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Original Article

Effect Of Perineural Versus Intravenous Dexamethasone on Postoperative Analgesia Following Ultrasound-Guided Supraclavicular Brachial Plexus Block: A Randomized Comparative Study

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ABSTRACT

Background: Ultrasound-guided supraclavicular brachial plexus block provides effective anaesthesia and postoperative analgesia for upper limb surgeries. Dexamethasone is commonly used as an adjuvant, but the optimal route of administration remains uncertain. This study compared the analgesic effects of perineural and intravenous dexamethasone.

Methods: A prospective randomized comparative study was conducted in the Department of Anaesthesiology, Pacific Medical College and Hospital, Udaipur, Rajasthan, among 72 patients undergoing elective upper limb surgeries. Patients were randomly allocated into Group RI (intravenous dexamethasone) and Group RP (perineural dexamethasone). The primary outcome was postoperative pain assessment using the Numeric Rating Scale (NRS). Secondary outcomes included haemodynamic parameters and adverse effects.

Results: A total of 72 patients completed the study, with 36 patients in each group. The demographic characteristics were comparable between the groups ($p > 0.05$). NRS scores, mean arterial blood pressure, heart rate, and the incidence of adverse effects did not differ significantly between the two groups ($p > 0.05$). Both perineural and intravenous dexamethasone provided effective postoperative analgesia with comparable clinical outcomes.

Conclusion: Both perineural and intravenous dexamethasone provided effective postoperative analgesia with comparable haemodynamic stability and safety following ultrasound-guided supraclavicular brachial plexus block.

Keywords: Ultrasound-guided supraclavicular brachial plexus block; Dexamethasone; Perineural; Intravenous; Postoperative analgesia; Ropivacaine.

INTRODUCTION

Effective postoperative pain control remains a fundamental component of perioperative care in patients undergoing upper limb surgeries. Inadequately controlled postoperative pain may delay functional recovery, prolong hospital stay, reduce patient satisfaction, and increase the risk of chronic pain development. Regional anaesthesia techniques, particularly brachial plexus blocks, have become increasingly popular because they provide excellent surgical anaesthesia while minimizing opioid consumption and opioid-related adverse effects. The introduction of ultrasound guidance has further improved the accuracy, efficacy, and safety of supraclavicular brachial plexus block, making it one of the preferred regional anaesthesia techniques for surgeries involving the upper extremity [1].

Among the various approaches to brachial plexus blockade, the ultrasound-guided supraclavicular approach offers rapid onset of anaesthesia and dense blockade because the trunks and divisions of the brachial plexus are compactly arranged at this level. In addition to providing effective intraoperative anaesthesia, this technique offers excellent postoperative analgesia and facilitates early mobilization and rehabilitation. Nevertheless, the duration of analgesia produced by a single injection of local anaesthetic remains limited, prompting continued investigation into adjuvants capable of prolonging nerve block duration without increasing adverse events [2,3].

Dexamethasone has emerged as one of the most extensively investigated adjuvants in peripheral nerve blockade. When combined with long-acting local anaesthetics such as ropivacaine, dexamethasone has consistently been associated with prolonged postoperative analgesia, delayed requirement for rescue analgesics, and improved patient comfort. Although its precise mechanism of action remains incompletely understood, proposed mechanisms include suppression of inflammatory mediators, reduction of ectopic neuronal discharge, modulation of potassium channel activity, and attenuation of perineural inflammation. These effects collectively contribute to prolonged sensory blockade and enhanced postoperative pain relief [4,5].

Despite substantial evidence supporting dexamethasone as a nerve block adjuvant, uncertainty persists regarding the optimal route of administration. Perineural administration may provide a more direct local effect and longer analgesic duration; however, concerns regarding potential neurotoxicity have encouraged many clinicians to administer dexamethasone intravenously. Recent randomized controlled trials and systematic reviews have reported conflicting findings, with some demonstrating equivalent efficacy between the two routes and others suggesting modest superiority of perineural administration. Consequently, the choice of administration route remains an area of active clinical interest [5,6].

The present randomized comparative study was undertaken to evaluate the effect of perineural versus intravenous dexamethasone as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block for elective upper limb surgeries. The study evaluated postoperative pain scores, haemodynamic parameters, and adverse effects associated with both routes of dexamethasone administration.

