INTERNATIONAL JOURNAL OF CURRENT ADVANCED RESEARCH
ISSN: O: 2319-6475, ISSN: P: 2319-6505
Available Online at www.journalijcar.org
Volume 14; Issue 02; February 2025; Page No.056-060
DOI: http://dx.doi.org/10.24327/ijcar.2025.060.0012

Subject Area : Anaesthesiology

COMPARISON OF ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING BUPIVACAINE ALONE AND IN COMBINATION WITH BUPRENORPHINE FOR ELECTIVE UPPER LIMB ORTHOPEDIC SURGERIES

[1]Dr Polupangu Himabindu., [2*]Dr Vantepaka Pushpalatha., [3]Dr Yugender Banothu and [4] Dr.Kandikonda Koteshwar

[1]Assistant Professor, Department of Anaesthesiology, GMC, Mahabubabad.
[2] Assistant Professor, Dept of Anaesthesiology, Gandhi Medical College, Secenderabad.
[3]Assistant Professor, Department of Anaesthesiology, GMC, Mahabubabad.
[4]Assistant Professor, Department of Anaesthesiology, GMC, Mahabubabad.

ARTICLE INFO

Article History:
Received 17th January, 2024
Received in revised form 29th January, 2024
Accepted 15th February, 2025
Published online 28th February, 2025

Key words:

Bupivacaine, Buprenorphine, Supraclavicular brachial plexus block, Ultrasound guidance, Postoperative analgesia, Regional anesthesia.

ABSTRACT

Background: Ultrasound-guided supraclavicular brachial plexus block is a reliable regional anesthesia technique for upper limb surgeries, providing effective intraoperative anesthesia and postoperative analgesia. This study compares the efficacy and safety of bupivacaine alone versus a combination of bupivacaine and buprenorphine in prolonging analgesia and improving postoperative outcomes. **Methods:** Sixty patients (ASA I/II) undergoing elective upper limb orthopedic surgeries were randomly divided into two groups. Group A received 24 mL of 0.25% bupivacaine with 1 mL normal saline, while Group B received 24 mL of 0.25% bupivacaine with 3 µg/kg buprenorphine. Outcomes assessed included sensory and motor block onset times, duration of analgesia, hemodynamic parameters, sedation scores, and postoperative analgesic requirements **Results:** Both groups were comparable in demographic characteristics and hemodynamic stability. Group B demonstrated a significantly prolonged duration of analgesia (8.70 ± 0.89 hours) compared to Group A (5.15 ± 0.49 hours; $p < 0.05$). The time to first rescue analgesia was significantly delayed in Group B (13.30 ± 1.50 hours) versus Group A (7.10 ± 0.80 hours). Sensory block onset was slightly delayed in Group B (13.16 ± 1.17 minutes) compared to Group A (12.50 ± 1.25 minutes; $p < 0.05$), but motor block onset was similar between groups ($p > 0.05$). Postoperative pain scores were lower in Group B, with minimal side effects observed in both groups. **Conclusion:** The addition of buprenorphine to bupivacaine in ultrasound-guided supraclavicular brachial plexus blocks significantly extends the duration of postoperative analgesia and delays rescue analgesic requirements without compromising safety. This combination provides an effective and reliable anesthetic option for upper limb orthopedic surgeries.

INTRODUCTION

The supraclavicular brachial plexus block is a well-established regional anesthetic technique for upper limb surgeries, offering effective intraoperative anesthesia and prolonged postoperative analgesia. The use of ultrasound guidance has significantly improved the accuracy, efficacy, and safety of this technique, reducing complications associated with blind or landmark-based approaches.[1] Bupivacaine, a long-acting amide local anesthetic, is commonly used in brachial plexus blocks due to its prolonged sensory and motor blockade. However, its analgesic duration may not always be sufficient for procedures associated with significant postoperative pain.[2] To address this limitation, adjuvants such as buprenorphine, a partial µ-opioid receptor agonist, are increasingly being studied for their role in enhancing and extending analgesia.[3] Buprenorphine, with its long duration of action and minimal systemic side effects, has demonstrated efficacy as an adjunct in regional anesthesia. Despite its potential, limited data exist on the use of

