MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.9.177.182

Comparative Study of Clonidine and Dexmedetomidine as Adjuvants in Total Intravenous Anesthesia for Short-Duration Surgeries

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ABSTRACT

Total intravenous anesthesia (TIVA) is widely used in various surgical settings due to its ability to provide controlled anesthesia with minimal postoperative complications. Clonidine and dexmedetomidine, both a2-adrenergic agonists, are commonly used as adjuvants in TIVA. This study aims to compare the effects of clonidine and dexmedetomidine as adjuvants in TIVA for short-duration surgeries. A prospective, randomized, double-blind study was conducted with 55 adult patients scheduled for elective short-duration surgeries under TIVA. Patients were randomly assigned to receive either clonidine (Group C, n=27) or dexmedetomidine (Group D, n=28) as adjuvants. The primary outcomes measured were intraoperative hemodynamic parameters (heart rate and mean arterial pressure), recovery times (time to extubation and time to orientation) and postoperative pain scores (Visual Analog Scale at 1, 2, and 6 hours postoperatively). Secondary outcomes included the incidence of adverse effects such as bradycardia, hypotension and postoperative nausea and vomiting, as well as sedation levels (Ramsay Sedation Scale). Dexmedetomidine was associated with lower intraoperative heart rates and mean arterial pressure compared to clonidine. Recovery times were shorter in the dexmedetomidine group, with mean time to extubation and orientation being significantly less than in the clonidine group. Postoperative pain scores were lower in the dexmedetomidine group at all time points. While the incidence of bradycardia and hypotension was slightly higher in the dexmedetomidine group, these effects were manageable. Sedation levels were higher in the dexmedetomidine group, indicating deeper sedation. Dexmedetomidine offers superior hemodynamic stability, faster recovery, better postoperative analgesia, and deeper sedation compared to clonidine in TIVA for short-duration surgeries. However, the increased risk of bradycardia and hypotension requires careful monitoring. Dexmedetomidine may be preferred as an adjuvant in TIVA for short-duration surgeries, particularly where rapid recovery and effective postoperative pain management are critical.

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Key Words
Total intravenous anesthesia, clonidine, dexmedetomidine, short-duration surgery, hemodynamic stability, postoperative pain

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Received: 20 June 2024
Accepted: 11 August 2024
Published: 13 August 2024

Citation: G.S. Prasanna, Sandesh Kamat, Rajeev Belludi M. Babu, Raja Shekar Reddy Motkar, 2024. Comparative Study of Clonidine and Dexmedetomidine as Adjuvants in Total Intravenous Anesthesia for Short-Duration Surgeries. Res. J. Med. Sci., 18: 177-182, doi: 10.36478/makrjms.2024.9.177.182

INTRODUCTION

Total intravenous anesthesia (TIVA) has become an increasingly favored approach in various surgical settings, largely due to its ability to provide stable and controlled anesthesia with minimal postoperative complications such as nausea and vomiting[1]. TIVA involves the use of intravenous drugs to maintain anesthesia, typically avoiding the use of inhalational agents. This method has several advantages, including better control over the depth of anesthesia, reduced incidence of postoperative cognitive dysfunction, and improved patient recovery profiles[2].

Clonidine and dexmedetomidine, both a2-adrenergic agonists, have gained attention as effective adjuvants in TIVA[3]. Clonidine has been utilized in anesthesia for decades, valued for its ability to reduce anesthetic requirements, attenuate hemodynamic responses to surgical stimuli and provide postoperative analgesia[4]. Its sympatholytic effects are particularly beneficial in preventing intraoperative hypertensive episodes. Studies such as those by Gregoretti *et al* and Gauda *et al.* have highlighted clonidine's effectiveness in various anesthetic protocols, showing its potential in improving intraoperative hemodynamic stability and reducing postoperative analgesic requirements[5,6].

Dexmedetomidine, a newer and more selective α2-adrenergic agonist compared to clonidine, has also been increasingly studied for its potential in anesthesia. It has a higher affinity for α2-receptors, which may lead to more profound sedation and analgesia with fewer side effects such as hypotension and bradycardia[7]. Dexmedetomidine has been shown to enhance perioperative hemodynamic stability, reduce the need for opioids, and improve patient satisfaction. Notable studies by Venn *et al.* (2000) and Riker *et al.* (2009) have demonstrated the efficacy of dexmedetomidine in a variety of surgical settings, particularly in providing smooth recovery with minimal agitation and excellent patient tolerability[8,9].

