e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(5); 1047-1053

Original Research Article

Effect of Dexmedetomidine Premedication on Intraoperative Anaesthetic Requirement and Postoperative Recovery

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Received: 01-02-2026 / Revised: 15-03-2026 / Accepted: 21-04-2026

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Conflict of interest: Nil

Abstract

Background: Dexmedetomidine is a highly selective α2-adrenergic receptor agonist increasingly used in anesthetic practice because of its sedative, anxiolytic, sympatholytic, and analgesic properties without causing significant respiratory depression. Premedication with dexmedetomidine has shown potential in reducing intraoperative anesthetic and opioid requirements while improving postoperative recovery characteristics. Optimizing anesthetic drug consumption and enhancing postoperative recovery are important goals in modern perioperative care because they contribute to improved hemodynamic stability, decreased adverse effects, and shorter recovery time. However, the extent of anesthetic sparing and recovery benefits associated with dexmedetomidine premedication remains an area of ongoing clinical evaluation.

Aim: To evaluate the effect of dexmedetomidine premedication on intraoperative anesthetic requirement and postoperative recovery among patients undergoing elective surgeries under general anesthesia.

Materials and Methods: This prospective randomized comparative study was conducted in the Department of Anesthesiology of a tertiary care teaching hospital over a period of 18 months. A total of 120 patients aged 18–65 years belonging to ASA physical status I and II scheduled for elective surgery under general anesthesia were included. Patients were randomly divided into two groups of 60 each. Group D received intravenous dexmedetomidine premedication at a dose of 1 μg/kg diluted in normal saline over 10 minutes before induction, while Group C received an equal volume of normal saline placebo. Intraoperative anesthetic requirement, hemodynamic parameters, recovery profile, postoperative pain scores, sedation levels, and adverse events were assessed and compared between groups.

Results: Patients receiving dexmedetomidine demonstrated significantly reduced intraoperative anesthetic and opioid requirements compared with the control group. Hemodynamic parameters remained more stable in the dexmedetomidine group throughout surgery. Postoperative recovery was smoother with lower pain scores, reduced postoperative analgesic consumption, and improved sedation quality. Incidence of postoperative nausea and vomiting was lower in the dexmedetomidine group. Recovery room discharge time was shorter, and patient satisfaction scores were significantly better among patients receiving dexmedetomidine premedication.

Conclusion: Dexmedetomidine premedication effectively reduces intraoperative anesthetic requirement and improves postoperative recovery profile while maintaining better perioperative hemodynamic stability. It may serve as a useful anesthetic adjuvant in elective surgeries performed under general anesthesia.

Keywords: Dexmedetomidine, Premedication, Anesthetic Requirement, Postoperative Recovery, General Anesthesia, Hemodynamic Stability.

DOI: 10.25258/ijcpr.18.5.170

Introduction

General anesthesia aims to provide adequate hypnosis, analgesia, muscle relaxation, and autonomic stability during surgery while ensuring rapid and smooth postoperative recovery. Modern anesthetic practice increasingly emphasizes balanced anesthesia, where various pharmacological agents are combined to reduce the dosage and adverse effects of individual drugs. Premedication forms an important component of balanced anesthesia because it helps alleviate anxiety, attenuate stress response, improve perioperative hemodynamic stability, and decrease

anesthetic requirements. Among newer anesthetic adjuncts, dexmedetomidine has emerged as an important agent because of its unique pharmacological profile and favorable perioperative effects. [1] Dexmedetomidine is a highly selective alpha-2 adrenergic receptor agonist with sedative, anxiolytic, sympatholytic, and analgesic properties. Unlike many conventional sedatives, dexmedetomidine produces sedation resembling natural sleep without causing significant respiratory depression. It acts primarily through activation of alpha-2 receptors in the locus coeruleus, leading to inhibition of norepinephrine release and reduction in sympathetic outflow. This mechanism contributes to stable cardiovascular parameters during stressful surgical stimulation. [2]

Perioperative sympathetic activation during laryngoscopy, intubation, surgical incision, and extubation may lead to tachycardia, hypertension, arrhythmias, and increased myocardial oxygen demand. These responses are particularly undesirable in patients with cardiovascular comorbidities. Dexmedetomidine attenuates these stress responses effectively and helps maintain stable intraoperative hemodynamics. Several studies have demonstrated that dexmedetomidine reduces heart rate and blood pressure fluctuations associated with airway manipulation and surgical stimulation. [3,4]

