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Original Research

The effects of different loading doses of dexmedetomidine on sedation

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ABSTRACT:
Aim: Dexmedetomidine is an FDA-approved sedative used for the sedation of intubated and mechanically ventilated patients. To study the effects of different loading doses of dexmedetomidine on sedation. **Materials and methods:** This prospective, randomized, double-blind study enrolled 30 patients. Patients with neurologic or cardiovascular disease, renal or liver failure, or contraindications to spinal anesthesia—such as bleeding disorders or patient refusal—were excluded. All patients fasted for eight hours preoperatively without premedication. Dexmedetomidine infusion was initiated 20 minutes post-spinal anesthesia, with group A receiving a loading dose of 1.0 µg/kg and group B receiving 0.5 µg/kg, followed by a maintenance dose of 0.5 µg/kg/min after 10 minutes. **Results:** Group A consisted of 12 males and 18 females, while Group B included 14 males and 16 females. The mean age of patients in Group A was 43.6 ± 7.4 years, compared to 40.1 ± 12.4 years in Group B. The average weight was similar between the groups, with Group A at 65.2 ± 8.5 kg and Group B at 65.7 ± 10.3 kg. Height measurements showed a mean of 159.5 ± 12.5 cm in Group A and 163.7 ± 9.2 cm in Group B. Sensory block level, measured in thoracic dermatomes, averaged 6.7 ± 1.7 in Group A and 6.3 ± 3.1 in Group B. **Conclusion:** The study found no significant differences between the two groups in terms of hemodynamic stability, BIS suppression, or adverse events. However, the higher dexmedetomidine dose (1.0 µg/kg) in Group A resulted in a longer recovery time to BIS 80 compared to the lower dose (0.5 µg/kg) in Group B.
Keywords: dexmedetomidine, sedation, anesthesia

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INTRODUCTION

Dexmedetomidine is an FDA-approved sedative used for the sedation of intubated and mechanically ventilated patients in the ICU, as well as for peri-procedural sedation in non-intubated patients. Over time, its use has expanded to off-label indications, including the prevention and treatment of delirium, adjunctive analgesia, ICU-related insomnia management, and alcohol withdrawal. It provides a sedated yet cooperative state without causing significant respiratory depression, allowing for extubation without discontinuation. Its opioid-sparing effect is particularly valuable, as most sedatives lack inherent analgesic properties. In ICU sedation, dexmedetomidine has been shown to reduce the incidence and duration of delirium, shorten ventilator-dependent hours, and improve postoperative recovery, particularly in elderly post-cardiac surgery patients. Although it is often used to improve ICU sleep quality due to its resemblance to stage 2 non-REM sleep, some studies suggest it may alter normal sleep patterns and lack clear clinical outcome benefits.[1-3]

Dexmedetomidine is widely used in anesthesia for procedural sedation, awake intubation, and as an adjunct infusion during general anesthesia. It has demonstrated benefits in reducing postoperative pain, opioid use, and nausea, particularly in patients undergoing spinal anesthesia. Additionally, its use has been explored for preventing emergence agitation, postoperative delirium, and cognitive dysfunction, with mixed results. While it has shown efficacy in reducing emergence agitation in both children and adults, a recent randomized trial found no significant impact on postoperative delirium prevention. Another promising application is its use in peripheral nerve blocks, where it may prolong the duration of analgesia

by approximately three hours. Despite these benefits, its opioid-sparing effect has been questioned in major spine surgeries, and its overall role in postoperative cognitive protection remains under investigation.[4- 6]
Dexmedetomidine exerts its effects as a highly selective alpha-2 adrenergic agonist, inhibiting central sympathetic outflow and norepinephrine release. Typical ICU dosing ranges from 0.2 to 0.7 mcg/kg per hour, with doses up to 1.5mcg/kg per hour used for deeper sedation. Though the manufacturer recommends limiting use to 24 hours, longer durations have been deemed safe. Common adverse effects include hypotension, bradycardia, and occasional hypertension, requiring careful monitoring of vital signs. While there are no absolute contraindications, it should be used cautiously in patients with bradycardia, hypotension, or heart failure due to potential exacerbation of myocardial dysfunction. Currently, there is no antidote for dexmedetomidine overdose, making supportive care essential. Despite its efficacy, the primary downside remains its cost, necessitating careful consideration of its benefits in clinical practice. Effective interprofessional collaboration among clinicians, pharmacists, and ICU nurses is crucial to optimizing patient outcomes while mitigating risks.[7,8]Hence in our study we aimed to study the effects of different loading doses of dexmedetomidine on sedation.