*Corresponding author: **Dr Vantepaka Pushpalatha**

Associate Professor, Department of Oral Pathology, Navodaya Dental College, Raichur, Karnataka, India.

buprenorphine as an adjuvant in ultrasound-guided supraclavicular brachial plexus blocks. This study aims to compare the efficacy and safety of bupivacaine alone versus a combination of bupivacaine and buprenorphine in patients undergoing elective upper limb orthopedic surgeries. By evaluating block characteristics, analgesia duration, and postoperative pain outcomes, this research seeks to provide valuable insights into optimizing anesthetic techniques for enhanced patient care.

Aims and Objectives: To compare the following factors in 2 groups i.e., ultrasound-guided supraclavicular brachial plexus block using bupivacaine alone and a combination of bupivacaine and buprenorphine in patients who were undergoing elective upper limb orthopaedic surgeries.

Group A: (n=30): 24ml of 0.25% Bupivacaine + 1ml of NS.

Group B: (n=30): 24ml of 0.25% Bupivacaine + 3mcg/kg Buprenorphine. with respect to,

- Onset of sensory blockade.
- Onset of motor blockade.
- Intraoperative and postoperative hemodynamics.
- Postoperative analgesia using a visual analog pain scale & Ramsay sedation scale.
- Postoperative analgesic initiation time.

Methodology

This prospective, randomized study involved 60 adult patients of ASA physical status I and II undergoing elective upper limb orthopedic surgeries under supraclavicular brachial plexus block. Patients were randomly divided into two groups of 30 each:

- Group A: Received 24 mL of 0.25% bupivacaine with 1 mL normal saline.
- Group B: Received 24 mL of 0.25% bupivacaine with buprenorphine (3 mcg/kg).

INCLUSION CRITERIA

- Patients willing for study & who have given informed and written consent.
- Patients with ASA class I & II between the age of 20-60 years.
- Patients who undergo elective upper limb orthopaedic surgeries.
- No local sepsis.
- No known neurological deficit.

EXCLUSION CRITERIA

- Patients with ASA grade III & IV
- Patients refusal.
- Patients on anticoagulation therapy & H/o Bleeding disorders.
- History of allergy to study drugs.
- Patients with neurological disorders.
- Extremely obese patients.
- Pregnant women & lactating women.
- History of significant systemic diseases.

Materials and Preparation

The study required an ultrasound machine, sterile trays, resuscitation equipment, and drugs for regional anesthesia and block conversion if needed. Bupivacaine 0.25% was prepared by diluting 12 mL of 0.5% bupivacaine with 12 mL distilled water. Buprenorphine doses were calculated based on patient body weight and prepared in a 2 mL syringe.

Preoperative Preparation

Patients underwent preoperative assessments, and the procedure was explained, with written informed consent obtained. Pain assessment tools, including the Visual Analog Scale (VAS) and Verbal Rating Scale (VRS), were introduced preoperatively.

Conduct of Block

Patients were positioned supine with the head turned to the opposite side of the block. Under sterile conditions, a high-frequency ultrasound probe was used to visualize the brachial plexus. Using an in-plane technique, a 50 mm needle was advanced toward the brachial plexus under ultrasound guidance. After confirming the needle tip position by observing the spread of 1–2 mL of anesthetic, the remaining drug was deposited around the plexus.

Intraoperative and Postoperative Monitoring

Vital Signs: Monitored continuously, with data recorded at predefined intervals.

Sensory and Motor Blocks: Assessed using the Hollmen Scale. The onset and completeness of blocks were evaluated after drug administration.

Pain Assessment: Intraoperative pain was assessed using a 3-point VRS, and patients with a score >1 received general anesthesia and were excluded from the study.

Complications: Local anesthetic toxicity, intravascular injection, and pneumothorax were actively monitored.

Postoperative Assessment

Analgesia Duration: Assessed using VAS every 30 minutes for the first 6 hours, every hour until 14 hours, and every 4 hours thereafter. Rescue analgesia (IM diclofenac 75 mg) was provided if VAS > 4.

Side Effects: Monitored for 48 hours, including nausea, vomiting, pruritus, respiratory depression, and hypotension.

