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

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2025; 17(1); 104-108

Original Research Article

Comparison of Efficacy of Injection Dexmedetomidine Vs Injection Dexamethasone with Injection Bupivacaine in Interscalene Block for Post-Operative Analgesia in Patients Undergoing Shoulder Surgeries - A Randomised Controlled Trial

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Received: 25-10-2024 / Revised: 23-11-2024 / Accepted: 26-12-2024

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Conflict of interest: Nil

Abstract:

Introduction: Postoperative pain management in shoulder surgeries, such as arthroscopic procedures, is crucial for recovery and early rehabilitation. Interscalene block (ISB) with bupivacaine is effective but limited by its short duration of action. Adjuvants like dexamethasone and dexmedetomidine have shown promise in prolonging analgesia. This randomised controlled trial aimed to compare the efficacy and safety of these adjuvants in ISB.

Materials and Methods: The study was conducted at Mamata Medical College, Khammam, India, with 60 patients undergoing elective shoulder surgeries. Participants were randomised into two groups: Group A received bupivacaine 0.5% (20 mL) with 10 mcg of dexmedetomidine, and Group B received bupivacaine 0.5% (20 mL) with 8 mg of dexamethasone. Pain was assessed using the Visual Analog Scale (VAS) at 6, 12, and 24 hours postoperatively. The duration of analgesia, adverse effects, and patient satisfaction were recorded. Statistical analysis was performed using SPSS version 25, with $p < 0.05$ considered significant.

Results: Group A demonstrated a significantly longer analgesic duration (14.5 ± 2.3 hours vs. 12.8 ± 2.1 hours, $p < 0.001$) and lower VAS scores at 6, 12, and 24 hours postoperatively ($p < 0.05$). Patient satisfaction was higher in Group A (8.9 ± 0.8 vs. 8.4 ± 1.0, $p = 0.005$). Adverse effects were mild and comparable between groups, with no severe complications.

Conclusion: Dexmedetomidine is superior to dexamethasone as an adjuvant to bupivacaine in ISB, offering longer analgesic duration, better pain control, and comparable safety. These findings support its use in postoperative pain management for shoulder surgeries.

Keywords: Dexmedetomidine, Dexamethasone, Bupivacaine, Shoulder Surgeries.

Introduction

Arthroscopic shoulder surgery is frequently performed for conditions such as rotator cuff injuries, shoulder impingement, and instability. Effective postoperative pain management is critical for enhancing recovery, patient satisfaction, and early rehabilitation.[1] Interscalene block (ISB) has emerged as the gold standard for managing perioperative pain in these surgeries.

This regional anaesthesia technique not only reduces opioid requirements but also minimises associated side effects such as nausea, vomiting, and respiratory depression. [2] However, the analgesic effects of a single injection of local anaesthetics in ISB are often limited to approximately 14 hours, necessitating strategies to extend its duration. [3] To address this challenge, the addition of perineural adjuvants to local anaesthetics has been widely studied. Dexamethasone, a potent glucocorticoid, and dexmedetomidine, a selective alpha-2 adrenergic receptor agonist, have shown promise in prolonging the duration of analgesia when used as adjuvants. [5-8]

Dexamethasone is believed to reduce nociceptive C-fiber activity through local vasoconstriction, direct glucocorticoid receptor effects, and systemic anti-inflammatory actions. [9] Dexmedetomidine exerts its effects by blocking hyperpolarization-

activated cation currents and substance P release in the dorsal root ganglion, thereby enhancing analgesia. These agents also reduce postoperative opioid requirements, further improving safety and recovery. [10] Several studies have demonstrated the efficacy of dexamethasone and dexmedetomidine as adjuvants in peripheral nerve blocks. Dexamethasone has been shown to prolong the duration of nerve block by reducing inflammation and neural activity [11] while dexmedetomidine enhances the quality and duration of the block without neurotoxic effects. [12] Despite extensive research on their individual effects, direct comparisons between dexamethasone and dexmedetomidine in the context of ISB remain limited. Some reports suggest that dexmedetomidine offers superior analgesia compared to dexamethasone due to its sedative and hemodynamic stabilising properties. [13] However, variations in study methodologies, doses, and modes of administration make it challenging to draw definitive conclusions. This study aims to address the existing gap by directly comparing the efficacy of dexamethasone and dexmedetomidine as adjuvants to bupivacaine in ISB for postoperative analgesia in patients undergoing shoulder surgeries. By evaluating the Duration of Analgesia, Pain Scores, Adverse Effects, Complications and Patient Satisfaction Scores, this randomized controlled trial seeks to determine the optimal adjuvant for enhancing ISB's analgesic profile. The findings will provide valuable insights for clinicians seeking to improve perioperative pain management and patient outcomes in shoulder surgery.

