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ORIGINAL RESEARCH

A comparative study to assess the hypotensive property of dexmedetomidine and clonidine in patients undergoing lumbar spine surgery

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ABSTRACT

Background: Managing capillary bleeding during lumbar spine surgery is crucial for improving surgical outcomes. Both dexmedetomidine and clonidine are α-2 adrenergic agonists used to achieve controlled hypotension, reducing intraoperative blood loss and enhancing the visibility of the surgical field. This study aims to compare the hypotensive properties and overall efficacy of dexmedetomidine and clonidine in patients undergoing lumbar spine surgery.

Methods and Methodology: This prospective, randomized, double-blind interventional study included 60 patients undergoing elective lumbar spine surgery. Patients were randomly assigned to receive either dexmedetomidine (Group A) or clonidine (Group B). Group A received dexmedetomidine 1 µg/kg in 10 ml saline over 10 minutes, followed by a 1 µg/kg/hr infusion. Group B received clonidine 2 µg/kg in 10 ml saline over 10 minutes, followed by a 1 µg/kg/hr infusion. Hemodynamic parameters, including heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO2), were recorded at various time points. The primary outcome measured was the efficacy in maintaining controlled hypotension and providing an oligemic surgical field.

Results: Dexmedetomidine was associated with a significantly lower mean heart rate at several time points and a longer time to first analgesia request (11.50 ± 1.49 minutes) compared to clonidine (6.99 ± 0.94 minutes, $p < 0.001$). Both drugs effectively maintained controlled hypotension, with dexmedetomidine showing a slightly better profile in terms of heart rate control and postoperative analgesia duration.

Conclusion: Both dexmedetomidine and clonidine are effective in achieving controlled hypotension during lumbar spine surgery. Dexmedetomidine provides better heart rate control and prolonged postoperative analgesia compared to clonidine, making it a preferable choice for improving surgical field visibility and patient outcomes.

Keywords: Dexmedetomidine, Clonidine, Lumbar spine surgery, Controlled hypotension, Hemodynamic stability, Postoperative analgesia.

INTRODUCTION

In the realm of anaesthesiology, the management of intraoperative hemodynamics is crucial, particularly during complex surgical procedures such as lumbar spine surgery.[1]

Effective blood pressure control can significantly influence surgical outcomes, including reducing blood loss and minimizing the risk of perioperative complications. Two alpha-2 adrenergic agonists, dexmedetomidine and clonidine, have been recognized for their hypotensive properties and are commonly used to achieve controlled hypotension during surgery. Despite their clinical usage, there remains a significant research gap in the comparative assessment of their hypotensive efficacy and safety profiles specifically in the context of lumbar spine surgery. [2]

Firstly, although both dexmedetomidine and clonidine have been extensively studied in various surgical contexts, there is a paucity of direct comparative

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studies focusing on their use in lumbar spine surgery. This type of surgery is unique due to its particular requirements for patient positioning, duration, and the potential for significant intraoperative blood loss. Most existing studies tend to generalize findings across different types of surgeries, thereby neglecting the specific nuances and demands of lumbar spine procedures.[3]

Secondly, most of the research comparing dexmedetomidine and clonidine primarily focuses on their sedative properties, analgesic effects, and general hemodynamic control. There is a limited focus on their direct impact on intraoperative blood pressure regulation and subsequent outcomes in lumbar spine surgery. A more targeted investigation is required to determine which agent provides superior hypotensive control while balancing the risk of adverse effects such as bradycardia and prolonged sedation, which could complicate postoperative recovery and prolong hospital stays.

Moreover, the existing literature often does not address patient-specific factors that might influence the efficacy and safety of dexmedetomidine and clonidine. Factors such as patient age, comorbidities (e.g., hypertension, cardiovascular diseases), and baseline hemodynamic status are crucial in determining the appropriate anesthetic regimen. We need to better understand how these drugs work for different types of patients having lumbar spine surgery. This study aimed to assess the hypotensive property of dexmedetomidine and clonidine in patients undergoing lumbar spine surgery.