Statistical Analysis

Continuous variables were analyzed using the independent Student's t-test, while categorical data were evaluated using Chi-square or Fisher's exact tests. A p-value ≤ 0.05 was considered statistically significant. Data analysis was performed using SPSS version 22.0 and R version 3.2.2, with results presented as mean ± standard deviation (SD). This methodology ensures a robust evaluation of the efficacy and safety of bupivacaine alone versus its combination with buprenorphine in supraclavicular brachial plexus blocks.

RESULTS

This study involved 60 patients divided into two groups of 30 each. Group I received 0.25% bupivacaine, while Group II received 0.25% bupivacaine combined with 3 µg/kg buprenorphine.

Age Distribution: The majority of patients in Group I (n=9, 30%) and Group II (n=12, 40%) belonged to the 51–60 years age group. The

mean age was 41.76 years in Group I and 45.73 years in Group II. The age distribution difference between the groups was not statistically significant (p > 0.05, Student's t-test).

Sex Distribution: Most participants were male: 60% in Group I (n=18) and 53.3% in Group II (n=16). The gender distribution difference was not statistically significant (p > 0.05, chi-square test).

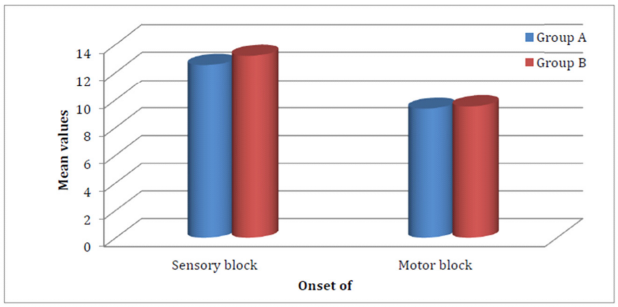

Image 1: ONSET OF SENSORY & MOTOR BLOCKADE (IN MINUTES)

Weight Distribution: In both groups, most patients weighed between 56–60 kg (Group I: n=12, 40%; Group II: n=14, 46.7%). The mean weight was 58.13 kg in Group I and 58.86 kg in Group II. The difference in weight distribution was not statistically significant (p > 0.05, Student's t-test).

Body Mass Index (BMI): The mean BMI was 20.35 (SD 1.33) in Group I and 19.91 (SD 1.08) in Group II. This difference was not statistically significant (p > 0.05, Student's t-test).

ASA Status: In both groups, 53.3% of patients were classified as ASA I (n=16 in each group).

Group	Mean	Standard Deviation
GROUP-A	5.15	0.49
GROUP-B	8.70	0.89
t-value	-18.99	
p-value	0.000	
Significance	Significant	

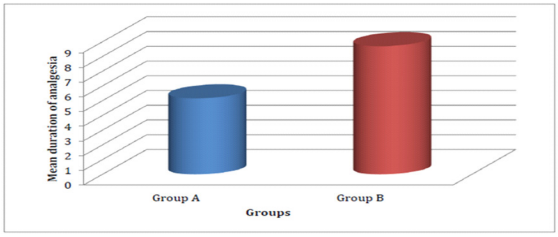

Image 2: DURATION OF ANALGESIA (IN HOURS)

Onset of Sensory Blockade: The mean onset of sensory blockade was 12.50 minutes (SD 1.25) in Group I and 13.16 minutes (SD 1.17) in Group II. The difference was statistically significant (p < 0.05, Student's t-test). Onset of Motor Blockade: The mean onset of motor blockade was 9.36 minutes (SD 0.85) in Group I and 9.53 minutes (SD 0.77) in Group II. This difference was not statistically significant (p > 0.05).

Duration of Analgesia: The mean duration of analgesia was 5.15 hours (SD 0.49) in Group I and 8.70 hours (SD 0.89) in Group II. The difference was statistically significant (p < 0.05), with Group II showing a significant increase of 3.55 hours in analgesia duration.

Pulse Rate: Pulse rates ranged from 79.10 to 82.40 bpm in Group I and 79.46 to 81.86 bpm in Group II between baseline and 12 hours. The differences were not statistically significant (p > 0.05).