MATERIALS AND METHODS

Study Design and Setting: This prospective, randomized comparative study was conducted in the Department of Anaesthesiology, Pacific Medical College and Hospital, Udaipur, Rajasthan, after obtaining Institutional Ethics Committee approval. Written informed consent was obtained from all participants before enrolment.

Study Population: A total of 72 patients undergoing elective upper limb surgery under ultrasound-guided supraclavicular brachial plexus block were randomly allocated into two equal groups (n = 36 each).

Group RI: Intravenous dexamethasone (8 mg) + perineural normal saline.
Group RP: Perineural dexamethasone (8 mg) + intravenous normal saline.

Inclusion Criteria

- Age 18–60 years
- ASA physical status I or II
- Elective upper limb surgery
- Written informed consent

Exclusion Criteria

- ASA III or IV
- Allergy to study drugs
- Coagulopathy or anticoagulant therapy
- Infection at injection site
- Peripheral neuropathy or severe systemic illness
- Pregnancy or lactation
- Refusal to participate

Study Procedure: Standard monitoring (ECG, NIBP, pulse rate, and SpO2) was applied before block administration. Ultrasound-guided supraclavicular brachial plexus block was performed under aseptic precautions using 0.5% ropivacaine. Group RP received 8 mg perineural dexamethasone, whereas Group RI received 8 mg intravenous dexamethasone according to the randomized allocation.

Outcome Measures

Primary outcomes: Postoperative pain assessment using the Numeric Rating Scale (NRS).

Secondary outcomes: Mean arterial blood pressure (MABP), heart rate, and adverse effects.

Statistical Analysis: Data were analysed using SPSS version 25.0. Continuous variables were expressed as mean ± SD and compared using the Independent Student's t-test, while categorical variables were analysed using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

RESULTS

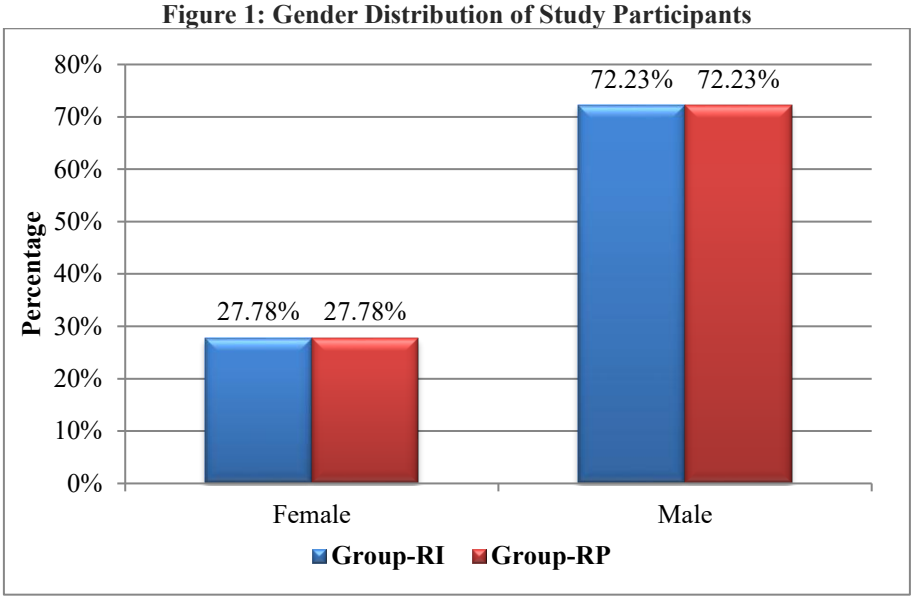
A total of 72 patients were enrolled in the study and were equally randomized into Group RI (n = 36) and Group RP (n = 36). All enrolled participants completed the study and were included in the final analysis. The demographic characteristics, postoperative analgesic outcomes, haemodynamic parameters, and adverse events observed in both groups are presented below.

