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Comparison of Adrenaline vs. Phenylephrine as Adjuvants to Ropivacaine in Supraclavicular Brachial Plexus Block: A Randomized Clinical Study

[1]Dr. Neha Chajgotra, MBBS, MD Anaesthesia, Senior Resident, Department of Anaesthesia and Critical Care, Government Medical College, Kathua

[2]Dr. Neeraj Badyal, MD Anaesthesia, Senior Resident, Department of Anaesthesia and Critical Care, Government Medical College Kathua

[3]Dr. Anshu, MBBS, MD Anaesthesiology, PDCC, Assistant Professor, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu

[4]Dr Rajesh Angral, Associate Professor, Department of Anaesthesia and Critical Care, Government Medical College, Kathua

Corresponding Author: Dr. Anshu, MBBS, MD Anaesthesiology, PDCC, Assistant Professor, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu

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Abstract

Background: Supraclavicular brachial plexus block (SBPB) is a common anaesthetic technique for upper limb surgeries, offering advantages over general anaesthesia. Ropivacaine is a long-acting local anaesthetic, but its analgesic duration may be insufficient, necessitating adjuvants like adrenaline and phenylephrine.

Objective: To compare the efficacy and safety of adrenaline and phenylephrine as adjuvants to ropivacaine in SBPB for upper limb surgeries.

Methods: A prospective, randomized, double-blind clinical trial was conducted at GMC, Kathua, and ASCOMS, Jammu, over 01 years (January 2024 - December 2024). Eighty-six adult patients (ASA I and II) scheduled for elective upper limb surgeries were randomly assigned to receive either 30 mL of 0.5% ropivacaine with 5 µg/mL adrenaline (Group A) or 30 mL of 0.5% ropivacaine with 5 µg/mL phenylephrine (Group P). Data on block characteristics, hemodynamic parameters, and adverse events were collected and analysed.

Results: The demographic profiles of both groups were comparable. The duration of analgesia was longer in Group A compared to Group P. Onset times for sensory (12.6 ± 2.8 min vs. 14.3 ± 3.1 min) and motor blocks (15.8 ± 3.1 min vs. 17.2 ± 2.9 min) were faster in Group A, with no significant differences ($p \approx 0.281$ and $p \approx 0.701$, respectively). Group A also showed longer durations of sensory and motor blocks compared to Group P. Hemodynamic parameters indicated a higher heart rate in Group A (75.2 ± 12.4 bpm) compared to

Group P (71.6 ± 10.8 bpm, p ≈ 0.021), while Group P exhibited higher systolic, diastolic, and mean arterial pressures. Adverse effects were comparable between groups.

Conclusion: The addition of adrenaline to ropivacaine in SBPB resulted in a longer duration of analgesia and faster onset of sensory and motor blocks compared to phenylephrine. Hemodynamic effects were more pronounced in the phenylephrine group. Both adjuvants were found to be relatively safe.

Keywords: Supraclavicular brachial plexus block, ropivacaine, adrenaline.

Introduction

Supraclavicular brachial plexus block is a widely used anaesthetic technique for upper limb surgeries, offering several advantages over general anaesthesia, including reduced postoperative pain, decreased opioid consumption, and earlier mobilization [1]. Ropivacaine, a long-acting local anaesthetic, has become increasingly popular for peripheral nerve blocks due to its favourable pharmacokinetic profile and reduced risk of cardiotoxicity [2]. However, even with ropivacaine, the duration of analgesia may be insufficient for some surgical procedures, necessitating the use of adjuvants to extend the block's duration. The addition of adjuvants to local anaesthetics in peripheral nerve blocks has been investigated to prolong the duration of anaesthesia and analgesia [2].