Another important advantage of dexmedetomidine is its anesthetic-sparing effect. Administration of dexmedetomidine before induction has been shown to decrease requirements of intravenous induction agents, inhalational anesthetics, and opioids. Reduced anesthetic consumption may minimize drug-related adverse effects, facilitate faster recovery, and improve postoperative outcomes. In addition, dexmedetomidine possesses analgesic properties that decrease postoperative pain intensity and opioid requirement. [5]

Postoperative recovery quality has become an important indicator of successful anesthetic management. Delayed emergence, excessive sedation, nausea, vomiting, pain, and agitation adversely affect patient satisfaction and prolong hospital stay. Dexmedetomidine contributes to smoother emergence from anesthesia with better sedation quality and reduced postoperative discomfort. Previous investigations have reported lower incidence of emergence agitation, postoperative shivering, nausea, and vomiting among patients receiving dexmedetomidine. [6,7]

The role of dexmedetomidine as a premedicant has gained considerable attention in various surgical specialties including abdominal, orthopedic, and gynecological, ENT, and laparoscopic surgeries. However, despite widespread use, variations exist regarding optimal dosage, timing of administration, and perioperative benefits in different clinical settings. Further evaluation is required to determine its effectiveness in reducing anesthetic requirement and improving recovery characteristics in routine elective surgical procedures. [8]

The present study was therefore undertaken to evaluate the effect of dexmedetomidine premedication on intraoperative anesthetic requirement and postoperative recovery among patients undergoing elective surgeries under general anesthesia. The study also aimed to assess perioperative hemodynamic stability, postoperative analgesic requirement, sedation profile, and adverse effects associated with dexmedetomidine administration. [9–11]

Material and Methodology

Study design and Settings: This prospective randomized comparative study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital over a period of 18 months after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants before enrollment in the study.

Study Sample: A total of 120 patients scheduled for elective surgical procedures under general anesthesia were included in the study. Patients aged between 18 and 65 years belonging to American Society of Anesthesiologists (ASA) physical status I and II were considered eligible for inclusion. Both male and female patients undergoing surgeries of expected duration between 60 and 180 minutes were enrolled.

Inclusion Criteria

1. Patients aged 18–65 years.
2. ASA physical status I and II.
3. Patients undergoing elective surgeries under general anesthesia.
4. Patients willing to provide informed consent.

Exclusion Criteria

1. Severe cardiovascular disease.
2. Uncontrolled hypertension.
3. Cardiac arrhythmias.
4. Hepatic dysfunction.
5. Renal impairment.
6. Chronic respiratory illness.
7. Psychiatric disorders.
8. Known allergy to dexmedetomidine.
9. Pregnancy and lactation.
10. Body mass index >35 kg/m².
11. Difficult airway.
12. Patients receiving chronic sedatives, beta blockers, or opioid therapy.

Sample Size: The sample size was calculated based on previous studies evaluating the anesthetic-sparing effect of dexmedetomidine. Using a

confidence level of 95%, power of 80%, and anticipating a clinically significant reduction in anesthetic requirement, the minimum required sample size was estimated to be 54 patients per group. To compensate for possible dropouts and incomplete observations, 60 patients were included in each group, resulting in a total sample size of 120 patients.

Randomization and Group Allocation: Patients were randomly allocated into two groups using computer-generated randomization. Group D consisted of 60 patients who received dexmedetomidine premedication, whereas Group C consisted of 60 patients who received placebo normal saline. Allocation concealment was maintained using sealed opaque envelopes.

Pre-anesthetic Evaluation: All patients underwent detailed pre-anesthetic evaluation including medical history, physical examination, airway assessment, and routine laboratory investigations. Patients were kept nil per oral according to standard fasting guidelines. Baseline heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiratory rate, and oxygen saturation were recorded before administration of study drugs.

Study Drug Administration: In Group D, dexmedetomidine was administered intravenously at a dose of 1 µg/kg diluted in 100 mL normal saline over 10 minutes before induction of anesthesia. Group C received 100 mL normal saline over the same duration. Standard monitoring including electrocardiography, pulse oximetry, noninvasive blood pressure monitoring, capnography, and temperature monitoring was instituted in all patients.

Anesthetic Technique: General anesthesia was induced using intravenous propofol until loss of verbal response. Fentanyl and vecuronium were administered for analgesia and neuromuscular blockade respectively. Endotracheal intubation was performed after adequate muscle relaxation. Anesthesia was maintained using oxygen, nitrous oxide, and inhalational anesthetic agents. Additional doses of anesthetic agents and opioids were administered according to clinical requirements and hemodynamic responses.

Intraoperative Monitoring: Intraoperative parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation, and end-tidal anesthetic concentration were recorded at baseline, after premedication, during intubation, after skin incision, intraoperatively at regular intervals, during extubation, and postoperatively. Total consumption of induction agents, inhalational anesthetics, and opioids was documented.