Table 1: Age-wise Distribution of Study Participants

Age Group	Group-RI	Group-RP
≤20	1(2.78)	2(5.56)
21-30	16(44.45)	13(36.12)
31-40	5(13.89)	7(19.45)
41-50	7(19.45)	8(22.23)
>50	7(19.45)	6(16.67)
Mean±SD	37.87±13.14	36.03±12.77

The age distribution was comparable between the two groups, with no statistically significant difference ($p > 0.05$). This indicates that both groups were demographically similar at baseline.

Figure 1: Gender Distribution of Study Participants



The proportion of male and female patients was similar in both groups, and no statistically significant difference was observed ($p > 0.05$), suggesting comparable gender distribution.

Table 2: Comparison of NRS Score at the Time of Rescue Analgesia between the Study Groups

	Group-RI	Group-RP	p-value
NRS Scale (at time of rescue analgesia)	6.14±0.72	5.89±0.92	0.232

The mean NRS score at the time of rescue analgesia was comparable between the two groups ($p = 0.232$), indicating similar postoperative pain intensity at the time of rescue analgesic requirement.

Table 3: Comparison of Mean Arterial Blood Pressure (MABP) at Different Time Intervals between the Study Groups

	Group-RI	Group-RP	p-value
MABP before drug administration (mmHg)	83.98±12.01	84.09±6.61	0.9610

MABP at 1 min (mmHg)	83.67±6.36	83.78±6.91	0.9440
MABP at 3 min (mmHg)	82.12±7.17	83.25±6.59	0.4850
MABP at 5 min (mmHg)	82.09±7.13	83.12±6.94	0.5370
MABP at 10 min (mmHg)	80.14±7.22	82.95±6.97	0.0980
MABP at 15 min (mmHg)	79.23±7.15	82.39±6.32	0.0509
MABP at 20 min (mmHg)	79.06±6.9	81.98±7.41	0.088

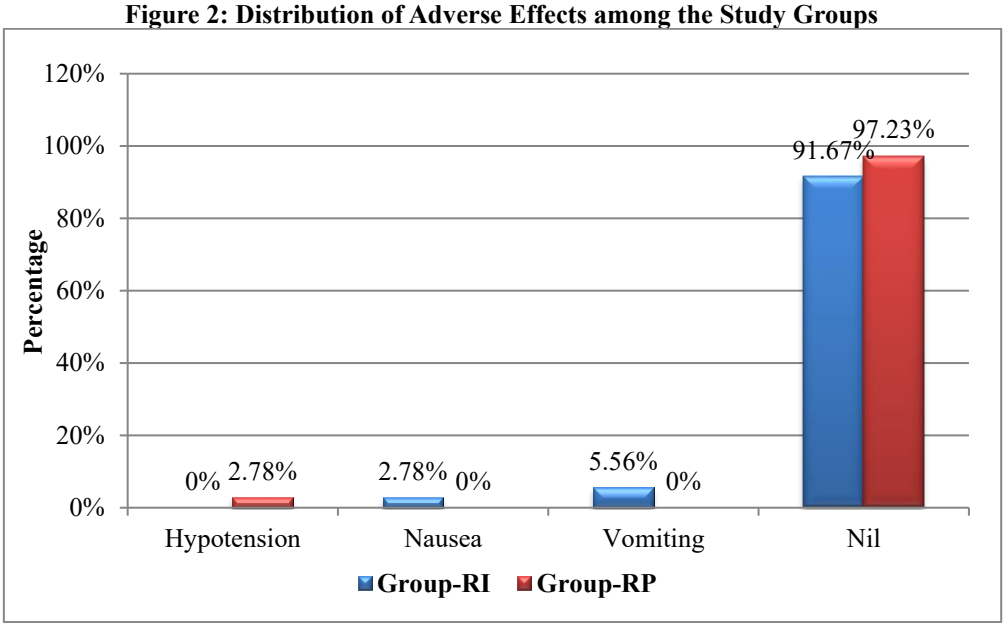
Mean arterial blood pressure remained stable throughout the observation period in both groups, with no statistically significant intergroup differences at any recorded time point.