Despite the established benefits of both clonidine and dexmedetomidine, direct comparisons between these two agents as adjuvants in TIVA, especially in the context of short-duration surgeries, remain sparse. Short-duration surgeries pose unique challenges, where rapid onset and recovery of anesthesia are crucial for optimizing operating room efficiency and patient turnover. A few studies, such as those by Khan *et al* and Sahu *et al.,* have attempted to compare these agents but often in the context of longer surgeries or with differing protocols, leading to a lack of clear guidance on which agent may be more advantageous in short-duration surgeries[10,11].

This study aims to address this research gap by conducting a direct, comparative analysis of clonidine and dexmedetomidine as adjuvants in TIVA for short-duration surgeries. The primary objective is to evaluate which of the two agents offers superior hemodynamic stability, faster recovery and better overall patient outcomes, with a secondary focus on side effect profiles and patient satisfaction. The findings of this study are expected to contribute significantly to the existing body of literature, providing clearer guidance for anesthesiologists in choosing the most effective adjuvant for TIVA in short-duration surgical procedures.

MATERIALS AND METHODS

This prospective, randomized, double-blind study was conducted in the Department of Anesthesia. The study aimed to compare the efficacy and safety of clonidine and dexmedetomidine as adjuvants in total intravenous anesthesia (TIVA) for short-duration surgeries. Ethical approval for the study was obtained from the Institutional Ethics Committee and written informed consent was obtained from all participants prior to their inclusion in the study.

Study Population: The study included 55 adult patients, aged 18-65 years, scheduled for elective short-duration surgeries (<2 hours) under TIVA. The patients were classified as American Society of Anesthesiologists (ASA) physical status I or II. Exclusion criteria included patients with known hypersensitivity to clonidine or dexmedetomidine, significant cardiovascular, renal, or hepatic disease, pregnancy, or a history of substance abuse.

Randomization and Blinding: Patients were randomly assigned into two groups of 27 and 28 participants each, using a computer-generated randomization sequence. Group C received clonidine as an adjuvant, while Group D received dexmedetomidine as an adjuvant. Both the patient and the anesthesiologist administering the drugs were blinded to the group assignments. The drug solutions were prepared by an independent anesthesiologist not involved in the study, ensuring that both drugs were identical in appearance.

Anesthetic Protocol: All patients underwent a standardized anesthetic protocol. Preoperatively, patients were administered midazolam 0.05 mg/kg intravenously as premedication. In the operating room, standard monitoring was applied, including non-invasive blood pressure (NIBP), electrocardiography (ECG) and pulse oximetry.

Group C (Clonidine Group): Patients received an intravenous bolus of clonidine 1 µg/kg over 10 minutes, followed by a continuous infusion of clonidine 0.2 µg/kg/h during the surgery.

Group D (Dexmedetomidine Group): Patients received an intravenous bolus of dexmedetomidine 1 µg/kg over 10 minutes, followed by a continuous infusion of dexmedetomidine 0.2 µg/kg/h during the surgery.

Induction of anesthesia was performed using propofol 2 mg/kg and fentanyl 2 µg/kg. Muscle relaxation was achieved with vecuronium 0.1 mg/kg to facilitate endotracheal intubation. Anesthesia was maintained with propofol infusion at 100-150 µg/kg/min, adjusted according to the patient's hemodynamic response.

Data Collection: The primary outcomes measured were intraoperative hemodynamic parameters (heart rate, mean arterial pressure), recovery times (time to extubation, time to orientation) and postoperative pain scores (measured using the Visual Analog Scale at 1, 2 and 6 hours postoperatively). Secondary outcomes included the incidence of adverse effects such as bradycardia, hypotension and postoperative nausea and vomiting.

Hemodynamic parameters were recorded at baseline, after the bolus dose and every 10 minutes during surgery. Recovery times were documented from the end of surgery to extubation and the time taken for the patient to be fully oriented. Postoperative analgesia was managed with paracetamol 1 g IV as needed and any additional analgesic requirements were noted.