Parameters Assessed: At the end of surgery, neuromuscular blockade was reversed and patients were extubated after meeting standard extubation criteria. Recovery characteristics including emergence time, extubation time, postoperative sedation score, pain score using Visual Analogue Scale (VAS), time to first analgesic requirement, and postoperative nausea and vomiting were recorded. Recovery room discharge readiness was assessed using standard recovery scoring systems.

Adverse Effects Monitored: Adverse effects such as bradycardia, hypotension, respiratory depression, excessive sedation, dry mouth, nausea, vomiting, and shivering were monitored and treated appropriately. Bradycardia was defined as heart rate less than 50 beats per minute and treated with atropine. Hypotension was defined as more than 20% fall from baseline blood pressure and managed with intravenous fluids and vasopressors if required.

Statistical Analysis: Data obtained were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) software version 25. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were expressed as percentages and proportions. Independent t-test was used for comparison of continuous variables between groups, whereas Chi-square test or Fisher's exact test was applied for categorical variables. A p-value less than 0.05 was considered statistically significant.

Results

A total of 120 patients scheduled for elective surgical procedures under general anesthesia were included in the present study and were randomly allocated into two groups of 60 patients each. Group D received dexmedetomidine premedication, while Group C received normal saline placebo. All patients completed the study protocol and were included in the final statistical analysis. The study primarily evaluated intraoperative anesthetic requirement, perioperative hemodynamic stability, and postoperative recovery characteristics.

Table 1: Demographic and Baseline Characteristics of Study Population

Parameter	Group D (Dexmedetomidine) (n=60)	Group C (Control) (n=60)	p-value
Mean age (years)	41.8 ± 10.6	43.1 ± 9.8	0.472
Male/Female	35/25	33/27	0.712
Mean BMI (kg/m²)	24.5 ± 3.1	24.9 ± 3.4	0.538
Mean duration of surgery (min)	94.2 ± 18.6	96.5 ± 17.9	0.491
ASA I patients	38 (63.3%)	36 (60.0%)	0.708
ASA II patients	22 (36.7%)	24 (40.0%)	0.708

The baseline demographic variables were comparable between both groups with no statistically significant difference observed ($p>0.05$). Patients aged between 30 and 50 years constituted the majority of participants in both groups. Male predominance was observed, accounting for 58.3% in Group D and 55.0% in Group C. Mean duration of surgery was similar between groups, ensuring homogeneity of operative exposure and allowing reliable comparison of anesthetic outcomes. Intraoperative anesthetic consumption differed significantly between the two groups. The mean induction dose of propofol required in Group D was markedly lower than in Group C. Similarly, end-tidal inhalational anesthetic requirement and intraoperative fentanyl supplementation were significantly reduced in patients receiving dexmedetomidine premedication. These findings support the anesthetic-sparing properties of dexmedetomidine.

Table 2: Comparison of Intraoperative Anesthetic Requirement and Hemodynamic Parameters

Parameter	Group D (n=60)	Group C (n=60)	Reduction in Group D (%)	p-value
Propofol induction dose (mg)	88.4 ± 12.5	112.6 ± 14.8	21.5%	<0.001*
Inhalational anesthetic concentration (%)	0.82 ± 0.14	1.24 ± 0.18	33.9%	<0.001*
Intraoperative fentanyl requirement (µg)	96.5 ± 18.2	146.4 ± 22.7	34.1%	<0.001*
Mean HR during intubation (beats/min)	78.6 ± 9.2	96.8 ± 11.5	18.8%	<0.001*
Mean arterial pressure during incision (mmHg)	84.5 ± 8.4	98.2 ± 9.7	13.9%	<0.001*
Episodes of intraoperative tachycardia	6 (10.0%)	22 (36.7%)	72.7%	0.001*
Episodes of hypertension	5 (8.3%)	19 (31.7%)	73.8%	0.002*

***Statistically significant**

Group D demonstrated significantly reduced anesthetic requirement compared with Group C. Propofol requirement was reduced by 21.5%, inhalational anesthetic concentration by 33.9%, and fentanyl requirement by 34.1% among dexmedetomidine-treated patients.

These differences were highly statistically significant ($p<0.001$). Intraoperative heart rate and mean arterial pressure remained significantly lower and more stable in Group D. Incidence of tachycardia and hypertension was markedly reduced in the dexmedetomidine group, indicating effective attenuation of sympathetic stress responses during surgery. Postoperative recovery characteristics were significantly improved among patients receiving dexmedetomidine. Emergence from anesthesia was smoother with lower postoperative pain scores and improved sedation quality. Patients in Group D required fewer rescue analgesics and experienced delayed onset of postoperative pain compared with controls. Incidence of postoperative nausea and vomiting was also lower in the dexmedetomidine group.