Table 4: Comparison of Heart Rate at Different Time Intervals between the Study Groups

	Group-RI		Group-RP		p-value
	Mean±SD	p-value	Mean±SD	p-value	
HR before drug administration (bpm)	86.12±16.29	-	82.09±12.93	-	0.249
HR at 1 min (bpm)	86.81±17.14	<0.0001	82.25±12.13	<0.0001	0.197
HR at 3 min (bpm)	85.26±14.91	<0.0001	80.45±12.81	<0.0001	0.149
HR at 5 min (bpm)	81.03±16.7	<0.0001	78.34±12.76	<0.0001	0.444
HR at 10 min (BPM)	80.56±16.48	<0.0001	77.53±11.3	<0.0001	0.366
HR at 15 min (BPM)	79.92±15	<0.0001	75.78±11.06	<0.0001	0.187
HR at 20 min (BPM)	78.89±12.66	<0.0001	77.5±10.09	<0.0001	0.608

Heart rate remained within normal physiological limits in both groups during the perioperative period, and no significant differences were observed between the groups.

Figure 2: Distribution of Adverse Effects among the Study Groups



Only a few minor adverse effects were observed during the study period. The incidence of adverse events was comparable between the two groups, with no serious complications reported.

DISCUSSION

The present randomized comparative study evaluated the effect of perineural versus intravenous dexamethasone as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block for patients undergoing elective upper limb surgeries. Both routes of dexamethasone provided effective postoperative analgesia with stable haemodynamic parameters and a low incidence of adverse effects. The demographic characteristics, postoperative pain scores,

haemodynamic variables, and safety outcomes were comparable between the two groups, indicating that both perineural and intravenous administration are effective and safe adjuvant options for ultrasound-guided supraclavicular brachial plexus block. [7]

Baseline demographic characteristics, including age and gender distribution, were comparable between the study groups, indicating successful randomization and minimizing the possibility of selection bias. Similar baseline characteristics have also been reported by Abdallah et al. and Soni et al., who found no significant demographic differences between patients receiving perineural and intravenous dexamethasone during supraclavicular brachial plexus block. [8,9]

In the present study, postoperative pain assessment using the Numeric Rating Scale (NRS) demonstrated satisfactory analgesia in both groups. Although the NRS scores at the time of rescue analgesia were comparable between the groups, both routes of dexamethasone provided satisfactory postoperative pain control. These findings are consistent with previous studies demonstrating the effectiveness of dexamethasone as an adjuvant in ultrasound-guided supraclavicular brachial plexus block. [10,11]

Haemodynamic parameters, including mean arterial blood pressure and heart rate, remained stable throughout the perioperative period without significant intergroup differences. This suggests that both routes of dexamethasone administration are haemodynamically safe when used as an adjuvant to ropivacaine in ultrasound-guided supraclavicular brachial plexus block. Similar observations have been reported in recent clinical trials and systematic reviews evaluating dexamethasone as a peripheral nerve block adjuvant. [10,12]

The incidence of adverse effects in the present study was low, and no major complications related to either route of dexamethasone administration were observed. This favourable safety profile supports previous evidence indicating that dexamethasone can be safely administered as an adjunct to peripheral nerve blocks when appropriate patient selection and ultrasound guidance are employed. [11,12]

Overall, the findings of the present study suggest that both perineural and intravenous dexamethasone are effective and safe adjuvants to 0.5% ropivacaine for ultrasound-guided supraclavicular brachial plexus block. Comparable postoperative pain scores, haemodynamic stability, and a low incidence of adverse effects support the clinical utility of both routes in patients undergoing elective upper limb surgeries. [7,10,12]

Strengths of the Study

- Prospective randomized comparative design.
- Ultrasound-guided block ensured accurate drug administration.
- Both efficacy and safety outcomes were evaluated.

Limitations of the Study

- Single-centre study.
- Relatively small sample size.
- Long-term follow-up was not performed.

CONCLUSION

Both perineural and intravenous dexamethasone provided effective postoperative analgesia when used as an adjuvant to 0.5% ropivacaine in ultrasound-guided supraclavicular brachial plexus block. The two groups demonstrated comparable postoperative pain scores, haemodynamic stability, and a low incidence of adverse effects. These findings suggest that both routes of dexamethasone administration are safe and effective options for postoperative pain management in patients undergoing elective upper limb surgeries.

Conflict of interest

The authors declare no conflict of interest.

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