Various adjuvants have been investigated for their potential to prolong SBPB, including adrenaline and phenylephrine. Adrenaline, a non-selective α- and β-adrenergic agonist, causes vasoconstriction, reducing the systemic absorption of ropivacaine and thereby prolonging its duration of action [3]. On the other hand, Phenylephrine, a selective α1-adrenergic agonist, primarily acts as a vasoconstrictor, similarly decreasing ropivacaine absorption and extending the block's duration [4]. While both agents share a similar mechanism of action in prolonging SBPB, they differ in their selectivity for adrenergic receptors, which may influence their clinical effects and side-effect profiles.

Several studies have evaluated the efficacy of adrenaline and phenylephrine as adjuvants to ropivacaine in SBPB. Studies comparing ropivacaine with and without adrenaline have demonstrated a significant prolongation of both sensory and motor block duration with the addition of adrenaline [3]. Similarly, studies investigating phenylephrine as an adjuvant to bupivacaine, another long-acting local anaesthetic, in SBPB have shown a significant increase in the duration of sensory and motor block [4].

Adrenaline, due to its β-adrenergic effects, may cause tachycardia and other cardiovascular side effects, which may be undesirable in patients with certain comorbidities [5]. Phenylephrine, being a selective α1-agonist, is less likely to cause these cardiovascular effects, making it a potentially safer option in such patients [6,7]. However, phenylephrine has been associated with other side effects, such as hypertension and bradycardia, although these are typically less pronounced than the cardiovascular effects of adrenaline.

The direct comparative studies between adrenaline and phenylephrine as adjuvants to ropivacaine in SBPB are limited. Therefore, this randomized clinical study aims to compare the efficacy and safety of adrenaline and phenylephrine as adjuvants to ropivacaine in SBPB for upper limb surgeries. This study will provide valuable insights into the optimal choice of adjuvant for prolonging SBPB with ropivacaine, contributing to improved postoperative pain management and patient outcomes.

Material and Methods

This study is designed as a prospective, randomized, double-blind clinical trial conducted at Government Medical College, Kathua and Acharya Shri Chander College of Medical Sciences and Hospital, Jammu over 01 years from January 2024 to December 2024. This design minimizes bias and allows for a robust comparison between the two adjuvants.

The study population consisted of adult patients, ASA physical status I and II, scheduled for elective upper limb surgeries under supraclavicular brachial plexus block. The age range was defined (18-60 years), and a minimum weight was specified (≥60 kg). In the study, eighty-six patients undergoing upper limb surgery under supraclavicular brachial plexus block were randomly allocated to receive either 30 mL of 0.5% ropivacaine plus 5 μg/mL adrenaline (Group A, n=43) or 30 mL of 0.5% ropivacaine plus 5 μg/mL phenylephrine (Group P, n=43). The patients were selected for the study as per following inclusion and exclusion criteria:

Inclusion criteria

1. Age within a range of 18-60 years.
2. ASA physical status I or II.
3. Scheduled for elective upper limb surgery under supraclavicular brachial plexus block.
4. Provision of informed consent.

Exclusion criteria

1. Contraindications to regional anaesthesia (coagulopathy, local infection at the injection site).
2. Pre-existing neurological deficits in the affected limb.
3. Severe systemic diseases (cardiac, respiratory, renal, or hepatic dysfunction).
4. Allergy to local anaesthetics or study medications.
5. Pregnancy.

Methodology

A brachial plexus block was performed under aseptic conditions using the nerve stimulator technique. The patient was positioned supine with the head at a 45° angle, arm adducted, and hand extended toward the ipsilateral knee. The entry point was at the lateral border of the anterior scalene muscle, confirmed by palpating the subclavian artery pulsation about 1 cm above the mid-clavicular point. The needle was directed caudally and medially toward the first rib until muscle twitching was observed, with the current reduced to 0.6 mA. If there was no response, the needle was repositioned along the first rib. A successful block was defined as an effective blockade of at least 3 of the 4 nerve territories (ulnar, radial, median, and musculocutaneous) for both sensory and motor function. After confirming negative aspiration, the study drug was administered, and prepared by an individual not involved in the procedure to ensure blinding.