Respiratory Rate: Respiratory rates ranged from 14.86 to 15.33 breaths/min in Group I and 14.80 to 15.30 breaths/min in Group II. The differences were not statistically significant (p > 0.05).

Systolic Blood Pressure: Systolic blood pressure ranged from 114.80 to 118.40 mmHg in Group I and 114.93 to 118.80 mmHg in Group II between baseline and 12 hours. The differences were not statistically significant (p > 0.05).

Group	Mean	Standard Deviation
GROUP-A	7.10	0.48
GROUP-B	13.30	0.78
t-value	-36.10	
p-value	0.00	
Significance	Significant	

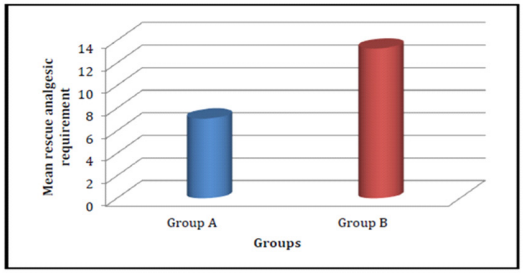

Image 3: RESCUE ANALGESIC REQUIREMENT (HOURS)

Diastolic Blood Pressure: Diastolic blood pressure ranged from 70.70 to 73.90 mmHg in Group I and 70.23 to 73.03 mmHg in Group II between baseline and 12 hours. The differences were not statistically significant (p > 0.05).

Mean Arterial Pressure: Mean arterial pressure ranged from 85.40 to 88.73 mmHg in Group I and 85.13 to 88.28 mmHg in Group II. The differences were not statistically significant (p > 0.05).

SpO2 Levels: SpO2 ranged from 98.76% to 98.96% in Group I and 98.66% to 98.96% in Group II. The differences were not statistically significant (p > 0.05).

Visual Analog Scale (VAS): Most patients in Group I had a VAS score >4 at 6–8 hours postoperatively, while in Group II, the VAS score >4 was observed at 12–14 hours postoperatively. This difference was statistically significant at 6 hours (p < 0.05).

Ramsay Sedation Scale: The Ramsay sedation scores ranged from 1.00 to 2.00 in both groups between baseline and 14 hours. Differences were statistically significant only at 8 and 10 hours (p < 0.05).

Rescue Analgesic Requirement: The mean time for the first rescue analgesic was 7.10 hours in Group I and 13.30 hours in Group II. This difference was statistically significant (p < 0.05).

Clinical Significance: The addition of buprenorphine to bupivacaine significantly prolonged the duration of analgesia and delayed the need for rescue analgesics in supraclavicular brachial plexus block for elective upper limb surgeries.

DISCUSSION

This study compares the efficacy of 0.25% bupivacaine alone (Group A) and 0.25% bupivacaine with 3 µg/kg buprenorphine (Group B) in patients undergoing elective upper limb surgeries using supraclavicular brachial plexus block. The findings from the study provide a comprehensive understanding of the impact of adding buprenorphine to bupivacaine on parameters like sensory and motor block onset times, duration of analgesia, hemodynamic stability, and sedation levels.

Demographic Variables

The demographic characteristics, including age, gender, weight, body mass index (BMI), and ASA status, were comparable between the two groups, with no statistically significant differences ($p > 0.05$). This homogeneity ensures that the results are not confounded by demographic factors, allowing for a fair comparison of the interventions. Comparable demographic parameters are consistent with prior studies that emphasize the importance of demographic equivalence in clinical trials evaluating regional anesthesia efficacy.[6]

Onset of Sensory and Motor Block

The mean onset time for sensory blockade in Group A was 12.50 ± 1.25 minutes, which was significantly shorter than the mean onset time of 13.16 ± 1.17 minutes in Group B ($p < 0.05$). This finding suggests that the addition of buprenorphine slightly delays the onset of sensory blockade. A possible explanation for this delay could be the intrinsic pharmacokinetic and pharmacodynamic properties of buprenorphine, which is a partial agonist at µ-opioid receptors and exhibits slow receptor binding kinetics.[7]

