Original Research

EFFECT OF INTRATHECAL DEXMEDETOMIDINE AS AN ADJUVANT TO BUPIVACAINE IN SPINAL ANESTHESIA: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Background: Spinal anesthesia using bupivacaine is widely employed for lower abdominal and lower limb surgeries. However, its limited duration of action often necessitates the use of adjuvants. Dexmedetomidine, a highly selective α2-adrenergic agonist, has shown promising results in prolonging sensory and motor blockade.
Aim: To evaluate the efficacy of intrathecal dexmedetomidine as an adjuvant to bupivacaine in spinal anesthesia.
Methods: A prospective comparative study was conducted on 80 patients randomly allocated into two groups. Group A received intrathecal hyperbaric bupivacaine alone, while Group B received bupivacaine combined with dexmedetomidine. Outcomes included onset time, duration of sensory and motor block, postoperative analgesia, and hemodynamic parameters.
Results: The baseline demographic characteristics were comparable between the two groups, indicating no significant difference ($p>0.05$). The addition of dexmedetomidine significantly prolonged sensory and motor block duration and improved postoperative analgesia ($p < 0.05$) without major complications. VAS pain scores were consistently lower in Group B at all postoperative time intervals compared to Group A.
Conclusion: Intrathecal dexmedetomidine is an effective and safe adjuvant to bupivacaine, enhancing the quality and duration of spinal anesthesia.

Keywords: Dexmedetomidine, Bupivacaine, Spinal Anesthesia, Intrathecal Adjuvant, Analgesia.

INTRODUCTION

Spinal anesthesia is commonly employed for lower abdominal and lower limb surgeries due to its simplicity, rapid onset, and reliable intraoperative conditions [1]. Despite these advantages, its relatively limited duration of action often necessitates the use of supplementary analgesia, particularly in prolonged procedures and during the postoperative period. Bupivacaine is the most commonly used local anesthetic for spinal anesthesia because of its favorable sensory and motor blocking properties. However, its duration of action may not be sufficient for extended surgeries, and early regression of analgesia can lead to discomfort in the postoperative phase [2].

To address these limitations, various intrathecal adjuvants such as opioids, clonidine, and other α2-adrenergic agonists have been investigated to enhance the quality and duration of spinal blockade [3]. Dexmedetomidine, a highly selective α2-adrenergic receptor agonist, has gained increasing attention as a potential intrathecal adjuvant. It exerts its effects by reducing the release of norepinephrine and inhibiting pain signal transmission at the spinal level, thereby prolonging both sensory and motor blockade [4]. Compared to clonidine, dexmedetomidine offers greater receptor selectivity, which may contribute to improved efficacy with a relatively favorable side effect profile [5]. Recent clinical studies and systematic reviews have demonstrated that the addition of dexmedetomidine to intrathecal bupivacaine significantly prolongs the duration of anesthesia and improves postoperative analgesia without causing major adverse effects [6]. However, variations in dosing, study design, and patient populations across studies highlight the need for further evaluation to establish its optimal use in routine clinical practice.

Therefore, the present study was undertaken to assess the efficacy and safety of intrathecal dexmedetomidine as an adjuvant to bupivacaine in spinal anesthesia.

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MATERIALS AND METHODS

This prospective comparative study was conducted in the Department of Anesthesiology at Mahavir Institute of Medical Sciences, Bhopal, Madhya Pradesh, over a period of six months. A total of 80 patients scheduled for elective lower abdominal and lower limb surgeries under spinal anesthesia were included in the study. Patients were randomly allocated into two equal groups of 40 each using a computer-generated randomization sequence. Group A received 3 ml of 0.5% hyperbaric bupivacaine, while Group B received 3 ml of 0.5% hyperbaric bupivacaine combined with 5 µg dexmedetomidine intrathecally. The sample size was calculated based on previous studies, considering a confidence level of 95% and statistical power of 80% to detect a significant difference between the groups.

Inclusion Criteria

- Age 18–60 years
- ASA grade I & II
- Elective lower abdominal/lower limb surgery
- Patient consent

Exclusion Criteria

- ASA grade III & IV
- Coagulopathy
- Infection at injection site
- Known allergy to study drugs
- Severe cardiac/respiratory disease

Parameters Assessed: the following parameters were assessed;-

- Onset of sensory block
- Duration of sensory block
- Duration of motor block
- Time to first analgesic request
- Hemodynamic parameters

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The Student's unpaired t-test was used to compare continuous variables between the two groups, and the Chi-square test was applied for categorical data. A p-value of less than 0.05 was considered statistically significant.

Ethical Approval: The study was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participants.

RESULTS

All enrolled patients completed the study and were included in the final analysis. The baseline demographic characteristics were comparable between the two groups, indicating no significant difference (p>0.05).

Table 1: Demographic Profile among Study Patients

Parameter	Group A	Group B	p-value
Age (years)	38.4 ± 10.2	39.1 ± 9.8	>0.05
Gender (M/F)	22/18	24/16	>0.05
Weight (kg)	62.3 ± 8.5	63.1 ± 7.9	>0.05

Both groups were comparable with respect to demographic variables [Table 1].