Materials and Methods

This randomized, controlled trial was conducted at Mamata Medical College in Khammam, India, from July 2023 to July 2024. It aimed to compare the efficacy of an interscalene block for postoperative analgesia in shoulder surgery, using Bupivacaine 0.5% (Heavy) combined with either Dexmedetomidine or Dexamethasone. Ethical approval was obtained, and informed consent was secured from all participants.

Sixty patients aged 18 to 60 years, classified as ASA physical status I or II and scheduled for elective shoulder surgery under general anaesthesia, were enrolled. Exclusions included allergies to the study drugs, coagulopathy, local infection at the injection site, or pre-existing neuropathy. Participants were randomly assigned into two groups: Group A received 20 mL of Bupivacaine 0.5% (Heavy) with 10 mcg of Dexmedetomidine, and Group B received 20 mL of Bupivacaine 0.5% (Heavy) with 8 mg of Dexamethasone. The interscalene block was administered 30 minutes before surgery under ultrasound guidance. Patients were monitored for hemodynamic stability and adverse events during the surgery. Postoperative pain was measured using the Visual Analog Scale (VAS) at 6, 12, and 24 hours, and the duration of analgesia was recorded as the time until the first request for rescue analgesia. Secondary outcomes included adverse effects such as nausea and hypotension and patient satisfaction scores on a 10-point scale. Data were analysed using SPSS version 25, with a significance threshold of $p < 0.05$.

Results

The demographic and baseline characteristics of the participants were similar between the two groups. The mean age of patients in Group A was 45.3 ± 9.8 years, while in Group B, it was 46.7 ± 10.2 years ($p = 0.622$).

The gender distribution was also comparable, with a male-to-female ratio of 18:12 in Group A and 19:11 in Group B ($p = 0.791$). The mean weight of participants in Group A was 65.2 ± 8.1 kg, compared to 66.5 ± 7.9 kg in Group B ($p = 0.548$). Both groups exhibited a similar distribution of ASA grades, with no statistically significant differences observed ($p = 0.775$). (Table 1)

Table 1: Demographic and Baseline Characteristics of Participants

Parameter	Group A (n=30)	Group B (n=30)	p-value
Age (years), Mean ± SD	45.3 ± 9.8	46.7 ± 10.2	0.622
Gender (Male: Female)	18:12	19:11	0.791
Weight (kg), Mean ± SD	65.2 ± 8.1	66.5 ± 7.9	0.548
ASA Grade (I/II)	22/8	21/9	0.775

Group A showed a significantly longer duration of analgesia compared to Group B, with a mean duration of 14.5 ± 2.3 hours versus 12.8 ± 2.1 hours, respectively ($p < 0.001$). Pain scores, as measured using the Visual Analog Scale (VAS), were significantly lower in Group A at all time points. At 6 hours postoperatively, the mean VAS score for Group A was 1.2 ± 0.6, while for Group B it was 2.1 ± 0.8 ($p = 0.001$). Similarly, the VAS scores at 12 and 24 hours were lower in Group A, with scores of 2.8 ± 0.7 and 4.5 ± 1.1, compared to Group B's scores of 3.5 ± 0.9 and 5.3 ± 1.2. These differences were statistically significant ($p = 0.004$ and $p = 0.047$, respectively). (Table 2)

Table 2: Duration of Analgesia and Pain Scores

Parameter	Group A (n=30)	Group B (n=30)	p-value
Duration of Analgesia (hours)	14.5 ± 2.3	12.8 ± 2.1	< 0.001
VAS Score at 6 hours (Mean ± SD)	1.2 ± 0.6	2.1 ± 0.8	0.001
VAS Score at 12 hours (Mean ± SD)	2.8 ± 0.7	3.5 ± 0.9	0.004
VAS Score at 24 hours (Mean ± SD)	4.5 ± 1.1	5.3 ± 1.2	0.047

The adverse effects reported were mild and similar between the two groups. Bradycardia occurred in 10% of patients in Group A and in 3.3% of those in Group B (p = 0.301).

Nausea and vomiting were observed in 6.7% of patients in Group A and 13.3% in Group B (p = 0.389). Local site reactions were minimal, affecting 3.3% of patients in Group A and 6.7% in Group B (p = 0.554). Hypotension was noted in 6.7% of patients in Group A and in 3.3% of those in Group B (p = 0.554).