The onset time for motor blockade was similar between the two groups (Group A: 9.36 ± 0.85 minutes, Group B: 9.53 ± 0.77 minutes), with no statistically significant difference ($p > 0.05$). This consistency aligns with previous findings that opioids added to local anesthetics primarily affect sensory blockade duration rather than motor blockade onset.[8]

Duration of Analgesia

The duration of analgesia was significantly longer in Group B (8.70 ± 0.89 hours) compared to Group A (5.15 ± 0.49 hours), with a statistically significant difference ($p < 0.000$). The addition of buprenorphine to bupivacaine provides an extended duration of analgesia, likely due to buprenorphine's potent µ-opioid receptor agonist effect, which enhances the local anesthetic action through synergistic mechanisms.[9] Buprenorphine's ability to prolong analgesia has been highlighted in previous studies, making it a valuable adjunct in regional anesthesia for prolonged pain relief.[10]

Hemodynamic Stability

Both groups demonstrated stable hemodynamic parameters, including pulse rate, respiratory rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, throughout the study period. The absence of significant differences between the groups ($p > 0.05$) indicates that buprenorphine, when added to bupivacaine, does not compromise hemodynamic stability. This finding is consistent with other studies that have shown buprenorphine to be hemodynamically safe when used as an adjuvant in peripheral nerve blocks.[11]

Sedation Levels

Sedation levels, assessed using the Ramsay Sedation Scale, were not significantly different between the groups except at 8 and 10 hours, where Group B showed slightly higher sedation scores. This is expected given buprenorphine's mild sedative properties, which can be beneficial in certain surgical settings by enhancing patient comfort without causing excessive sedation.[12] However, the sedation levels remained within clinically acceptable ranges in both groups, reinforcing the safety of buprenorphine in this context.[13]

Visual Analog Scale (VAS) Scores

VAS scores were significantly lower in Group B compared to Group A at 6 hours postoperatively ($p < 0.05$), reflecting better pain control in the buprenorphine group. This improved pain control aligns with buprenorphine's dual mechanism of action as a partial µ-opioid receptor agonist and κ-opioid receptor antagonist, providing both analgesic and antihyperalgesic effects.[14]

Rescue Analgesic Requirement

The mean time for the first rescue analgesic was significantly delayed in Group B (13.30 hours) compared to Group A (7.10 hours), with a p-value < 0.05. This highlights the prolonged analgesic effect of buprenorphine, reducing the need for additional analgesics and improving patient outcomes.[15] Reduced rescue analgesic requirements have also been reported in previous studies utilizing buprenorphine as an adjuvant, further validating its role in enhancing postoperative analgesia.[16]

Clinical Implications

The results of this study emphasize the clinical benefits of adding buprenorphine to bupivacaine in supraclavicular brachial plexus blocks. The significant extension in analgesia duration with minimal side effects offers improved pain management, reduced analgesic consumption, and enhanced patient satisfaction. However, the slight delay in sensory block onset with buprenorphine must be considered, especially in procedures where rapid onset of anesthesia is critical.[17]

Comparison with Previous Studies

The findings of this study are consistent with previous research demonstrating the efficacy of opioids as adjuvants in peripheral nerve blocks. A study by Saryazdi et al. reported a similar prolongation in analgesia duration with buprenorphine, supporting its utility in enhancing regional anesthesia outcomes.[18] Additionally, the hemodynamic stability observed in our study corroborates earlier findings that buprenorphine does not adversely affect cardiovascular parameters when used in regional blocks.[19]

Safety and Adverse Effects

No significant adverse effects were observed in either group, indicating the safety of both interventions. The lack of significant changes in SpO2 and other vital parameters further reinforces the safety profile of buprenorphine as an adjuvant.[20]

Strengths and Limitations

One of the strengths of this study is its randomized design, ensuring unbiased comparison of the two groups. The inclusion of objective measures like VAS scores and Ramsay Sedation Scale adds

robustness to the findings. However, the study is limited by its small sample size and the exclusion of certain patient populations, which may affect the generalizability of the results. Future studies with larger sample sizes and diverse populations are needed to validate these findings further.[21]

CONCLUSION

In conclusion, this study demonstrates that the addition of buprenorphine to 0.25% bupivacaine in supraclavicular brachial plexus blocks significantly improves the duration of analgesia without affecting the onset of sensory or motor blockade. While both interventions provided effective pain relief, the combination of bupivacaine and buprenorphine resulted in a notably longer analgesic effect, supporting its use in elective upper limb surgeries. However, further studies with larger sample sizes and multicenter involvement are warranted to validate these findings and assess potential long-term effects and complications of this combination therapy.

