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Research Article

COMPARATIVE STUDY OF BUPIVACAINE WITH DEXMEDETOMIDINE AND BUPIVACAINE ALONE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT

Objective: The objective is to compare the efficacy of bupivacaine with dexmedetomidine and bupivacaine alone when used for supraclavicular brachial plexus block in patients undergoing upper limb surgeries.

Methods: This was a comparative study conducted in the department of anesthesiology of a tertiary care medical college. 80 patients scheduled for upper limb surgeries under supraclavicular brachial plexus block were included on the basis of a predefined inclusion and exclusion criteria. Patients were divided into 2 groups depending on whether they received only Bupivacaine (Group B) or Bupivacaine and Dexmedetomidine (Group BD) for supraclavicular block. The onset and duration of sensory as well as motor blockade, intensity of Pain as assessed by Visual Analog Score, requirement of rescue analgesia, hemodynamic profile, and side effects were compared in both the groups. For statistical purpose $p<0.05$ was taken as statistically significant.

Results: Group BD exhibited significantly faster onset and longer duration of sensory blockade compared to Group B. Group BD also showed significantly faster onset and longer duration of motor blockade compared to Group B. Moreover, Group BD had significantly longer analgesia duration (614.84±52.02 min) compared to Group B (352.62±32.46 min). The hemodynamic parameters, including mean heart rate and mean arterial pressure, were not significantly different between the groups. In addition, side effects such as bradycardia and hypotension were observed in Group BD, but these differences were not statistically significant.

Conclusion: Dexmedetomidine, when used as an adjuvant to bupivacaine during supraclavicular brachial plexus block in upper limb surgeries provided longer-lasting analgesia, and reduced pain intensity as compared to Bupivacaine alone with a comparable side effect profile.

Keywords: Brachial plexus block, Upper limb surgeries, Bupivacaine, Dexmedetomidine.

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INTRODUCTION

Regional anesthesia, including peripheral nerve blocks, has evolved to become a cornerstone in modern anesthesia practice. These techniques offer several advantages over general anesthesia, such as reduced systemic side effects, improved postoperative pain control, faster recovery, and earlier patient mobilization [1]. Among the various peripheral nerve block techniques, the supraclavicular brachial plexus block is a well-established and frequently used procedure for surgeries of the upper limb [2]. Supraclavicular brachial plexus block is a widely employed technique that provides excellent anesthesia for upper limb surgeries. This technique has been an integral part of modern anesthesia practice, offering numerous benefits, such as avoiding the risks and complications associated with general anesthesia [3].

Bupivacaine, a widely employed local anesthetic, plays a pivotal role in the context of supraclavicular brachial plexus blocks. This long-acting amide local anesthetic is favored for its reliable sensory and motor block characteristics, making it an integral component of upper limb regional anesthesia [4]. When administered in the supraclavicular brachial plexus region, bupivacaine effectively produces anesthesia by blocking nerve conduction, thereby rendering the upper extremity insensate. Its slow onset and prolonged duration of action are particularly advantageous in surgical settings, as they contribute to extended postoperative pain relief, reduced opioid requirements, and improved patient comfort [5]. While bupivacaine has demonstrated its efficacy and safety in brachial plexus blocks, ongoing research explores ways to further enhance its performance through the addition of adjuvants like dexmedetomidine [6].