MATERIALS AND METHODS

This prospective, randomized, double-blind study enrolled 30 patients. Patients with neurologic or cardiovascular disease, renal or liver failure, or contraindications to spinal anesthesia—such as bleeding disorders or patient refusal—were excluded. All patients fasted for eight hours preoperatively without premedication. In the operating room, 5 L/min of oxygen was administered via a mask, and an intravenous line was placed in the forearm. Pre-hydration with Ringer's lactate solution (10 ml/kg) preceded spinal anesthesia, which was performed in the lateral decubitus position using a 25-gauge Quincke spinal needle at L3-4 or L4-5. Intrathecal administration of hyperbaric 0.5% bupivacaine (12 mg) was followed by immediate supine positioning. Sensory block levels were assessed using a pinprick test with a 25-gauge needle. A BIS monitor was placed on the forehead after alcohol swabbing to record the initial BIS value. Heart rate (HR), oxygen saturation (SpO2), non-invasive blood pressure, Ramsay sedation score, and BIS values were recorded at baseline (T0), immediately after dexmedetomidine loading (TL), and at 10-minute intervals thereafter (T10, T20, T30). Dexmedetomidine infusion was initiated 20 minutes post-spinal anesthesia, with group A receiving a loading dose of 1.0 µg/kg and group B receiving 0.5 µg/kg, followed by a maintenance dose of 0.5 µg/kg/min after 10 minutes. Data collection continued at 10-minute intervals until the end of surgery. Following surgery, dexmedetomidine infusion was discontinued, and the lowest BIS score during the procedure, along with the time to reach BIS 80 post-infusion, was documented. Complications, including hypertension, hypotension, bradycardia, tachycardia, hypoxemia (SpO2 < 95%), and oral dryness, were recorded along with the administration of ephedrine or atropine for management. Data analysis was done using SSPS software. Data were expressed as mean ± standard deviation (SD), with statistical significance set at $P < 0.05$.

RESULTS

Group A consisted of 12 males and 18 females, while Group B included 14 males and 16 females. The mean age of patients in Group A was 43.6 ± 7.4 years, compared to 40.1 ± 12.4 years in Group B. The average weight was similar between the groups, with Group A at 65.2 ± 8.5 kg and Group B at 65.7 ± 10.3 kg. Height measurements showed a mean of 159.5 ± 12.5 cm in Group A and 163.7 ± 9.2 cm in Group B. Sensory block level, measured in thoracic dermatomes, averaged 6.7 ± 1.7 in Group A and 6.3 ± 3.1 in Group B.

Table 1: Patient Characteristics

	Group A	Group B
Gender (M/F)	12/18	14/16
Age (years)	43.6 ± 7.4	40.1 ± 12.4
Weight (kg)	65.2 ± 8.5	65.7 ± 10.3
Height (cm)	159.5 ± 12.5	163.7 ± 9.2
Sensory block Level (thoracic dermatome)	6.7 ± 1.7	6.3 ± 3.1

Values are mean ± SD or number of patients. There are no significant differences between two groups. Group B: loading dose 0.5 µg/kg, Group A: loading dose 1.0 µg/kg.

Table 2: Complications, Drug Use, Minimal BIS and Time to Reach BIS 80

	Group A	Group B
Bradycardia	4	3
Hypoxemia	2	1
Hypertension	1	1
Hypotension	1	2

BISMIN	50.2 ± 12.8	52.5 ± 16.7
Time to reach BIS 80(sec)	152.5 ± 32.4	82.2 ± 6.2

Values are mean ± SD or number of patients. There are no significant differences between two groups. Group B: loading dose 0.5 µg/kg, Group A: loading dose 1.0 µg/kg. BISmin: Lowest value of BIS during the study.