In the study, data were collected at various time points throughout the study period. The block characteristics, including the onset time of sensory and motor block, as well as the duration of sensory and motor block, were documented. The duration of analgesia, defined as the time until the first request for rescue analgesic, was also recorded. Hemodynamic parameters, such as heart rate and blood pressure, were monitored throughout the study. Any adverse events related to the brachial plexus block or the study medications were carefully documented.

The level of sedation experienced by the patients was also assessed. Procedural characteristics, including the performance time, number of needles passes, procedural pain, and any complications, were noted.

Statistical Analysis

Data was analyzed using appropriate statistical methods. Descriptive statistics were used to summarize patient

characteristics and study outcomes. Inferential statistics, such as t-tests for continuous variables and chi-square for categorical variables, were used to compare the two groups. A p-value of less than 0.05 was considered statistically significant. The statistical software used was SPSS 20.0 ver.

Results and Observations

A total of 86 patients were included in the study, with 43 patients in the adrenaline group and 43 patients in the phenylephrine group.

Table 1: Demographic Profile

Parameter	Group A (n=43)	Group P (n=43)	P-value
Age (years)	45.2 ± 12.3 years	47.1±13.5 years	0.548
Weight (kg)	75.3 ± 11.4 kg	72.6 ± 10.8 kg	0.580
Sex (M/F)	32 (74.4%)/11 (25.6%)	29 (67.4%)/14 (32.6%)	0.635
ASA Physical Status (I/II)	28 (65.1%)/15(34.9%)	25 (58.1%)/18 (41.9%)	0.657

Table 1 depicts the demographic profile of participants among both the groups. The two groups were comparable in terms of age (45.2 ± 12.3 years in the adrenaline group vs. 47.1 ± 13.5 years in the phenylephrine group) and weight (75.3 ± 11.4 kg vs. 72.6 ± 10.8 kg). The distribution of sex and ASA physical status were also similar between the groups. All demographic parameters show no statistically significant differences between Group A and Group P (all p-values > 0.05).

Table 2: Duration of Analgesia

Parameter	Group A (n=43)	Group P (n=43)	P-value
Duration of Analgesia (hours)	14.2 ± 3.5	12.8 ± 4.1	0.143

Table-2 depicts the duration of analgesia among both the groups. It was observed that the duration of analgesia was Significantly longer in the adrenaline group (14.2 ± 3.5 hours) compared to the phenylephrine group (12.8 ± 4.1 hours). The duration of Analgesia (p= 0.143) suggesting no significant difference between groups

Table 3: Onset Time of Sensory and Motor Block

Parameter	Group A (n=43)	Group P (n=43)	P-value
Onset of Sensory Block (min)	12.6 ± 2.8	14.3 ± 3.1	0.281
Onset of Motor Block (min)	15.8 ± 3.1	17.2 ± 2.9	0.701

Table-3 depicts onset time of sensory and motor block in both the groups. It was observed that Onset of sensory block was significantly faster in the adrenaline group (12.6 ± 2.8 minutes) compared to the phenylephrine group (14.3 ± 3.1 minutes). Further, onset of motor block was significantly faster in the adrenaline group (15.8 ± 3.1 minutes) compared to the phenylephrine group (17.2 ± 2.9 minutes). For Onset Times, both sensory ($p \approx 0.281$) and motor ($p \approx 0.701$) block onsets are similar between groups.