Dexmedetomidine, an alpha-2 adrenergic agonist, has garnered significant attention as an adjuvant to local anesthetics in brachial plexus blocks due to its multifaceted pharmacological properties [7]. It acts through a selective activation of alpha-2 receptors in the central and peripheral nervous systems. Its mechanism of action involves the inhibition of norepinephrine release from presynaptic nerve terminals, resulting in sympatholysis and reduced peripheral nerve activity. This, in turn, leads to several advantageous effects when combined with local anesthetics for brachial plexus blocks [8]. Dexmedetomidine enhances the quality and duration of sensory and motor blockade. By decreasing nerve conduction and potentiating the effect of local anesthetics, it promotes more profound anesthesia and prolonged pain relief, reducing the need for postoperative opioids. Secondly, its sedative properties can provide patient comfort, reducing anxiety and discomfort during the procedure and postoperatively [9]. Thirdly, dexmedetomidine exhibits a favorable hemodynamic profile, resulting in stable blood pressure and heart rate, which can be particularly beneficial in patients with comorbidities or those at risk of hemodynamic instability [10]. Overall, the addition of dexmedetomidine to local anesthetics in brachial plexus blocks offers the potential for superior anesthesia, prolonged postoperative pain control, and improved perioperative patient experience, making it an appealing adjuvant in modern regional anesthesia practice [11] Previous studies have demonstrated the effectiveness of dexmedetomidine when added to local anesthetics in various regional anesthesia techniques, including brachial plexus blocks. However, there is a paucity of research comparing bupivacaine with dexmedetomidine to bupivacaine alone in supraclavicular brachial plexus block specifically [12].

We undertook this study to compare the efficacy of bupivacaine with dexmedetomidine and bupivacaine alone when used for supraclavicular brachial plexus block in patients undergoing upper limb surgeries.

Aims and objectives

To compare the efficacy of bupivacaine with dexmedetomidine and bupivacaine alone when used for supraclavicular brachial plexus block in patients undergoing upper limb surgeries.

METHODS

This was a comparative case series study in which 80 patients scheduled for upper limb surgeries under brachial plexus block were included on the basis of predefined inclusion and exclusion criteria. The study was conducted in the department of anesthesiology of a tertiary care medical institute and institutional ethical committee approved the study. The sample size was calculated on the basis of pilot studies done on the subject of brachial plexus block for upper limb surgeries assuming 90% power and 95% confidence interval, the sample size required was 36 patients per arm (total 72). Based on the central limit theorem, the sample size was calculated to be sufficient if it was more than 36 thus, 40 patients were included in each group. Computer-based randomization was used for randomization and anesthetists were blind to allocation information.

Group B: Patients undergoing upper limb surgeries under supraclavicular brachial plexus block and with 0.25% Bupivacaine (34 mL) plus 1 mL normal saline to make a total volume of 35 mL.

Group bupivacaine and dexmedetomidine (BD): Patients undergoing upper limb surgeries under supraclavicular brachial plexus block and with 0.25% Bupivacaine (34 mL) plus 30 µg dexmedetomidine (diluted in normal saline) to make a total volume of 35 mL.

Continuous monitoring of vital signs, including pulse rate, blood pressure, respiratory rate, and peripheral oxygen saturation (SpO_2), was initiated and was monitored at every 5-min intervals during the first 30 min, after which monitoring was conducted at 15-min intervals up to 180 min after brachial plexus block. A reduction in systolic blood pressure by more than 30% from baseline or a measurement below 90 mmHg was considered indicative of hypotension.

Satisfactory anesthesia was defined by the absence of any reported pain or discomfort during the intraoperative period and the absence of the need for intraoperative sedation. Postoperatively, patients were closely monitored in the recovery room and on the postoperative ward. To assess the duration of analgesia, a 0–10 Visual Analog Score (VAS) for pain was used at 30-min intervals for the initial 10 h and then hourly for up to 24 h. When patients reported a VAS score above 5, it was considered that the analgesic effects of the administered drugs had ceased, at which point a rescue analgesic (intramuscular Diclofenac at a dosage of 1–1.5 mg/kg) was administered. The onset of sensory and motor block as well as duration of sensory and motor block was noted and compared in both the groups. The total doses of rescue analgesia and time to request 1st dose of rescue analgesia was noted and compared in both the groups.

Data analysis was done using SPSS 21.0 software. Group comparison was made using independent sample t-test for continuously distributed data, and Chi-square test for categorical data. Repeated observations were compared using paired t-test or repeated measures analysis of variance as applicable. $p<0.05$ was taken as statistically significant.