In Group A, four patients experienced bradycardia, two had hypoxemia, one developed hypertension, and one had hypotension. In Group B, three patients had bradycardia, one experienced hypoxemia, one had hypertension, and two developed hypotension. The lowest BIS value (BISMIN) recorded was 50.2 ± 12.8 in Group A and 52.5 ± 16.7 in Group B. The time to reach BIS 80 after infusion termination was 152.5 ± 32.4 seconds in Group A and 82.2 ± 6.2 seconds in Group B. All values are presented as mean ± standard deviation (SD) or as the number of patients, with no significant differences observed between the two groups. Group A received a dexmedetomidine loading dose of 1.0 µg/kg, while Group B received 0.5 µg/kg.

DISCUSSION

Dexmedetomidine, a selective α2-adrenergic agonist, is widely used for sedation due to its anxiolytic, analgesic, and hemodynamic stabilizing properties. Its dose-dependent effects influence the depth and duration of sedation, making the choice of loading dose crucial in various clinical settings, including spinal anesthesia. While higher doses may provide deeper sedation, they can also prolong recovery time and increase the risk of hemodynamic fluctuations.[9] Understanding the impact of different loading doses on sedation levels, hemodynamic stability, and recovery can help optimize its use for safe and effective patient management.

In our study, Group A consisted of 12 males and 18 females, while Group B included 14 males and 16 females. The mean age of patients in Group A was 43.6 ± 7.4 years, compared to 40.1 ± 12.4 years in Group B. The average weight was similar between the groups, with Group A at 65.2 ± 8.5 kg and Group B at 65.7 ± 10.3 kg. Height measurements showed a mean of 159.5 ± 12.5 cm in Group A and 163.7 ± 9.2 cm in Group B. Sensory block level, measured in thoracic dermatomes, averaged 6.7 ± 1.7 in Group A and 6.3 ± 3.1 in Group B.

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In a similar study by Sim JH et al.,[10] dexmedetomidine was evaluated for its sedative effects and complications at different loading doses (0.5 and 1.0 µg/kg) in patients undergoing spinal anesthesia. The results showed that BIS values decreased significantly earlier in Group H (immediately after loading) than in Group L (after 10 minutes), with a significant difference between groups at the 10-minute mark. Ramsay scores were comparable except at TL, where Group H had a higher score. Vital signs and complications showed minimal differences between groups. Overall, a higher loading dose (1.0 µg/kg) led to a faster onset of sedation without severe complications.Ko KH et al.,[11]did a study on the effective dose (ED) of dexmedetomidine for achieving adequate sedation in elderly patients undergoing spinal anesthesia. Forty-seven ASA I and II patients aged 65 years or older were randomly assigned to receive dexmedetomidine loading doses of 0.1, 0.3, 0.5, 0.7, or 1.0 µg/kg over 10 minutes, followed by a maintenance infusion of 0.3 µg/kg/h for the next 10 minutes. Sedation depth was assessed using the Ramsay sedation scale every five minutes, along with monitoring of vital signs and oxygen saturation. Logistic regression analysis determined the ED50 and ED95 for adequate sedation (Ramsay score ≥ 3) as 0.29 µg/kg (95% CI: 0.14-0.44) and 0.86 µg/kg (95% CI: 0.52-1.20), respectively. Hypotension was significantly more frequent in patients receiving higher doses (0.7 and 1.0 µg/kg) compared to lower doses (31.6% vs. 3.6%, P = 0.013). The findings suggested that while an ED95 of 0.86 µg/kg was effective for sedation, doses exceeding 0.5 µg/kg increased the risk of hemodynamic instability.

Song, J et al.,[12]in their study evaluated the appropriate intravenous dose of dexmedetomidine for sedation under spinal anesthesia. Results showed significant decreases in systolic blood pressure, heart rate, and SpO_2, while RSS scores increased at 20 and 40 minutes post-administration across all groups, with no significant differences between them. The incidence of hypotension correlated positively with the infusion dose, though bradycardia and additional midazolam use did not. The study concluded that while all three infusion rates achieved adequate sedation, the risk of hypotension increased with higher doses, suggesting that 0.25 µg/kg/hr may be the safest option for continuous administration.

CONCLUSION

Our findings suggest that while both doses are effective and safe under spinal anesthesia, the lower dose may be preferable for faster sedation recovery without compromising stability.

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