MATERIAL AND METHOD

This is a hospital-based prospective randomized double-blind interventional study done in Department of Anaesthesiology, National Institute of Medical Sciences and Research, Jaipur from July 2022 to December 2023 on all the patients coming to the hospital for elective lumbar spine surgeries. Permission to conduct is study was taken from Institutional ethics committee . Total of 30 cases per group were included. We included cases of age 18 to 60 years of either sex, weighing 45-85 kg, ASA (American society of anaesthesiologists) grade I & II patients, patient willing to sign informed consent and patient scheduled for lumbar spine surgery. We excluded cases where patients had uncontrolled hypertension , suffering from severe hepatic, renal, endocrine, cardiac dysfunction, psychiatric illness & substance abuse , having morbid obesity, pregnant & breast feeding patients and if allergy to alfa 2 agonist .Pre anesthetic checkup was done of every patient one day prior to surgery. Informed written consent and a detailed history was taken. Detail physical and systemic examination was performed. An airway examination was also done. Routine blood investigations like complete blood count, blood sugar (fasting and post prandial) , liver function test and renal function test were done. Radiological investigation like Chest X-ray, along with ECG and 2 D echo were done. On arrival of the patient in the operating room, standard monitoring was applied; ECG, non-invasive blood pressure, pulse rate, and oxygen saturation (Spo2) were monitored. Two 20-gauge and 18-gauge intravenous cannulas were secured.

Randomization was done using the systemic randomization technique. Concealment of randomization was performed through the sealed envelope method. Blinding was done such that the anaesthesiologist who administered anaesthesia was different from the anaesthesiologist who recorded study variables. Patients were randomly divided into two groups of 30 each. Group A received dexmedetomidine 1 μg/kg in 10 ml of saline over 10 minutes followed by a 1 μg/kg/hr infusion. Group B received clonidine 2 μg/kg in 10 ml of saline over 10 minutes followed by a 1 μg/kg/hr infusion. The loading dose of the study drug was given 10 minutes before the induction of general anaesthesia (GA), and its maintenance dose infusion was started soon after induction and continued intraoperatively until 5 minutes before the completion of surgery or discontinued upon the occurrence of hypotension below our target, whichever occurred earlier. Intraoperative hemodynamic parameters such as heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and oxygen saturation (SpO2) were recorded at baseline, after the loading dose, after induction, 1 minute after intubation, 5 minutes after intubation, and thereafter every 10 minutes until shifting of the patient to the recovery area.

After data collection, appropriate statistics were used to analyze the data. All statistical analyses were performed using SPSS and Microsoft Excel software.

RESULTS

Table 1: Duration of surgery, blood loss and analgesia request distribution among patients receiving dexmedetomidine (Group A) or clonidine (Group B).

Variable	Group A (n=30)	Group B (n=30)	Total (n=60)	p-value
Duration of surgery (min), Mean ±SD	133.00±17.64	126.00±12.75	129.50±15.66	0.84
Blood loss (ml), Mean + SD	230.33±83.56	216.17±76.87	223.25±79.92	0.497
Time to first analgesia request	11.50±1.49	6.99±0.94	<0.001	

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(hrs), Mean +SD			
All the data is presented in number (n) and percentage (%). *p-value was statistically significant at $p \leq 0.05$.			

The mean duration of surgery was 133.00 ± 17.64 minutes for Group A and 126.00 ± 12.75 minutes for Group B, with an overall mean duration of 129.50 ± 15.66 minutes. The estimated blood loss was 230.33 ± 83.56 ml for Group A and 216.17 ± 76.87 ml for Group B. The overall mean blood loss was 223.25 ± 79.92 ml. The p-value of 0.84 and 0.497 indicates no statistically significant difference in duration of surgery and blood loss between the groups respectively (Table 1). The time to first analgesia request was significantly longer in Group A (11.50 ± 1.49 hrs) compared to Group B (6.99 ± 0.94 hrs), with a p-value of less than 0.001. This suggests that dexmedetomidine provides longer postoperative analgesia compared to clonidine.

The trend of mean systolic blood pressure showed no significant differences between Group A and Group B at various time points during and after surgery, except at the 30-minute mark, where the p-value was 0.040, indicating a significant difference. Similarly, mean diastolic blood pressure trends did not show significant differences between the groups, except at the 30-minute mark (p-value 0.063, borderline significance) (Table 2).. Postoperative SBP and DBP trends did not show significant differences.

Table 2: Trend of mean Systolic and Diastolic blood pressure (SBP), (Mean ± S.D.)