Inclusion criteria

1. Patients undergoing upper limb surgeries under brachial plexus blocks
2. ASA Grade I and II
3. Patients who gave informed and written consent to be part of the study.

Exclusion criteria

1. Those who refused consent to be part of the study
2. ASA grade III and IV patients
3. Patients with peripheral neuropathy
4. Patients with known bleeding or coagulation defect disorders
5. Patients with known allergy to local anesthetic drugs.

RESULTS

In this study of 80 patients divided into 2 groups, there was an overall male preponderance in Group B as well as Group BD. The overall M: F ratio was found to be 1:0.33. The mean age, weight, height, and body mass index (BMI) were comparable in two groups. There was no statistically significant difference ($p>0.05$) among them in any of these parameters (Table 1).

The analysis of ASA grades showed that in Group B 27 (67.50%) patients belonged to ASA I whereas 13 (32.50%) patients belonged to ASA II. In Group BD, 28 (70%) and 12 (30%) patients belonged to ASA I and ASA II, respectively. The mean surgery time in Group B and Group BD was found to be 58.68±9.88 min and 60.70±8.90 min, respectively. Both the groups were found to be comparable in terms of ASA grades and duration of surgery with no statistically significant difference (Table 2).

The comparison of the mean time of onset of sensory blockade as well as duration of sensory blockade showed that the mean time for onset of sensory blockade was 12.42±0.82 min and 9.12±0.46 min in Group B and Group BD, respectively, whereas the mean duration of sensory blockade was 198.62±12.02 and 482.70±18.22 in Group B and Group BD, respectively. The onset of sensory blockade was early in Group BD as compared to Group B and duration of sensory blockade was more in Group BD as compared to Group B. The difference was statistically highly significant ($p<0.0001$) (Table 3).

The comparison of the mean time of onset of motor blockade as well as duration of motor blockade showed that the mean time for

Table 1: Mean age, weight, height and BMI of the studied cases

Characteristics	Group B	Group BD	p-value
Gender			
Males	29	31	p=0.7968
Females	11	9	
Mean age (years)	24.72±2.98	23.68±2.76	p=0.1094
Weight (kg)	62.54±6.98	60.72±7.12	p=0.2518
Height (cm)	152.1±4.1	153.60±3.4	p=0.0809
BMI (kg/m^2)	23.68±2.02	24.10±1.98	p=0.3506

BMI: Body mass index

Table 2: ASA grades and Duration of surgery in studied cases

ASA grade and duration of surgery	Group B	Group BD	p-value
ASA grades			
ASA I	27	28	p=1.00
ASA II	13	12	
Duration of surgery (min)	58.68±9.88	60.70±8.90	p=0.33

Table 3: Onset and duration of sensory blockade in studied cases

Onset and duration of sensory blockade	Group B	Group BD	p-value
Onset of sensory blockade	12.42±0.82	9.12±0.46	p<0.0001*
Duration of sensory blockade	198.62±12.02	482.70±18.22	p<0.0001*

*Highly Significant

onset of motor blockade was 19.22±1.02 min and 14.12±1.42 min in Group B and Group BD, respectively, whereas the mean duration of motor blockade was 272.74±16.36 and 626.40±28.62 in Group B and Group BD, respectively. Onset as well as duration of motor blockade was less in Group B as compared to Group BD and the difference was statistically highly significant (p<0.0001) (Table 4).

The comparison of the mean duration of analgesia showed that it was 352.62±32.46 min and 614. 84±52.02 in Group B and Group BD, respectively. The mean duration of analgesia was more in Group BD as compared to Group B and the difference was statistically highly significant (p<0.0001) (Table 5).

The analysis of pain as assessed by VAS score showed that the intensity of pain was comparable in both the groups till 2 h post-operatively. From 150 min to 270 min postoperatively, mean VAS score was less in patients of Group BD as compared to patients in Group B. The difference was found to be statistically highly significant (p<0.0001) (Table 6).