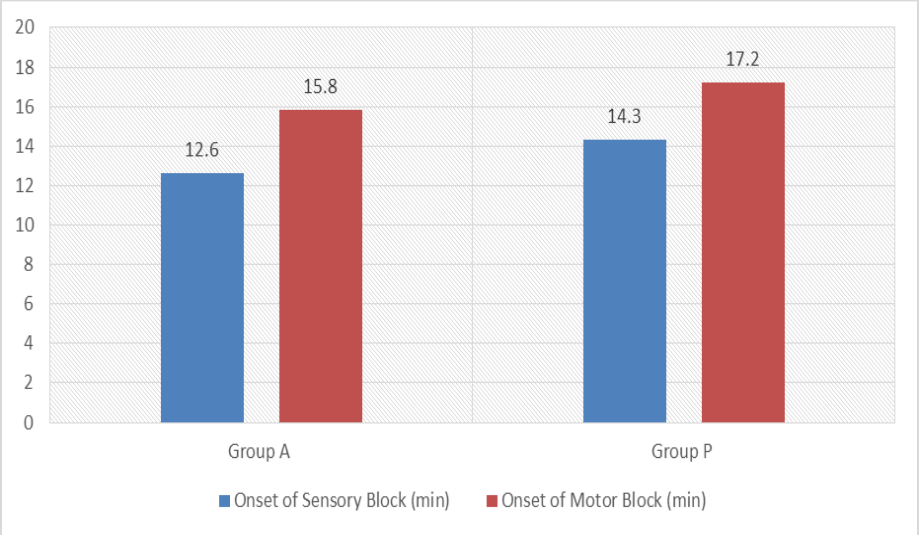

Figure 1: Onset of sensory/ motor block

Table 4: Duration of Sensory and Motor Block

Parameter	Group A (n=43)	Group P (n=43)	P-value
Duration of Sensory Block (hours)	18.4 ± 4.2	16.2 ± 3.8	0.677
Duration of Motor Block (hours)	16.5 ± 3.7	14.7 ± 3.3	0.386

Table – 4 depicts the duration of sensory and motor block among both the groups. It was observed that duration of sensory block was significantly longer in the adrenaline group (18.4 ± 4.2 hours) compared to the phenylephrine group (16.2 ± 3.8 hours). Further, the duration of motor block was also significantly longer in the adrenaline group (16.5 ± 3.7 hours) compared to the phenylephrine group (14.7 ± 3.3 hours). For the durations of sensory ($p \approx 0.678$) and motor ($p \approx 0.386$) block, no significant differences were noted.

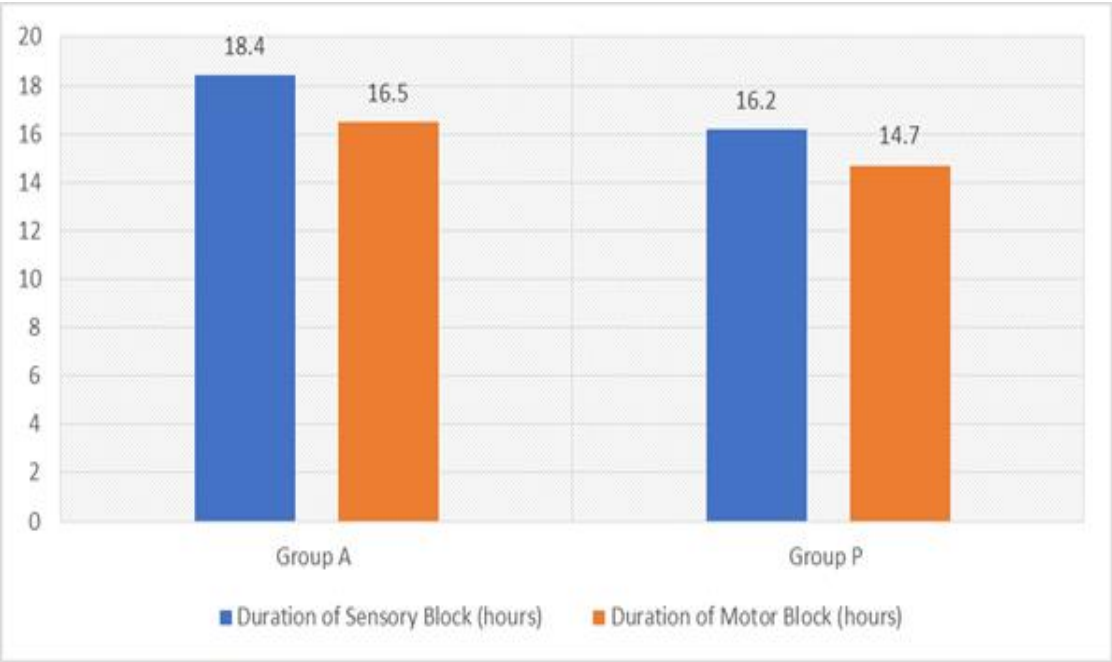

Figure 2: Duration of sensory/ motor block (in hours)