Overall, these findings suggest that both interventions were well tolerated, with no severe complications reported. (Table 3)

Table 3: Adverse Effects and Complications

Adverse Effects/Complications	Group A (n=30)	Group B (n=30)	p-value
Bradycardia	3 (10%)	1 (3.3%)	0.301
Nausea/Vomiting	2 (6.7%)	4 (13.3%)	0.389
Local Site Reaction	1 (3.3%)	2 (6.7%)	0.554
Hypotension	2 (6.7%)	1 (3.3%)	0.554

Patient satisfaction was significantly higher in Group A, with a mean score of 8.9 ± 0.8, compared to 8.4 ± 1.0 in Group B (p = 0.005). This increased satisfaction is due to the longer-lasting analgesic effect and lower pain scores from the Bupivacaine and Dexmedetomidine combination. Group A showed better analgesic efficacy and patient satisfaction while maintaining a similar safety profile to Group B. (Table 4)

Table 4: Patient Satisfaction Scores

Satisfaction Score (0-10)	Group A (n=30)	Group B (n=30)	p-value
Mean ± SD	8.9 ± 0.8	8.4 ± 1.0	0.005

Discussion

The present randomised controlled trial (RCT) investigated the comparative efficacy of dexmedetomidine and dexamethasone as adjuvants to bupivacaine in interscalene blocks for postoperative analgesia in shoulder surgeries. The study demonstrated that dexmedetomidine provided a significantly longer duration of analgesia, with a mean duration of 14.5 ± 2.3 hours compared to 12.8 ± 2.1 hours with dexamethasone (p < 0.001). Pain scores assessed using the Visual Analog Scale (VAS) were consistently lower in the dexmedetomidine group at 6, 12, and 24 hours postoperatively. Adverse effects were mild and comparable between the two groups, highlighting the safety and tolerability of both agents.

These findings are in line with existing literature, which consistently shows the superior efficacy of dexmedetomidine in prolonging the duration of analgesia and enhancing pain control. Vorobeichik et al. [14] reported that dexmedetomidine extended sensory block duration by at least 63% compared to controls, while Margulis R et al. [15] noted its ability to delay the time to first postoperative analgesic request. The reduced VAS scores observed in this study are also consistent with the findings of Kumar Chaurasiya M et al. [16] and Sane S et al. [17] who emphasised the role of dexmedetomidine in lowering postoperative pain scores through mechanisms such as norepinephrine suppression and alpha-2 adrenergic agonism. The comparable adverse effect profiles between the two adjuvants mirror the observations of Rodrigues D et al. [18] who found no significant differences in hemodynamic stability and safety when comparing dexmedetomidine and dexamethasone.

While dexamethasone effectively prolonged analgesic duration and reduced pain scores, its performance was slightly inferior to dexmedetomidine in this study. Wei XM et al. [19] similarly highlighted the additional benefits of dexmedetomidine, including reduced opioid consumption and improved pain control, making it a more effective adjuvant. Moreover, studies exploring the combination of dexamethasone and dexmedetomidine, such as Rodrigues D et al. [18] found no added advantage over the use of dexamethasone alone, further supporting the use of dexmedetomidine as a single agent.

The findings of this study have significant clinical implications, particularly in improving postoperative pain management in shoulder surgeries. Dexmedetomidine's extended analgesic duration, superior pain control, and favorable safety

profile make it an attractive adjuvant to bupivacaine for interscalene blocks. These benefits can contribute to better patient outcomes, reduced opioid requirements, and enhanced recovery experiences. However, it is important to acknowledge the need for larger multicenter trials to validate these results and evaluate the long-term safety of dexmedetomidine. Cost-effectiveness studies could also provide further insights into its utility in various clinical settings. In conclusion, dexmedetomidine demonstrates superior efficacy over dexamethasone as an adjuvant to bupivacaine in interscalene blocks, making it a valuable tool in multimodal postoperative pain management strategies for shoulder surgeries. The evidence from this study, combined with findings from existing literature, establishes dexmedetomidine as a safe and effective option for enhancing postoperative analgesia.

Conclusion

Dexmedetomidine outperforms dexamethasone as an adjuvant to bupivacaine in interscalene blocks for shoulder surgeries, offering longer analgesic duration, superior pain control, and comparable safety. These findings highlight dexmedetomidine as a more effective choice for enhancing postoperative analgesia, supporting its role in multimodal pain management strategies to improve patient outcomes.

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