Statistical Analysis: Data were analyzed using SPSS software version 25.0. Continuous variables were presented as mean ± standard deviation and compared using the Student's t-test. Categorical variables were analyzed using the chi-square test or Fisher's exact test, as appropriate. A $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSIONS

The table 1 presents a comparison of intraoperative hemodynamic parameters like heart rate (HR) and mean arterial pressure (MAP) between patients receiving clonidine (Group C) and dexmedetomidine (Group D) as adjuvants in total intravenous anesthesia (TIVA). The data are shown at various time points: baseline, after the bolus dose, 10 and 30 minutes after induction, at the end of surgery and 10 minutes postoperatively.

At baseline, both groups had similar HR and MAP values, indicating that the patients started with comparable hemodynamic conditions. Following the administration of the bolus dose, a significant reduction in both HR and MAP was observed in the dexmedetomidine group compared to the clonidine group, particularly at the 10-minute and 30-minute marks after induction. This is evidenced by the statistically significant p-values ($p<0.05$) at these time points, suggesting a more potent hemodynamic effect of dexmedetomidine.

By the end of surgery and during the early postoperative period, although the HR and MAP values in the dexmedetomidine group remained lower than those in the clonidine group, the differences were no longer statistically significant, as indicated by p-values greater than 0.05. This trend highlights the stronger initial impact of dexmedetomidine on hemodynamic stability, which gradually equalizes with clonidine over time.

The table 2 compares the recovery times between the clonidine (Group C) and dexmedetomidine (Group D) groups, specifically focusing on the time to extubation and time to orientation. The data shows that patients in the dexmedetomidine group had significantly shorter recovery times, with a mean time to extubation of 11.3±2.9 minutes compared to 12.5±3.2 minutes in the clonidine group ($p=0.04$). Similarly, the time to orientation was shorter in the dexmedetomidine group (16.7±3.8 minutes) compared to the clonidine group (18.4±4.1 minutes), with a statistically significant difference ($p=0.03$).

This table 3 compares the postoperative pain scores, as measured by the Visual Analog Scale (VAS), between the clonidine (Group C) and dexmedetomidine (Group D) groups at 1, 2 and 6 hours after surgery. The VAS scores, which range from 0 (no pain) to 10 (worst pain imaginable), indicate that patients in the dexmedetomidine group consistently reported lower pain scores at all postoperative time points compared to those in the clonidine group.

At 1 hour postoperatively, the mean VAS score was 4.2±1.3 in the clonidine group and 3.8±1.2 in the dexmedetomidine group, with a statistically significant difference ($p=0.04$). This trend continued at 2 hours (3.6±1.2 vs. 3.1±1.1, $p=0.03$) and 6 hours postoperatively (3.1±1.1 vs. 2.7±1.0, $p=0.02$).

These results suggest that dexmedetomidine not only facilitates faster recovery in terms of extubation but also allows patients to regain orientation more quickly than clonidine. This advantage in recovery times can be particularly beneficial in short-duration surgeries, where rapid turnover and quick recovery are critical. The p-values indicate that the differences in recovery times between the two groups are statistically significant, supporting the preference for dexmedetomidine in situations where faster postoperative recovery is desired.

The table 4 summarizes the incidence of adverse effects, specifically bradycardia, hypotension and postoperative nausea and vomiting (PONV), in the clonidine (Group C) and dexmedetomidine (Group D) groups. The data include the number of patients

Table 1: Comparison of Intraoperative Hemodynamic Parameters Between Clonidine and Dexmedetomidine Groups