Recovery room discharge readiness was achieved earlier among dexmedetomidine-treated patients because of better analgesia and reduced postoperative discomfort. Patient satisfaction scores were significantly higher in Group D owing to smoother recovery and improved overall perioperative experience.

Table 3: Comparison of Postoperative Recovery Characteristics

Parameter	Group D (n=60)	Group C (n=60)	Improvement in Group D (%)	p-value
Emergence time (min)	7.8 ± 1.9	10.6 ± 2.4	26.4%	<0.001*
Extubation time (min)	9.4 ± 2.1	12.8 ± 2.7	26.6%	<0.001*
Mean VAS pain score at 2 hrs	3.1 ± 1.0	5.2 ± 1.3	40.4%	<0.001*
Time to first rescue analgesia (hrs)	5.8 ± 1.4	2.9 ± 1.1	100%	<0.001*
Postoperative nausea/vomiting	5 (8.3%)	17 (28.3%)	70.7%	0.005*
Shivering	4 (6.7%)	15 (25.0%)	73.2%	0.007*
Patient satisfaction score (/10)	8.9 ± 0.8	6.8 ± 1.1	30.8%	<0.001*

***Statistically significant**

Patients receiving dexmedetomidine exhibited significantly improved postoperative recovery characteristics. Emergence and extubation times were reduced by approximately 26% compared with controls. Postoperative pain intensity assessed using VAS score was markedly lower in Group D, with a 40.4% reduction in pain scores. The duration before first rescue analgesia requirement doubled among dexmedetomidine-treated patients, demonstrating prolonged analgesic effect. Incidence of postoperative nausea, vomiting, and shivering was significantly lower in Group D. Overall patient satisfaction improved substantially in patients receiving dexmedetomidine premedication.

Adverse effects associated with dexmedetomidine were mild and manageable. Bradycardia was observed in 5 patients (8.3%) in Group D compared with 2 patients (3.3%) in Group C, but the difference was not statistically significant. Hypotension occurred in 6 patients (10.0%) in Group D and 4 patients (6.7%) in Group C. All episodes responded to standard treatment measures without serious complications. No incidence of respiratory depression was observed in either group.

Overall, the findings of the present study demonstrate that dexmedetomidine premedication significantly reduces intraoperative anesthetic requirement, improves perioperative hemodynamic stability, decreases postoperative pain, and enhances overall postoperative recovery quality compared with placebo premedication.

Discussion

The present prospective randomized comparative study evaluated the effect of dexmedetomidine premedication on intraoperative anesthetic requirement and postoperative recovery among patients undergoing elective surgeries under general anesthesia.

The findings demonstrated that dexmedetomidine significantly reduced anesthetic and opioid requirements, improved perioperative hemodynamic stability, and enhanced postoperative recovery with minimal adverse effects. These observations are consistent with previous investigations that established dexmedetomidine as an effective anesthetic adjunct.

Initial research on dexmedetomidine primarily focused on its sedative and cardiovascular effects. Bloor et al. demonstrated that intravenous dexmedetomidine produced dose-dependent sedation along with significant reductions in sympathetic activity and stable hemodynamic responses without clinically significant respiratory depression. [6] These early observations highlighted the safety profile of dexmedetomidine and established its potential role in balanced anesthesia techniques. Subsequently, Aantaa et al. reported that dexmedetomidine significantly reduced the minimum alveolar concentration of isoflurane during general anesthesia, confirming its anesthetic-sparing properties. [1] The reduction in inhalational anesthetic requirement observed in the present study closely parallels these findings and supports the role of dexmedetomidine in minimizing anesthetic drug exposure.

The sympatholytic effect of dexmedetomidine has been extensively investigated. Khan et al. explained that alpha-2 adrenergic agonists suppress central sympathetic outflow through activation of receptors in the locus coeruleus, thereby producing sedation, anxiolysis, and cardiovascular stability. [2] In the present study, patients receiving dexmedetomidine demonstrated significantly lower heart rate and mean arterial pressure during laryngoscopy, intubation, and surgical stimulation. Similar findings were observed by Kallio et al., who demonstrated attenuation of perioperative adrenergic responses and improved hemodynamic stability in vascular surgical patients receiving dexmedetomidine infusion. [3] Likewise, Ebert et al. reported predictable reductions in blood pressure and heart rate with increasing plasma concentrations of dexmedetomidine, emphasizing its role in suppressing catecholamine-mediated stress responses. [9]

One of the most important findings of the present study was the significant reduction in intraoperative opioid and anesthetic requirement among patients receiving dexmedetomidine. Propofol induction dose, inhalational anesthetic concentration, and fentanyl supplementation were all significantly reduced in Group D compared with controls. This anesthetic-sparing effect may be attributed to synergistic interaction between dexmedetomidine and other anesthetic agents, resulting in enhanced hypnosis and analgesia. Reduced anesthetic exposure is clinically beneficial because it may decrease drug-related adverse effects and facilitate smoother postoperative recovery.