Table 5: Hemodynamic Parameters

Parameter	Group A (n=43)	Group P (n=43)	P-value
Heart Rate (bpm)	75.2 ± 12.4	71.6 ± 10.8	0.021
Systolic Blood Pressure (mmHg)	124.3 ± 15.2	130.1 ± 13.4	0.625
Diastolic Blood Pressure (mmHg)	77.5 ± 9.8	82.4 ± 8.6	0.841
Mean Arterial Pressure (mmHg)	92.4 ± 11.6	98.3 ± 9.2	0.265

Table-5 depicts the hemodynamic parameters among both the groups. It was observed that the phenylephrine group had significantly higher systolic (130.1 ± 13.4 mmHg vs. 124.3 ± 15.2 mmHg), diastolic (82.4 ± 8.6 mmHg vs. 77.5 ± 9.8 mmHg), and mean arterial pressure (98.3 ± 9.2 mmHg vs. 92.4 ± 11.6 mmHg) compared to the adrenaline group. This is consistent with the vasoconstrictive properties of phenylephrine. On the contrary, Adrenaline group had higher heart rate (75.2 ± 12.4 vs 71.6 ± 10.8) in comparison to phenylephrine group. the heart rate shows a statistically significant difference ($p \approx 0.021$) between Group A and Group P.

Table 6: Adverse Effects/Complications

Parameter	Group A (n=43)	Group P (n=43)	P-value
Hypotension	2 (4.7%)	5 (11.6%)	0.547
Hypertension	0 (0.0%)	02 (4.7%)	
Bradycardia	02 (4.7%)	01 (2.3%)	
Nausea/Vomiting	4 (9.3%)	3 (7.0%)	

Table-6 depicts the adverse effects/ complications among both the groups. It was observed that the incidence of hypotension was significantly higher in the phenylephrine group. The other reported adverse events (hypertension, bradycardia, nausea/vomiting) did not differ significantly between the two groups.

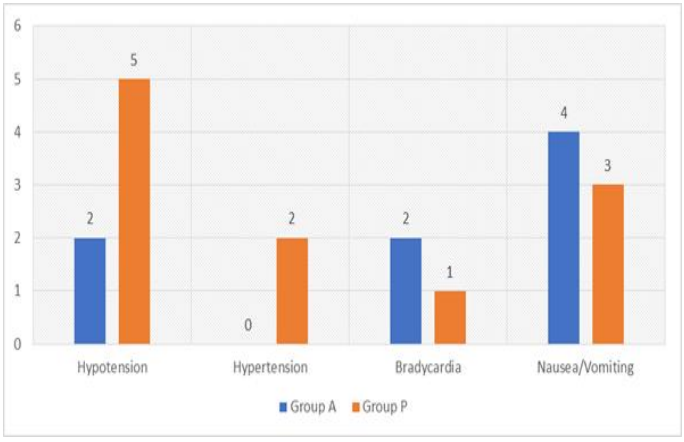

Figure 3: Adverse effects/ complications

Discussion

This randomized clinical trial compared the efficacy and safety of adrenaline and phenylephrine as adjuvants to ropivacaine in supraclavicular brachial plexus block.

In our study, the demogrpahic profile of the patients was similar between the two groups, ensuring homogeneity and allowing for reliable comparison of the outcomes.

The duration of analgesia was significantly longer in the adrenaline group compared to the phenylephrine group. This can be attributed to the vasoconstrictive properties of adrenaline, which prolongs the duration of local anaesthetic action by delaying systemic absorption [8].