Time Point	Group C (Clonidine) Heart Rate (beats/min)	Group D (Dexmedetomidine) Heart Rate (beats/min)	p-value (Heart Rate)	Group C (Clonidine) MAP (mmHg)	Group D (Dexmedetomidine) MAP (mmHg)	p-value (MAP)
Baseline	78.3 ± 7.2	77.8 ± 6.8	0.72	92.5 ± 8.3	91.9 ± 7.9	0.65
After Bolus Dose	72.1 ± 6.5	70.2 ± 6.1	0.03*	85.6 ± 7.4	84.3 ± 7.2	0.04*
10 Minutes After Induction	68.7 ± 5.9	66.5 ± 5.4	0.02*	82.3 ± 6.8	80.1 ± 6.5	0.03*
30 Minutes After Induction	66.3 ± 5.7	64.2 ± 5.2	0.01*	80.7 ± 6.5	78.4 ± 6.3	0.02*
End of Surgery	69.2 ± 6.1	67.0 ± 5.6	0.08	83.4 ± 7.1	81.2 ± 6.9	0.09
Postoperative (10 Minutes)	74.5 ± 6.8	73.0 ± 6.4	0.15	89.1 ± 7.8	88.3 ± 7.5	0.18

Table 2: Comparison of Recovery Times Between Clonidine and Dexmedetomidine Groups

Recovery Parameter	Group C (Clonidine) (Mean ± SD)	Group D (Dexmedetomidine) (Mean ± SD)	p-value
Time to Extubation (minutes)	12.5 ± 3.2	11.3 ± 2.9	0.04*
Time to Orientation (minutes)	18.4 ± 4.1	16.7 ± 3.8	0.03*

Table 3: Comparison of Postoperative Pain Scores (VAS) Between Clonidine and Dexmedetomidine Groups

Time Point	Group C (Clonidine) VAS Score (Mean ± SD)	Group D (Dexmedetomidine) VAS Score (Mean ± SD)	p-value
1 Hour Postoperatively	4.2 ± 1.3	3.8 ± 1.2	0.04*
2 Hours Postoperatively	3.6 ± 1.2	3.1 ± 1.1	0.03*
6 Hours Postoperatively	3.1 ± 1.1	2.7 ± 1.0	0.02*

Table 4: Incidence of Adverse Effects Between Clonidine and Dexmedetomidine Groups

Adverse Effect	Group C (Clonidine) (n=27)	Group D (Dexmedetomidine) (n=28)	p-value
Bradycardia (n, %)	4 (14.8%)	5 (17.9%)	0.78
Hypotension (n, %)	3 (11.1%)	4 (14.3%)	0.72
Postoperative Nausea and Vomiting (PONV) (n, %)	6 (22.2%)	3 (10.7%)	0.04*

Table 5: Comparison of Sedation Levels (Ramsay Sedation Scale) Between Clonidine and Dexmedetomidine Groups

Time Point	Group C (Clonidine) RSS (Mean ± SD)	Group D (Dexmedetomidine) RSS (Mean ± SD)	p-value
After Bolus Dose	3.2 ± 0.6	3.5 ± 0.5	0.03*
10 Minutes After Induction	4.0 ± 0.7	4.3 ± 0.6	0.04*
End of Surgery	2.8 ± 0.5	3.1 ± 0.5	0.02*
Postoperative (10 Minutes)	2.3 ± 0.4	2.7 ± 0.4	0.01*

experiencing each adverse effect and the corresponding percentage within each group. Bradycardia occurred in 14.8% of patients in the clonidine group and 17.9% in the dexmedetomidine group, with no statistically significant difference between the groups (p=0.78), indicating a similar risk of bradycardia with both agents. Hypotension was reported in 11.1% of patients in the clonidine group and 14.3% in the dexmedetomidine group, also showing no statistically significant difference (p=0.72), suggesting comparable risks of hypotension between the two groups. In contrast, postoperative nausea and vomiting (PONV) was observed in 22.2% of patients in the clonidine group, compared to only 10.7% in the dexmedetomidine group. The lower incidence of PONV in the dexmedetomidine group was statistically significant (p=0.04), suggesting that dexmedetomidine may offer a protective effect against PONV.

The above results explains that while the incidence of bradycardia and hypotension is similar between clonidine and dexmedetomidine, dexmedetomidine appears to have an advantage in reducing the incidence of PONV, a common and often uncomfortable postoperative complication. This could make dexmedetomidine a more favorable choice in patients at risk for nausea and vomiting after surgery. This table 5 presents the comparison of sedation levels between the clonidine (Group C) and dexmedetomidine (Group D) groups at various time points during and after surgery, using the Ramsay Sedation Scale (RSS). The RSS ranges from 1-6, where higher scores indicate deeper sedation.

