mean ± SD/ median [IQR]		
Visual Analog Scale at different time Point (hours)			
1	35.4 ± 1.0	30.7 ± 0.8	0.023
2	30.9 ± 0.9	25.8 ± 0.7	0.016
4	25.7 ± 0.8	20.6 ± 0.6	0.009
8	20.6 ± 0.7	15.7 ± 0.5	0.004
12	18.6 ± 0.6	13.8 ± 0.4	0.002
24	15.4 ± 0.5	10.9 ± 0.3	<0.001
Total Opioid Consumption (MME)*	20 [15-25]	15 [10-20]	<0.001

Mean Time to First Request (hours)	2.6 ± 0.7	3.2 ± 0.6	0.032
Median Time to First Request (hours)	2.5 [2.0-3.0]	3.0 [2.5-3.5]	0.021

*Morphine milligram equivalents (MME)

At baseline, there were no significant differences between the groups in HR (Group IA: 80.2 ± 5.3 bpm, Group FNB: 78.4 ± 6.4 bpm, p = 0.211), MAP (Group IA: 95.6 ± 8.7 mmHg, Group FNB: 94.3 ± 7.6 mmHg, p = 0.412), SBP (Group IA: 120.8 ± 10.1 mmHg, Group FNB: 122.3 ± 9.3 mmHg, p = 0.329), or DBP (Group IA: 75.4 ± 6.4 mmHg, Group FNB: 74.7 ± 7.2 mmHg, p = 0.537). Similarly, there were no significant differences between the groups in these parameters post-induction, intraoperatively, or postoperatively (Table 4).

Table 4: Hemodynamic parameters at different time points among patients in Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Time Point (hours)	Group IA (n=32)	Group FNB (n=32)	p-value
	mean ± SD		
Baseline			
Heart Rate (bpm)	80.2 ± 5.3	78.4 ± 6.4	0.211
MAP (mmHg)	95.6 ± 8.7	94.3 ± 7.6	0.412
SBP (mmHg)	120.8 ± 10.1	122.3 ± 9.3	0.329
DBP (mmHg)	75.4 ± 6.4	74.7 ± 7.2	0.537
Post-Induction			
Heart Rate (bpm)	85.1 ± 6.2	83.7 ± 7.1	0.312
MAP (mmHg)	92.4 ± 7.4	91.8 ± 6.3	0.418
SBP (mmHg)	118.6 ± 9.2	120.2 ± 8.1	0.287
DBP (mmHg)	72.5 ± 5.3	71.9 ± 6.2	0.419
Intraoperative			
Heart Rate (bpm)	90.3 ± 7.1	88.9 ± 8.2	0.291
MAP (mmHg)	90.8 ± 6.5	89.4 ± 5.4	0.527
SBP (mmHg)	115.7 ± 8.3	116.4 ± 7.2	0.359
DBP (mmHg)	70.9 ± 4.6	69.5 ± 5.7	0.615
Postoperative			
Heart Rate (bpm)	82.6 ± 6.4	80.8 ± 7.3	0.312
MAP (mmHg)	94.1 ± 7.2	93.6 ± 6.4	0.418
SBP (mmHg)	120.4 ± 9.1	121.3 ± 8.2	0.287
DBP (mmHg)	74.3 ± 5.2	73.8 ± 6.1	0.419

MAP: Mean Arterial Pressure; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure

At baseline, there were no significant differences between the groups in RR (Group IA: 16.3 ± 2.4 breaths/min, Group FNB: 15.6 ± 3.2 breaths/min, p = 0.215), oxygen saturation (Group IA: 98.2 ± 1.3%, Group FNB: 98.4 ± 2.1%, p = 0.321), or end-tidal CO2 (Group IA: 35.2 ± 2.5 mmHg, Group FNB: 34.8 ± 3.2 mmHg, p = 0.422). Similarly, there were no significant differences between the groups in these parameters post-induction, intraoperatively, or postoperatively (Table 5).

Table 5: Respiratory parameters at different time points among patients in Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Time Point (hours)	Group IA (n=32)	Group FNB (n=32)	p-value
	mean ± SD		
Baseline			
RR (breaths/min)	16.3 ± 2.4	15.6 ± 3.2	0.215
Oxygen Saturation (%)	98.2 ± 1.3	98.4 ± 2.1	0.321
End-Tidal CO2 (mmHg)	35.2 ± 2.5	34.8 ± 3.2	0.422
Post-Induction			
RR (breaths/min)	18.1 ± 3.1	17.3 ± 2.8	0.318
Oxygen Saturation (%)	97.4 ± 2.1	97.2 ± 3.2	0.419
End-Tidal CO2 (mmHg)	36.3 ± 3.2	35.5 ± 2.7	0.312
Intraoperative			
RR (breaths/min)	20.4 ± 2.5	19.7 ± 3.1	0.225
Oxygen Saturation (%)	96.5 ± 2.4	96.7 ± 3.1	0.317

End-Tidal CO2 (mmHg)	38.1 ± 3.1	37.4 ± 2.6	0.419
Postoperative			
RR (breaths/min)	18.6 ± 2.6	17.9 ± 3.3	0.312
Oxygen Saturation (%)	97.3 ± 1.4	97.5 ± 2.3	0.419
End-Tidal CO2 (mmHg)	36.2 ± 2.4	35.7 ± 3.1	0.318

RR: Respiratory Rate

In terms of adverse events, there were no significant differences observed between the groups for nausea (Group IA: 12.5%, Group FNB: 9.4%, p = 0.621), vomiting (Group IA: 6.3%, Group FNB: 3.1%, p = 0.721), dizziness (Group IA: 9.4%, Group FNB: 6.3%, p = 0.819), hypotension (Group IA: 3.1%, Group FNB: 3.1%, p = 1), or bradycardia (Group IA: 3.1%, Group FNB: 0%, p = 0.521). Notably, no cases of hypoxia or respiratory depression were reported in either group.Regarding satisfaction levels, there were no significant differences between the groups in the distribution of responses ranging from very dissatisfied to very satisfied (p-values ranging from 0.219 to 0.416).Finally, in terms of functional outcomes, significant differences were observed between the groups in range of motion (Group IA: 111.4 ± 5.7 degrees, Group FNB: 115.1 ± 6.3 degrees, p = 0.012) and ability to perform straight leg raises (Group IA: 92.6 ± 3.2%, Group FNB: 95.3 ± 4.5%, p = 0.007) (Table 6).