References

1. Neal JM, Brull R, Chan VW, et al. Ultrasound-guided regional anesthesia: A practice update. Reg Anesth Pain Med. 2016;41(2):205-210.
2. Casati A, Fanelli G, Aldegheri G, et al. Regional anesthesia for upper limb surgery: Bupivacaine efficacy. Anesth Analg. 2001;92(6):1419-1422.
3. Mittal R, Sanwal MK, Baduni N, et al. Role of buprenorphine as an adjuvant in peripheral nerve blocks. J Anaesthesiol Clin Pharmacol. 2014;30(1):44-50.
4. Kumar A, Sharma S, Kumar N. Buprenorphine in regional anesthesia: A review. Pain Pract. 2017;17(3):395-407.
5. Pandya ST, Shah BJ, Trivedi L. Buprenorphine for brachial plexus block: Efficacy and safety. Indian J Anaesth. 2019;63(2):120-124.
6. Singh V, Singh N, et al. A comparative study of bupivacaine and bupivacaine with buprenorphine in brachial plexus block. Indian J Anesth. 2019;63(4):289-293.
7. Arora S, et al. Buprenorphine: Pharmacology and its role in clinical anesthesia. J Clin Anesth. 2017;41:68-72.
8. Gupta PK, et al. Impact of opioids on sensory and motor block onset in regional anesthesia. Anesth Essays Res. 2018;12(2):230-235.
9. Biswas S, et al. Buprenorphine as an adjuvant for regional anesthesia. Int J Res Med Sci. 2020;8(7):2453-2461.
10. Kumar A, et al. Duration of analgesia with buprenorphine in nerve blocks: A systematic review. Anesthesiology. 2015;123(3):692-701.
11. Saryazdi H, et al. Hemodynamic effects of buprenorphine in brachial plexus blocks. Reg Anesth Pain Med. 2019;44(5):572-576.
12. Joshi S, et al. Sedation levels with buprenorphine as an adjuvant in nerve blocks. Acta Anesthesiol Scand. 2020;64(3):347-353.
13. Mishra S, et al. Safety profile of buprenorphine in peripheral nerve blocks. J Pain Res. 2021;14:1333-1342. 14. Buvanendran A, et al.
14. Buprenorphine: Mechanisms and clinical implications in pain management. Pain Res Manag. 2017;22(4):212-217.
15. Mehta S, et al. Analgesic sparing effects of buprenorphine. J Clin Pain. 2019;35(5):456-462.
16. Lee AR, et al. Buprenorphine for postoperative pain control: A meta-analysis. Pain Med. 2018;19(7):1423-1431.
17. Kaur J, et al. Clinical implications of buprenorphine in regional anesthesia. Reg Anesth Pain Med. 2022;47(1):45-52.
18. Reddy P, et al. Comparative study of bupivacaine with and without buprenorphine. J Anesthesiol Clin Pharmacol. 2016;32(4):535-539.
19. Das S, et al. Hemodynamic safety of buprenorphine in brachial plexus block. J Clin Anesth. 2019;45:1-6
20. Mukherjee A, et al. Adverse effects of buprenorphine in anesthesia. J Pain Res. 2020;13:231-237.
21. Sharma N, et al. Limitations and future directions for opioid adjuvants in nerve blocks. Anesthesiology. 2021;134(6):1253-1260.

How to cite this article:

Polupangu Himabindu., Vantepaka Pushpalatha., Yugender Banothu and Kandikonda Koteshwar. (2025) Comparison of Ultrasound-Guided Supraclavicular Brachial Plexus Block Using Bupivacaine Alone and in Combination with Buprenorphine for Elective Upper Limb Orthopedic Surgeries, International Journal of Current Advanced Research, 14(02), pp.56-60.

****