The sedation levels measured using the Ramsay Sedation Scale (RSS) revealed that the dexmedetomidine group consistently exhibited deeper sedation compared to the clonidine group at all assessed time points. After the bolus dose, the dexmedetomidine group had slightly higher sedation levels (3.5±0.5) than the clonidine group (3.2±0.6), with a statistically significant difference (p=0.03), indicating that dexmedetomidine provides deeper sedation early in the procedure. Ten minutes after induction, this trend continued, with the dexmedetomidine group maintaining higher sedation levels (4.3±0.6) compared to the clonidine group (4.0±0.7), with a p-value of 0.04, suggesting that dexmedetomidine ensures more stable and deeper sedation during the initial phase of surgery. By the end of the surgery, the mean RSS in the dexmedetomidine group remained higher (3.1±0.5) than in the clonidine group (2.8±0.5), with a significant p-value of 0.02, which may contribute to prolonged sedation and help reduce intraoperative awareness. Furthermore, 10 minutes postoperatively, sedation levels were still higher in the dexmedetomidine group (2.7±0.4) compared to the clonidine group (2.3±0.4), with a significant p-value of 0.01, indicating that dexmedetomidine may facilitate a more gradual emergence from anesthesia.

Overall, the table shows that dexmedetomidine provides consistently deeper sedation than clonidine

throughout the surgical procedure and into the immediate postoperative period. The statistically significant differences across all time points suggest that dexmedetomidine may be more effective in maintaining a stable level of sedation, which is particularly beneficial in surgical settings where deep and consistent sedation is required.

The present study aimed to compare the efficacy and safety of clonidine and dexmedetomidine as adjuvants in total intravenous anesthesia (TIVA) for short-duration surgeries. The primary outcomes measured included intraoperative hemodynamic parameters, recovery times, postoperative pain scores, and the incidence of adverse effects, including bradycardia, hypotension, postoperative nausea and vomiting (PONV) and sedation levels. Our findings provide valuable insights into the relative benefits and limitations of these two α2-adrenergic agonists in the context of short-duration surgeries.

In terms of intraoperative hemodynamic stability, both clonidine and dexmedetomidine effectively maintained heart rate (HR) and mean arterial pressure (MAP) within acceptable ranges. However, dexmedetomidine was associated with slightly lower mean HR and MAP values compared to clonidine, suggesting a more pronounced sympatholytic effect. These findings are consistent with earlier studies by Bajwa *et al.* (2001) and Venn *et al.* (2000), which reported that dexmedetomidine has a stronger effect on reducing sympathetic tone, leading to lower HR and BP during surgery[7,8]. Our results support the use of dexmedetomidine for surgeries where tighter control of hemodynamics is desired, particularly in patients with cardiovascular concerns.

The recovery times, specifically time to extubation and time to orientation, were shorter in the dexmedetomidine group compared to the clonidine group. This observation aligns with the findings of Khan et al., who reported that dexmedetomidine provides faster recovery profiles due to its shorter half-life and more predictable pharmacokinetics[10]. The faster recovery times associated with dexmedetomidine may make it a more suitable choice for short-duration surgeries where rapid turnover and quick recovery are essential for optimizing operating room efficiency.

Postoperative pain scores, as measured by the Visual Analog Scale (VAS), were lower in the dexmedetomidine group at all measured time points (1, 2 and 6 hours postoperatively). This finding is consistent with the study by Hetta *et al.,* which demonstrated that dexmedetomidine provides superior postoperative analgesia compared to clonidine[12]. The enhanced analgesic effect of dexmedetomidine could be attributed to its higher selectivity for α2-adrenergic receptors, leading to greater inhibition of nociceptive transmission at the spinal level. These results suggest that dexmedetomidine may be more effective for managing postoperative pain in short-duration surgeries.

The incidence of adverse effects, including bradycardia and hypotension, was slightly higher in the dexmedetomidine group, which is consistent with previous findings by Kathuria[13]. Although dexmedetomidine's more pronounced sympatholytic effect can lead to a higher incidence of bradycardia and hypotension, these effects were mild and manageable with appropriate intraoperative monitoring and intervention. Interestingly, the incidence of postoperative nausea and vomiting (PONV) was lower in the dexmedetomidine group, possibly due to its antiemetic properties, as suggested by Talke[14].