The analysis of mean doses of rescue analgesia showed that in Group B, the mean analgesic doses required was 2.25±0.63 whereas the mean analgesic doses required in Group BD was 1.75±0.54. The mean doses of rescue analgesia were less in Group BD as compared to Group B and the difference was found to be statistically significant (p<0.0003) (Table 7).

The analysis of hemodynamic parameters in studied cases showed that heart rate, respiratory rate, and SPO_2 in both the groups were comparable in both the groups. Mean heart rate and mean arterial pressure were less in Group BD as compared to Group B however the difference was not found to be statistically significant (p>0.05). In Group BD, 2 patients developed bradycardia, and 1 patient developed hypotension. In Group B, hemodynamic parameters were normal in all the cases (Fig. 1).

The analysis of side effects in both the groups showed that in Group B 2 (5%) patients developed postoperative nausea and vomiting (PONV). IN the remaining 38 patients there was no side effect. In Group BD, 2 (5%) patients developed bradycardia, 1 (2.5%) patient developed hypotension and 3 (7.5%) patients developed post-operative nausea and vomiting. Although the side effects were seen in more patients in Group BD as compared to Group B the difference was statistically not significant (p=0.2633). (Fig. 2)

Table 4: Onset and duration of motor blockade in studied cases

Onset and duration of motor blockade	Group B	Group BD	p-value
Onset of motor blockade (in min)	19.22±1.02	14.12±1.42	p<0.0001*
Duration of motor blockade (in min)	272.74±16.36	626.40±28.62	p<0.0001*

*Highly Significant

Table 5: Comparison of mean duration of analgesia in studied cases

Duration of analgesia	Group B	Group BD	p-value
Mean duration of analgesia (in min)	352.62±32.46	614. 84±52.02	p<0.0001*

*Highly Significant

Table 6: Comparison of mean VAS scores in both the groups

Time interval (min)	Group B (mean VAS)	Group BD (mean VAS)	p-value
0	0	0	-
5	0	0	-
10	0	0	-
15	0	0	-
20	0	0	-
30	0.24+0.12	0.22+0.14	0.494
60	0.32+0.18	0.30+0.20	0.6396
90	0.46+0.22	0.42+0.24	0.4395
120	0.82+0.44	0.78+0.40	0.6717
150	3.14+0.62	1.90+0.50	<0.0001*
180	3.42+0.92	2.12+0.88	<0.0001*
210	3.78+1.02	2.60+0.98	<0.0001*
240	4.80+1.32	3.2+1.12	<0.0001*
270	5.12+1.40	3.8+1.2	<0.0001*
300	5.4+1.62	5.2+1.4	0.5564

VAS: Visual Analog Score, *Highly Significant

DISCUSSION

In this comparative study of 80 patients undergoing upper limb surgeries under brachial plexus block, both groups exhibited an overall male preponderance with an M: F ratio of 1:0.33. Demographic parameters, including mean age, weight, height, and BMI, were similar between the two groups, and no statistically significant differences were found. ASA grade analysis showed comparable distributions in ASA I and ASA II patients between the groups. In addition, there was no significant difference in the duration of surgery, with Group B having a mean surgery time of 58.68±9.88 min, and Group BD having a mean surgery time of 60.70±8.90 min.

In this study, the comparison of sensory and motor blockade between Group B and Group BD showed significant differences. The onset of sensory blockade was faster in Group BD (9.12±0.46 min) compared to Group B (12.42±0.82 min), while the duration of sensory blockade was considerably longer in Group BD (482.70±18.22 min) than in Group B (198.62±12.20 min), with highly significant statistical differences observed. Similarly, the onset of motor blockade was quicker in Group BD (14.12±1.02 min) than in Group B (19.22±1.02 min), and the duration of motor blockade was significantly prolonged in Group BD (626.40±28.62 min) compared to Group B (272.74±16.36 min). Agarwal *et al*. conducted a study to analyze the effect of adding dexmedetomidine to a 30 mL solution of 0.325% bupivacaine in supraclavicular brachial plexus block [13]. Fifty patients posted for upper limb surgeries were enrolled in this study. Patients were divided into two groups on the basis of whether bupivacaine or BD was used for supraclavicular brachial plexus block. The study found that the onset times for sensory and motor blocks were significantly shorter in bupivacaine with dexmedetomidine group as compared to Bupivacaine group (p<0.001), while the duration of blocks was significantly longer (p<0.001) in BD group. The findings of this study were similar to our study. Similar findings were also reported by the authors such as Aksu and Bicer [14] and Sane *et al.* [15].