	Time point	Group A (Dexmedetomidine)	Group B (Clonidine)	Total	Mann-Whitney U	p-value
Systolic	30 min	93.77 ± 3.60	95.90 ± 5.79	94.83 ± 4.90	312.000	0.040
Diastolic	30 min	58.57±6.49	61.90±7.17	60.23±6.98	325.00	0.063

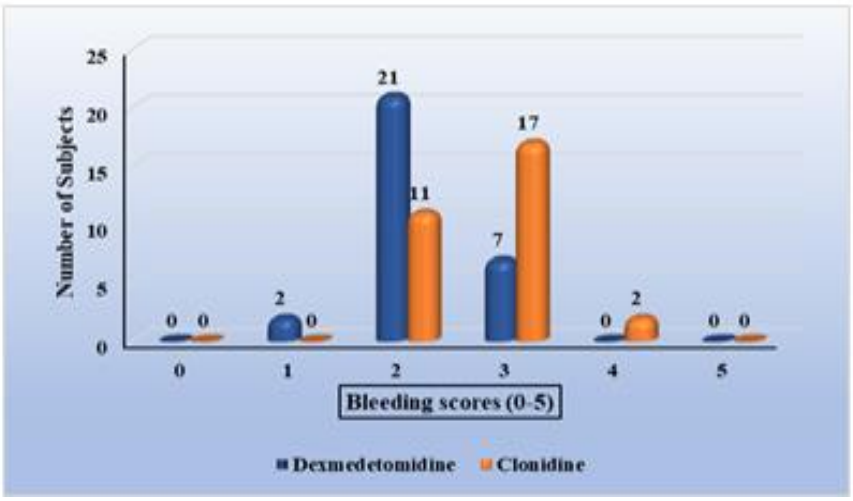

Figure 1: Bleeding Scores in dexmedetomidine (Group A) and clonidine (Group B) during Surgery.

Bleeding scores during surgery were significantly different between the two groups (p-value 0.010). Group B had more patients with bleeding compared to Group A. This suggests that dexmedetomidine may result in less intraoperative bleeding compared to clonidine (Figure 1).(0- No Bleeding; 1- Slight bleeding, no suctioning of blood required; 2- Slight bleeding, occasional suctioning required, surgical field not threatened; 3- Slight bleeding, frequent suctioning required, bleeding threatens surgical field; 4- Moderate bleeding, frequent suctioning required, bleeding threatens surgical field directly after suction is removed; 5- severe bleeding, constant suctioning required, bleeding appears faster than can be removed by suction, surgical field severely threatened and surgery suspended) Postoperative complications such as nausea, vomiting, shivering, dry mouth, bradycardia, and hypotension were assessed. For nausea, 16.7% of patients in Group A experienced this complication compared to 23.3% in Group B, resulting in an overall rate of 20.0% (p = 0.519). Vomiting occurred in 10.0% of patients in Group A and 16.7% in Group B, with a total incidence of 13.3% (p = 0.448). Shivering was reported in 16.7% of patients in Group A and 30.0% in Group B, leading to a combined rate of 23.3% (p = 0.222).

Dry mouth was not observed in any patients in Group A, whereas 10.0% of Group B experienced it, with an overall incidence of 5.0% (p = 0.076). Bradycardia was seen in 10.0% of Group A and 23.3% of Group B, for a total rate of 16.7% (p = 0.166). Lastly, hypotension was reported in 6.7% of Group A and 20.0% of Group B, resulting in a total occurrence of

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13.3% (p = 0.129). Overall, Group A had slightly lower rates of all complications compared to Group B, suggesting a marginally better postoperative profile. However, none of these differences reached statistical significance (p > 0.05).

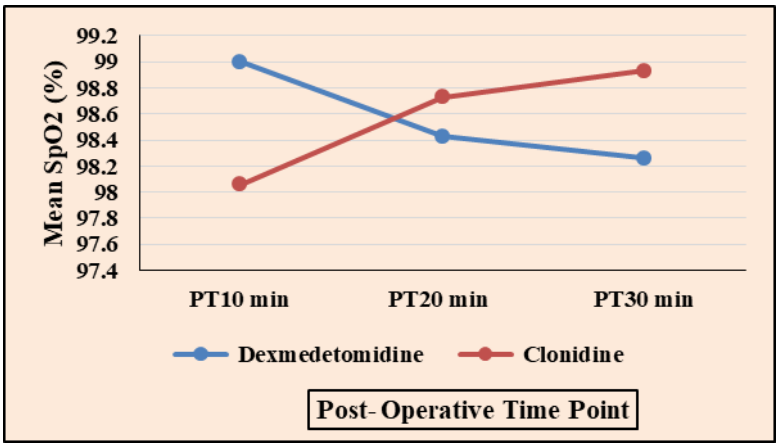

Figure 2: Post-Operative Mean SpO2, (Mean ± S.D.)

SpO2 levels were generally higher in Group B at several time points, with significant differences at T0, Ta, and PT30 (p-values less than 0.05). This indicates that clonidine might be associated with slightly better oxygen saturation levels (Figure 2).