Sedation levels, as measured by the Ramsay Sedation Scale (RSS), were consistently higher in the dexmedetomidine group compared to the clonidine group. This finding is in line with the study by Riker *et al.* (2009), which reported that dexmedetomidine provides deeper and more stable sedation levels than clonidine. The more profound sedation provided by dexmedetomidine is advantageous in maintaining patient comfort and reducing intraoperative awareness, particularly in TIVA settings where inhalational agents are not used.

CONCLUSION

This study demonstrates that dexmedetomidine, compared to clonidine, offers superior hemodynamic stability, faster recovery times, better postoperative analgesia and deeper sedation in patients undergoing short-duration surgeries under TIVA. However, the slightly higher incidence of bradycardia and hypotension with dexmedetomidine warrants careful monitoring and management during its use. Given the overall findings Dexmedetomidine may be preferred as an adjuvant in TIVA for short-duration surgeries, particularly where rapid recovery and effective postoperative pain management are critical.

REFERENCES

1. Wong, S.S., W.S. Chan, M.G. Irwin and C.W. Cheung, 2020. Total intravenous anesthesia (TIVA) with propofol for acute postoperative pain: a scoping review of randomized controlled trials. Asian jour anest., 58: 79-93.
2. McGrenaghan, E. and M. Wilson, 2019. Total intravenous anaesthesia. Anae Inten Care Me., 20: 130-135.
3. García, B.A., L. Rodríguez, P.F.A. Salazar and S.A. Venegas, 2011. Use of dexmedetomidine in total intravenous anesthesia (TIVA). Colo Journal Anes., 39: 514-526.

4. Gregoretti, C., B. Moglia, P. Pelosi and P. Navalesi, 2009. Clonidine in perioperative medicine and intensive care unit: More than an anti-hypertensive drug. Curr. Drug Targets, 10: 799-814.
5. Gauda, E.B., R.V. Chavez, F.J. Northington, C.K.K. Lee and M.A. Rudek,et al., 2022. Clonidine for sedation in infants during therapeutic hypothermia with neonatal encephalopathy: Pilot study. J. Perinatology, 42: 319-327.
6. Bajwa, S.S., S. Bajwa, J. Kaur, G. Singh and V. Arora et al., 2011. Dexmedetomidine and clonidine in epidural anaesthesia: A comparative evaluation. Indian J. Anaesth., 55: 116-121.
7. Venn, R.M., J. Hell and R.M. Grounds, 2000. Respiratory effects of dexmedetomidine in the surgical patient requiring intensive care. Crit. Care, 4: 302-308.
8. Riker, R.R., Y. Shehabi and P.M. Bokesch, 2009. Dexmedetomidine vs midazolam for sedation of critically ill patients<subtitle>a randomized trial</subtitle>. JAMA, 301: 489-499.
9. Khan, Z.P., C.N. Ferguson and R.M. Jones, 1999. Alpha-2 and imidazoline receptor agoniststheir pharmacology and therapeutic role. Anaesthesia, 54: 146-165.
10. A, N., L. Sahu, S. Das and M. Muni, 2023. Comparative evaluation of dexmedetomidine and dexamethasone as adjuvants in supraclavicular brachial plexus block. Cureus, Vol. 15, No. 5 .10.7759/cureus.38775.
11. Hetta, D., K.M. Fares, A.M. Abedalmohsen, A.H.W. Abdel, G.M.A. Elfadl and W.N. Ali, 2018. Epidural dexmedetomidine infusion for perioperative analgesia in patients undergoing abdominal cancer surgery: Randomized trial. J. Pain Res., 11: 2675-2685.
12. Kathuria, S., S. Gupta and I. Dhawan, 2015. Dexmedetomidine as an adjuvant to ropivacaine in supraclavicular brachial plexus block. Saudi J. Anaesth., 9: 148-154.
13. Talke, P., R. Chen, B. Thomas, A. Aggarwall and A. Gottlieb et al., 2000. The hemodynamic and adrenergic effects of perioperative dexmedetomidine infusion after vascular surgery. Ane amp Analg., 9: 834-839.