In our study, Group BD had a significantly longer mean duration of analgesia (614. 84±52.02 min) compared to Group B (352.62±32.46 min). The pain intensity, assessed using VAS scores, was similar in both groups until 2 h postoperatively, but from 150 to 270 min postoperatively, Group BD had significantly lower mean VAS scores than Group B (p<0.0001). In addition, the mean doses of rescue analgesia required were significantly lower in Group BD (1.75±0.54) compared to Group B (2.25±0.63). Waindeskar *et al*. conducted a study of 60 patients posted for upper limb surgeries were enrolled [16]. Patients were divided into two groups, the control group B and the study Group BD. In Group B (n=30), 30 mL of 0.325% bupivacaine and normal saline; and in Group BD (n=30), 30 mL of 0.325% bupivacaine and 1 µg/kg dexmedetomidine was given for supraclavicular brachial plexus block. The study found that the duration of analgesia was significantly longer in BD group than B group (p<0.0001). Similar findings were also reported by the authors such as Nazir and Jain [17] and Hussain *et al*. [18].

Table 7: Comparison of mean doses of rescue analgesia required in both the groups

Doses of Inj. diclofenac	Group B (mean VAS)	Group BD (mean VAS)	p-value
1 (75 mg)	04 (04 doses)	12 (12 doses)	p=0.0003
2 (150 mg)	22 (44 doses)	26 (52 doses)	Significant
3 (225 mg)	14 (42 doses)	02 (04 doses)	
Mean doses of rescue analgesia	2.25±0.63	1.75±0.54	