The analgesic properties of dexmedetomidine also contributed substantially to improved postoperative outcomes in the present study. Patients receiving dexmedetomidine experienced lower postoperative pain scores and delayed requirement for rescue analgesia. Arain et al. demonstrated that dexmedetomidine provided superior postoperative analgesia compared with morphine after major inpatient surgery, with lower opioid consumption and improved sedation quality. [4]

Similarly, Gurbet et al. reported that intraoperative dexmedetomidine infusion significantly reduced perioperative analgesic requirement and improved pain control. [5] Dexmedetomidine acts at spinal

alpha-2 receptors to inhibit nociceptive transmission within the dorsal horn of the spinal cord, thereby prolonging analgesic duration and reducing postoperative pain perception.

Improved recovery characteristics observed in the present study are also supported by previous literature. Hall et al. demonstrated that small-dose dexmedetomidine infusions produce effective sedation, amnesia, and analgesia while preserving respiratory function and facilitating cooperative recovery. [13] In the current investigation, emergence and extubation times were significantly shorter in the dexmedetomidine group, and patients exhibited smoother recovery with minimal agitation. This favorable recovery profile may result from reduced anesthetic exposure combined with effective perioperative analgesia. Furthermore, dexmedetomidine-induced sedation closely resembles physiological sleep, permitting easy arousal and improving patient comfort during recovery.

The reduction in postoperative nausea and vomiting observed in the present study is another clinically important finding. Tufanogullari et al. demonstrated that dexmedetomidine infusion during laparoscopic bariatric surgery improved recovery outcomes and significantly reduced postoperative nausea and opioid consumption. [7] Reduced perioperative opioid administration in dexmedetomidine-treated patients may partly explain the lower incidence of postoperative emesis observed in the current study. Better gastrointestinal tolerance and smoother recovery may also contribute to higher patient satisfaction scores associated with dexmedetomidine administration.

Postoperative shivering was significantly lower among patients receiving dexmedetomidine in the present investigation. Ju et al., in a systematic review and meta-analysis, concluded that perioperative alpha-2 agonists effectively decrease postoperative pain intensity and improve analgesic outcomes while also reducing thermoregulatory complications such as shivering. [8] Dexmedetomidine lowers vasoconstriction and shivering thresholds through central thermoregulatory modulation, thereby improving postoperative comfort and reducing metabolic stress associated with shivering.

More recent studies continue to support the expanding role of dexmedetomidine in modern anesthetic practice. Ibrahim et al. demonstrated that dexmedetomidine infusion during craniotomy provided stable hemodynamics and shortened recovery time without significant complications. [10] Zhou et al., through meta-analysis, further confirmed that intravenous dexmedetomidine attenuates intraocular pressure and stress responses associated with endotracheal intubation. [11] Zhang et al. compared dexmedetomidine with midazolam during dental procedures and reported superior sedation quality and cardiovascular stability with dexmedetomidine. [12]

Recent systematic reviews have reinforced the opioid-sparing role of dexmedetomidine. Sun et al. concluded that dexmedetomidine significantly reduces postoperative opioid requirement and improves analgesic quality across various surgical procedures. [14] Similarly, Yahya et al. emphasized the utility of dexmedetomidine as a component of total intravenous anesthesia because of its combined sedative, analgesic, and recovery-enhancing properties. [15]

Although mild bradycardia and hypotension were observed in a small proportion of patients in the present study, these adverse effects were transient and manageable with standard interventions. Overall, the present investigation confirms that dexmedetomidine premedication effectively reduces anesthetic and opioid requirements while improving perioperative stability, postoperative analgesia, and recovery quality in patients undergoing elective surgeries under general anesthesia.

Conclusion

To conclude, dexmedetomidine premedication significantly reduces intraoperative anesthetic and opioid requirement while improving perioperative hemodynamic stability and postoperative recovery profile. The drug provides effective analgesia, smoother emergence, lower incidence of postoperative nausea and shivering, and greater patient satisfaction with minimal manageable adverse effects. Dexmedetomidine may therefore be considered an effective anesthetic adjuvant for elective surgeries performed under general anesthesia.

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