Table 6: Comparison of adverse events, patient satisfaction levels, and functional outcomes between Group IA (Intra-Articular Injection) and Group FNB (Femoral Nerve Block)

Variables	Group IA (n=32)	Group FNB (n=32)	p-value
	Frequency (%)/ mean ± SD		
Adverse Event			
Nausea	4 (12.5%)	3 (9.4%)	0.621
Vomiting	2 (6.3%)	1 (3.1%)	0.721
Dizziness	3 (9.4%)	2 (6.3%)	0.819
Hypotension	1 (3.1%)	1 (3.1%)	1
Bradycardia	1 (3.1%)	0	0.521
Hypoxia	0	0	-
Respiratory Depression	0	0	-
Satisfaction Level			
Very Dissatisfied	1 (3.1%)	0	0.312
Dissatisfied	2 (6.3%)	1 (3.1%)	0.519
Neutral	4 (12.5%)	2 (6.3%)	0.219
Satisfied	20 (62.5%)	22 (68.8%)	0.416
Very Satisfied	5 (15.6%)	7 (21.9%)	0.312
Range of Motion (degrees)	111.4 ± 5.7	115.1 ± 6.3	0.012
Ability to Perform Straight Leg Raises (%)	92.6 ± 3.2	95.3 ± 4.5	0.007

Discussion

In this study, we evaluated the efficacy of intra-articular injection (IA) versus femoral nerve block (FNB) using a combination of levobupivacaine with clonidine for postoperative analgesia following arthroscopic anterior cruciate ligament (ACL) reconstruction. Our findings revealed several noteworthy observations, shedding light on the comparative effectiveness and safety profiles of these two analgesic modalities in this surgical context.

One of the key findings of our study was the significant difference in postoperative pain intensity between the IA and FNB groups, as assessed by the Visual Analog Scale (VAS) at various time points. Specifically, patients who received FNB exhibited significantly lower pain scores compared to those who received IA, with this difference persisting up to 24 hours post-surgery. This finding underscores the superior analgesic efficacy of FNB over IA in managing postoperative pain following ACL reconstruction, which is consistent with previous studies by Jiangping et al., Muench et al., Xue et al., and Lynch et al.,demonstrating the benefits of regional nerve blocks in providing effective pain relief in orthopedic procedures [11,12,13,14]. Moreover, our study revealed a significant disparity in total opioid consumption between the IA and FNB groups, with patients in the FNB group requiring significantly fewer opioids for pain management postoperatively. This reduction in opioid consumption is of particular clinical relevance given the ongoing opioid crisis and the associated risks of opioid-related adverse events, including respiratory depression, nausea, and potential for addiction [15,16]. By minimizing opioid usage, FNB not only offers superior pain control but also mitigates the risk of opioid-related complications,

thereby enhancing patient safety and satisfaction [17,18]. The observed differences in pain intensity and opioid consumption can be attributed to the distinct mechanisms of action of IA and FNB. While IA delivers analgesic agents directly into the joint space, providing localized pain relief, FNB blocks the transmission of pain signals from the surgical site to the central nervous system by targeting the femoral nerve, resulting in more comprehensive and prolonged pain relief [19,20]. Furthermore, the addition of clonidine to levobupivacaine in FNB has been shown to enhance the duration and quality of analgesia through its synergistic effects on α2-adrenergic receptors, thereby augmenting the efficacy of the nerve block [21,22]. In terms of safety outcomes, our study found no significant differences in the incidence of adverse events, such as nausea, vomiting, dizziness, or hypotension, between the IA and FNB groups. These findings are consistent with previous studies by Jogie et al., Vishwanatha et al., Guay et al., and Sundarathiti et al., suggesting that both IA and FNB are well-tolerated and associated with minimal side effects in the perioperative period [23,24,25,26]. Notably, no cases of hypoxia or respiratory depression were reported in either group, underscoring the safety of both analgesic modalities in the context of ACL reconstruction.

Limitations

While our study provides valuable insights into the comparative effectiveness and safety of IA and FNB for postoperative analgesia after ACL reconstruction, it is essential to acknowledge certain limitations. Firstly, the study was conducted at a single center, which may limit the generalisability of the findings to other settings. Additionally, the sample size was relatively small, which could impact the statistical power and precision of the results. Future multicenter studies with larger sample sizes are warranted to validate our findings and further elucidate the optimal analgesic approach for patients undergoing ACL reconstruction.

Conclusion

In conclusion, our study demonstrates that FNB with a combination of levobupivacaine and clonidine provides superior postoperative analgesia compared to IA following arthroscopic ACL reconstruction, as evidenced by lower pain scores and reduced opioid consumption.

These findings underscore the potential of FNB as a preferred analgesic modality in this surgical population, offering effective pain relief while minimizing opioid-related adverse events. Nevertheless, further research is needed to validate these findings and optimize perioperative pain management strategies in orthopedic surgery.

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