VAS: Visual analogue score

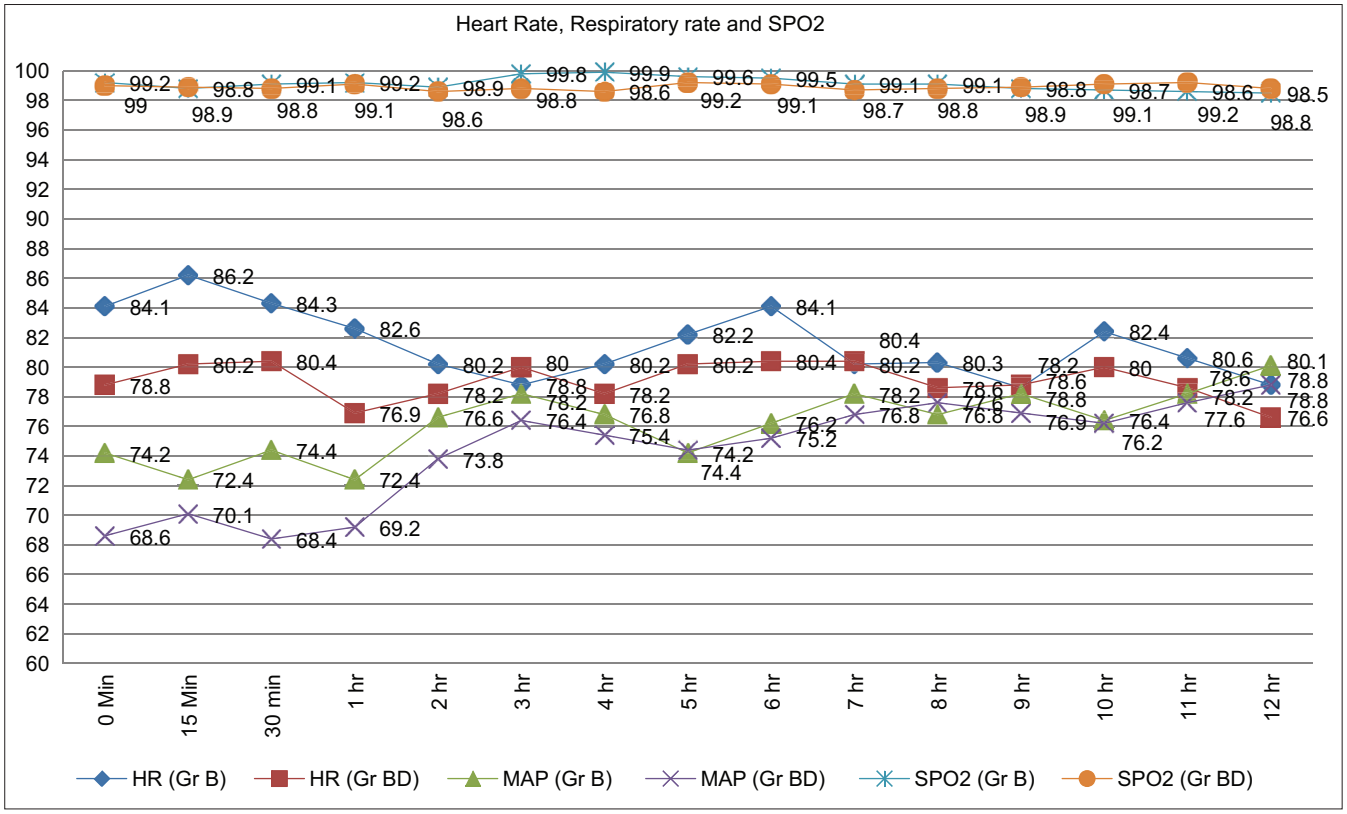

Fig. 1: Comparison of hemodynamic profile of patients in both the groups

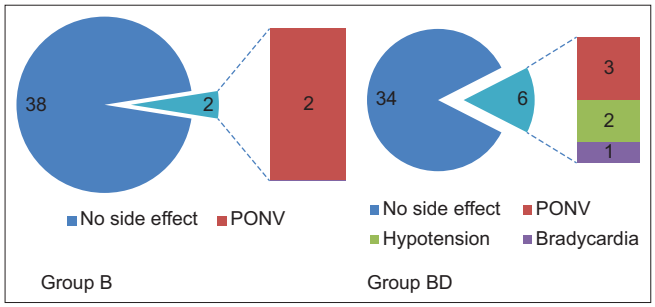

Fig. 2: Comparison of side effects in studied cases

The hemodynamic parameters, including heart rate, respiratory rate, and SPO_2, were comparable in both groups. Mean heart rate and mean arterial pressure were slightly lower in Group BD compared to Group B, but this difference was not statistically significant (p>0.05). In Group BD, 2 patients experienced bradycardia, and 1 patient had hypotension, while all patients in Group B had normal hemodynamic parameters. When it came to side effects, 5% of patients in both Group B and Group BD developed PONV. In addition, in Group BD, 5% of patients experienced bradycardia, 2.5% had hypotension, and 7.5% had PONV. Although side effects were more common in Group BD, the difference was not statistically significant (p=0.2633). Similar hemodynamic and side effects profile was also reported by the authors such as Bharti *et al.* [19] and Ping *et al.* [20].

CONCLUSION

Dexmedetomidine, when used as an adjuvant to bupivacaine during supraclavicular brachial plexus block in upper limb surgeries, demonstrated superior results compared to when Bupivacaine was used alone. It provided longer-lasting analgesia, reduced pain intensity, and required fewer rescue analgesics, with no significant differences in hemodynamic parameters or side effects observed.

CONFLICT OF INTEREST

None.

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