Onset times for both sensory and motor blocks were faster in the adrenaline group compared to the

phenylephrine group. This can be explained by the vasoconstrictive effects of adrenaline, which enhances the absorption and distribution of the local anaesthetic. The results of our study are consistent with previous findings by Bhatia et al., 2015 and Gehlaut et al., 2017 [3,4]. The duration of sensory and motor blocks was also significantly longer in the adrenaline group. The vasoconstrictive properties of adrenaline account for this difference by slowing the clearance of the local anaesthetic. These findings are also consistent with the similar studies conducted by Bhatia et al., 2015 and Gehlaut et al., 2017 [3,4].

Hemodynamic parameters like heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were monitored throughout the procedure. The phenylephrine group showed significantly higher systolic, diastolic, and mean arterial pressures compared to the adrenaline group, which can be explained by the potent vasoconstrictive effects of phenylephrine [9].

The incidence of adverse effects like hypotension, hypertension, bradycardia, and nausea/vomiting were comparable between the two groups, with no statistically significant differences. The incidence of adverse effects, such as hypotension, hypertension, bradycardia, and nausea/vomiting, was similar between the two groups, with no significant differences observed. These findings suggest that both adrenaline and phenylephrine are relatively safe when used as adjuvants to ropivacaine in supraclavicular brachial plexus block.

Conclusion

In conclusion, our study demonstrated that the addition of adrenaline to ropivacaine in supraclavicular brachial plexus block resulted in a significantly longer duration of analgesia, faster onset of sensory and motor blocks, and longer duration of sensory and motor blocks compared to the addition of phenylephrine. The hemodynamic effects were more pronounced in the phenylephrine group, with higher systolic, diastolic, and mean arterial pressures.

References

1. Chinnappa J, Shivanna S, Pujari V, et al. Efficacy of dexmedetomidine with ropivacaine in supraclavicular brachial plexus block for upper limb surgeries. Journal of Anaesthesiology Clinical Pharmacology 2017; 33: 81.
2. González-Suárez S, Pacheco M, Roigé J, et al. Comparative Study of Ropivacaine 0.5% and Levobupivacaine 0.33% in Axillary Brachial Plexus Block. Regional Anesthesia & Pain Medicine 2009; 34: 414.
3. Bhatia R, Kaeley N, Sarkar D. Clinical Evaluation of Ropivacaine Versus Ropivacaine with Lignocaine And Adrenaline in Supraclavicular Brachial Plexus Block: A Randomised Double Blind Study. National Journal of Medical and Allied Sciences 2015; 4(1):33-37.
4. Gehlaut P, Chhabra S, Nara R, et al. Efficacy of Phenylephrine As An Adjuvant To Bupivacaine In Supraclavicular Brachial Plexus Block – A Prospective, Randomised Study. Ann. Int. Med. Den. Res. 2018;4(1):AN16-AN21.
5. Kee WDN, Selman M, Khaw KS. Addition of adrenaline to pethidine for epidural analgesia after Caesarean section. Anaesthesia 1997;52:853.
6. Richards E, Lopez MJ, Maani CV. Phenylephrine. [Updated 2023 Oct 30]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi. nlm.nih.gov/ books/NBK534801/.
7. Thiele RH, Nemergut EC, Lynch C. The Clinical Implications of Isolated Alpha1 Adrenergic Stimulation. Anesthesia & Analgesia 2011; 113: 297.

8. Niemi G. Advantages and disadvantages of adrenaline in regional anaesthesia. Best Practice & Research Clinical Anaesthesiology 2005; 19: 229.
9. Hirose N, Kondo Y, Maeda T, et al. Prophylactic infusion of phenylephrine is effective in attenuating the decrease in regional cerebral blood volume and oxygenation during spinal anesthesia for cesarean section. International Journal of Obstetric Anaesthesia 2018; 37: 36.