Table 2: Comparison of Block Characteristics between the Groups

Parameter	Group A	Group B	p-value
Onset of sensory block (min)	4.8 ± 1.2	3.9 ± 1.0	<0.05
Duration of sensory block (min)	150 ± 20	220 ± 25	<0.001
Duration of motor block (min)	130 ± 18	200 ± 22	<0.001

Dexmedetomidine significantly prolonged both sensory and motor block duration (p<0.05) [Table 2].

Table 3: Comparison of Postoperative Analgesia between the Groups

Parameter	Group A	Group B	p-value
Time to first analgesic (min)	180 ± 25	320 ± 30	<0.001
VAS score at 6 hr	5.2 ± 1.1	3.1 ± 0.9	<0.001

Group B showed significantly better postoperative analgesia (p<0.05) [Table 3].

Table 4: Comparison of Hemodynamic Changes between the Groups

Parameter	Group A	Group B	p-value
Hypotension (%)	10%	15%	>0.05
Bradycardia (%)	5%	12%	>0.05

No significant difference in hemodynamic instability between groups (p>0.05) [Table 4].

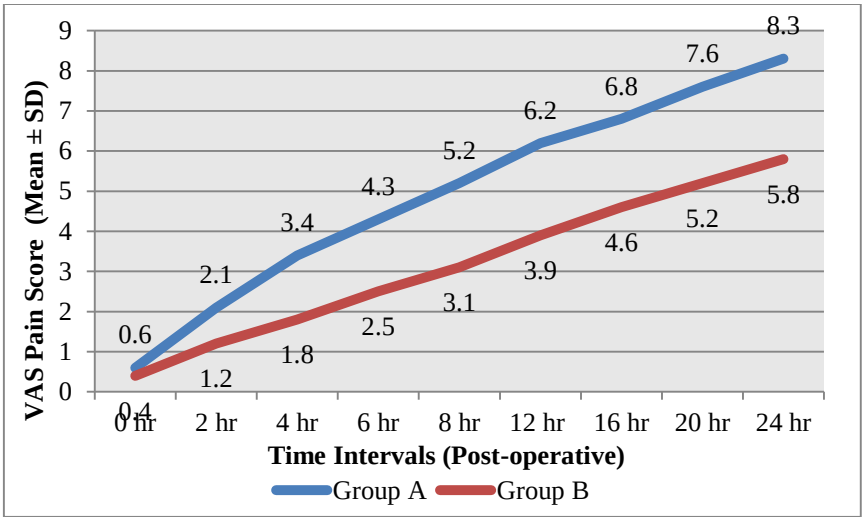

Figure 1: Comparison of VAS Pain Score over Time between Group A and Group B

VAS pain scores were consistently lower in Group B at all postoperative time intervals compared to Group A, indicating prolonged analgesia and better pain control with the addition of dexmedetomidine [Figure 1].

DISCUSSION

Dexmedetomidine has emerged as an effective intrathecal adjuvant due to its ability to enhance the quality of spinal anesthesia and prolong postoperative analgesia [7]. Its mechanism of action involves selective α2-adrenergic receptor activation in the dorsal horn of the spinal cord, leading to inhibition of nociceptive neurotransmission and prolonged sensory blockade. In the present study, the addition of dexmedetomidine to bupivacaine resulted in a significantly faster onset of sensory block along with a marked prolongation of both sensory and motor blockade. These findings are consistent with previous systematic reviews and meta-analyses, which have demonstrated that intrathecal dexmedetomidine significantly enhances block characteristics and extends the duration of anesthesia [7, 8]. The duration of postoperative analgesia was also significantly prolonged in the dexmedetomidine group, as reflected by delayed requirement of rescue analgesia and lower VAS scores. Similar findings have been reported in clinical studies evaluating intrathecal dexmedetomidine, where improved postoperative pain control and reduced analgesic consumption were noted [9]. Hemodynamic parameters remained largely stable in both groups in our study, although a slightly higher incidence of bradycardia was observed in the dexmedetomidine group. This finding is in agreement with previous randomized trials, which have reported mild but manageable bradycardia associated with α2-agonists without significant clinical consequences [10]. Compared to commonly used intrathecal adjuvants such as opioids, dexmedetomidine provides effective analgesia without side effects like pruritus, nausea, or respiratory depression. This makes it a safer and more favorable alternative for intrathecal use in a wide range of surgical procedures [11]. Overall, the findings of the present study are in accordance with existing literature, confirming that intrathecal dexmedetomidine significantly improves the quality and duration of spinal anesthesia while maintaining an acceptable safety profile [4, 12].

LIMITATIONS

The present study was conducted at a single center with a relatively small sample size, which may limit the generalizability of the findings. In addition, only a single dose of dexmedetomidine was evaluated, and long-term outcomes were not assessed.

CONCLUSION

Intrathecal dexmedetomidine is an effective and safe adjuvant to bupivacaine in spinal anesthesia. It significantly prolongs sensory and motor blockade and improves postoperative analgesia without causing clinically significant hemodynamic instability. Further large-scale studies are recommended to establish optimal dosing and broader applicability. These findings support its routine use as an adjuvant in spinal anesthesia in appropriate clinical settings.

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