Mean arterial pressure trends were similar between the groups, with no significant differences except at PT20 (postoperative 20 minutes) where the p-value was 0.039, indicating a significant difference (Figure 3a and 3b).

Mean heart rate was significantly lower in Group A at several time points, including T0 (baseline), PT10, PT20, and PT30, with p-values less than 0.05. This suggests that dexmedetomidine has a better control as compared to clonidine (Figures 4a and 4b).

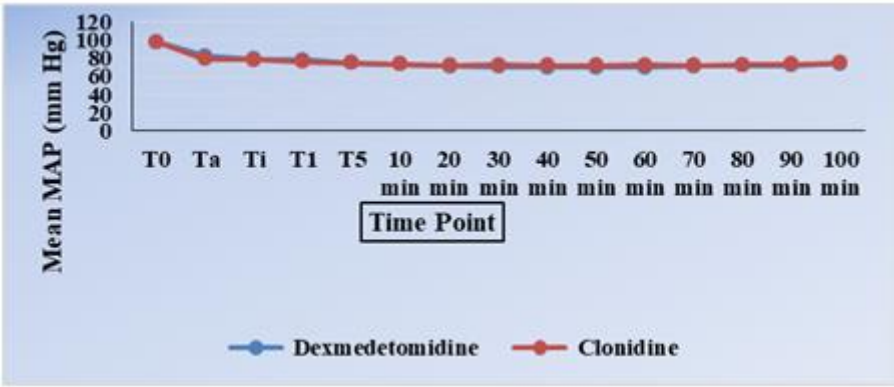

Figure 3a: Trend of mean arterial pressure (MAP), (Mean ± S.D.)

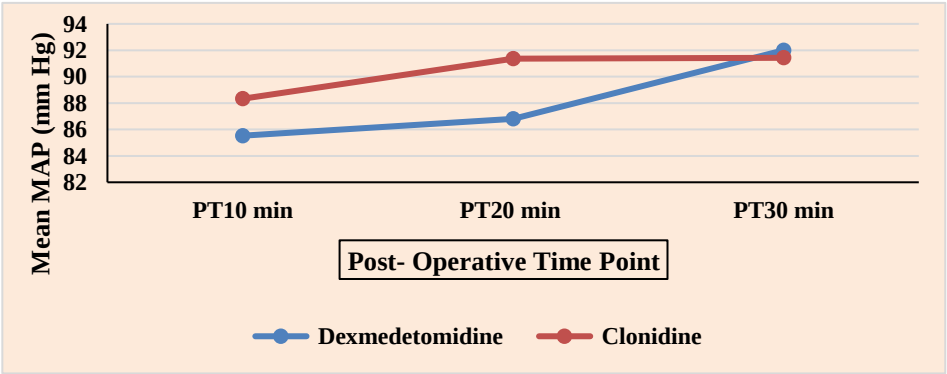

Figure 3b: Post-operative mean arterial pressure (MAP), (Mean ± S.D.)

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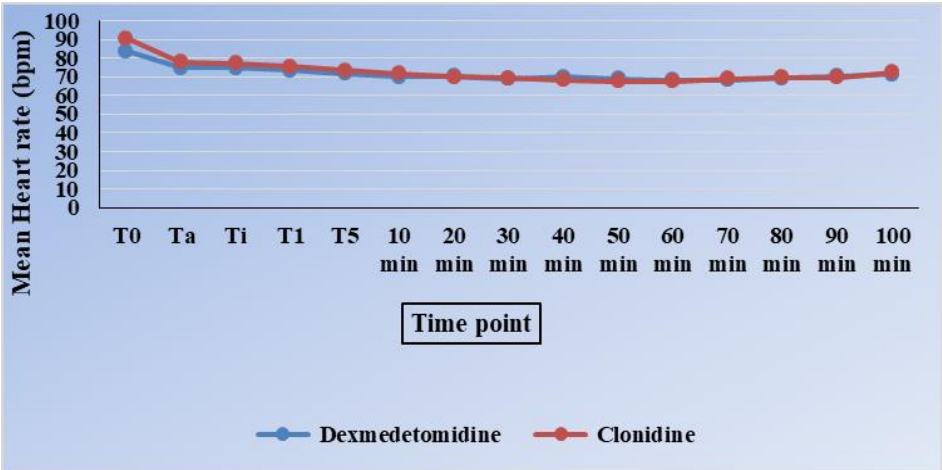

Figure 4a: Trend of mean heart rate (Beats per minute), (Mean ± S.D.)

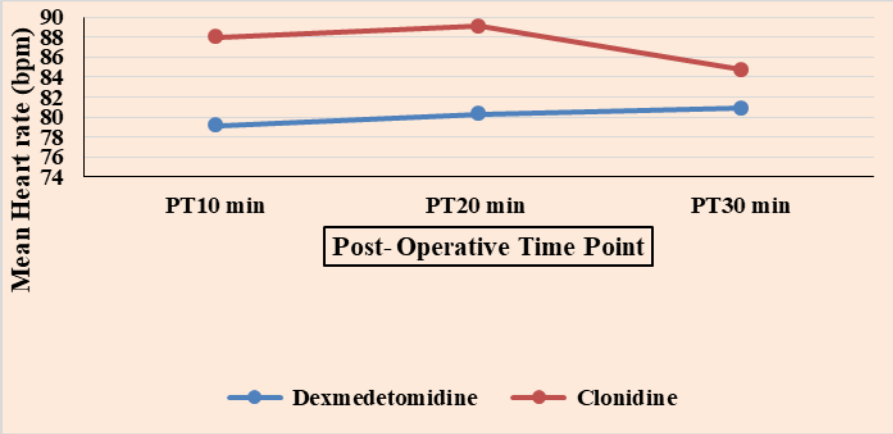

Figure 4b: Post-operative mean heart rate (Beats per minute)

DISCUSSION

The study found that both dexmedetomidine and clonidine effectively managed hypotension during lumbar spine surgery. However, dexmedetomidine resulted in lower intraoperative bleeding and a longer duration of postoperative analgesia compared to clonidine. These findings are consistent with previous studies, such as those by Aantaa et al[4], which highlighted dexmedetomidine's superior ability to reduce bleeding during surgery due to its potent vasoconstrictive properties Dexmedetomidine significantly reduced intraoperative bleeding compared to clonidine. This aligns with findings from Jalonen et al[5], who observed reduced blood loss in patients administered dexmedetomidine during cardiac surgery The lower bleeding scores ($p = 0.010$) observed in the dexmedetomidine group (Group A) indicate a potential benefit in surgeries where minimizing blood loss is crucial.

The time to first analgesia request was significantly longer in the dexmedetomidine group (11.50 ± 1.49 hrs) compared to the clonidine group (6.99 ± 0.94 hrs, $p < 0.001$). This suggests a prolonged analgesic effect of dexmedetomidine, supporting the findings by Talke et al[6], who reported extended analgesia with dexmedetomidine due to its central sympatholytic effects.

The mean systolic and diastolic blood pressure trends showed no significant differences between the groups at most time points, except at the 30-minute mark for systolic blood pressure ($p = 0.040$) and borderline significance for diastolic blood pressure ($p = 0.063$). This indicates that both drugs are effective in maintaining stable intraoperative blood pressure, consistent with studies by Khan et al[7], which highlighted the hemodynamic stability provided by these agents.

Both drugs had similar profiles concerning postoperative complications such as nausea, vomiting, shivering, dry mouth, bradycardia, and hypotension. The differences in these complications did not reach statistical significance, corroborating findings by Maze et al[8], who observed that both dexmedetomidine and clonidine have comparable safety profiles when used as adjuncts in anesthesia.

Dexmedetomidine demonstrated a better heart rates control as compared to clonidine, with significantly lower mean heart rates at various time points (e.g., T0: 83.73 ± 7.38 bpm for dexmedetomidine vs. 90.60 ± 8.13 bpm for clonidine, $p < 0.001$). This bradycardic effect is well-documented in the study done by Bloor et al[9], attributed to its alpha-2 adrenergic agonist activity, which reduces sympathetic outflow. Clonidine was associated with

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slightly better oxygen saturation levels at several time points, which is a novel finding that warrants further investigation. Previous studies have not extensively compared the effects of these drugs on oxygen saturation, suggesting a potential area for future research.[9]

CONCLUSION

The findings of this study provide valuable insights into the comparative efficacy and safety of dexmedetomidine and clonidine in managing controlled hypotension and perioperative hemodynamic stability during lumbar spine surgery. While both drugs are effective, dexmedetomidine offers advantages in terms of lower intraoperative bleeding, efficacy to provide an oligemic surgical field, and better heart rate control. Dexmedetomidine provides the additional benefit of longer postoperative analgesia. Further studies with larger sample sizes and additional parameters could provide more comprehensive insights into the optimal use of these medications in surgical settings.

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Conflict of Interest -None as stated by authors.

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