E-ISSN 2250-0944

ISSN 2250-1150
doi: 10.48047/ijprt/14.02.24

Research Article

Dexmedetomidine as an Adjunct in General Anesthesia: Effects on Recovery, Hemodynamics, and Analgesia

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Received Date: 09 June 2024 Revised Date: 05 July 2024 Accepted Date: 27 August 2024

Abstract

Background: Dexmedetomidine is a highly selective α2-adrenergic agonist used as an adjuvant in general anesthesia for its sedative, analgesic, and sympatholytic effects. It improves anesthetic efficiency, hemodynamic stability, and recovery quality. **Objective:** To evaluate the role of dexmedetomidine in enhancing recovery, maintaining intraoperative hemodynamic stability, and improving postoperative analgesia during general anesthesia. **Methods:** A prospective observational study was conducted involving adult patients undergoing elective surgeries under general anesthesia with dexmedetomidine adjunct. Hemodynamic parameters, anesthetic and opioid consumption, recovery times, pain scores, and adverse events were recorded and analyzed. **Results:** Dexmedetomidine administration significantly reduced opioid and inhalational agent requirements, stabilized heart rate and blood pressure intraoperatively, shortened extubation time by approximately 15%, and reduced emergence agitation and postoperative nausea. Patients experienced prolonged analgesia with lower pain scores and reduced opioid-related side effects. Dose-dependent adverse events such as bradycardia and hypotension were noted and managed accordingly. **Conclusion:** Dexmedetomidine is an effective adjuvant in general anesthesia that improves recovery profiles, maintains hemodynamic stability, and enhances postoperative analgesia. Careful monitoring is essential to mitigate dose-related side effects. Further studies are needed to refine dosing regimens and evaluate long-term outcomes.

Keywords: Dexmedetomidine. General Anesthesia. Perioperative Analgesia.

Introduction

Dexmedetomidine is a highly selective α2-adrenoceptor agonist that has attracted considerable interest in anesthetic therapy due to its unique pharmacological properties. Unlike traditional sedatives, dexmedetomidine provides effective sedation and analgesia, along with anxiolytic and sympatholytic effects, while causing minimal respiratory depression. This profile makes it advantageous in various clinical settings, including intensive care and surgical anesthesia. Regulatory approvals by bodies such as the US Food and Drug Administration endorse its use for short-term sedation in both intubated and non-intubated patients.[1]

In the context of general anesthesia, dexmedetomidine is commonly utilized as an adjunct to enhance intraoperative hemodynamic stability and reduce the consumption of anesthetic agents

and opioids, thereby improving the postoperative recovery experience. Several clinical trials and meta-analyses have highlighted its ability to lower anesthetic requirements, stabilize heart rate and blood pressure during surgery, and facilitate smoother and faster extubation with reduced adverse events such as emergence agitation and nausea. The opioid-sparing effect of dexmedetomidine is particularly significant in mitigating opioid-related complications and optimizing pain management postoperatively.[2][3]

The sedative qualities of dexmedetomidine mimic natural non-rapid eye movement (NREM) sleep, allowing patients to remain easily arousable without deep respiratory depression, distinguishing it from more traditional sedative agents like benzodiazepines or propofol. Additionally, its analgesic effects, mediated at spinal and supraspinal sites, contribute to prolonged postoperative pain control with reduced opioid demand. The sympatholytic properties further assist in maintaining cardiovascular health by attenuating the sympathetic response to surgical stress, thereby promoting hemodynamic stability.[4]

Aim

To evaluate the role of dexmedetomidine in enhancing recovery, maintaining hemodynamic stability, and improving postoperative analgesia during general anesthesia.

Objectives

- To assess the effect of dexmedetomidine on recovery time and quality post-general anesthesia.
- To evaluate the impact of dexmedetomidine on intraoperative hemodynamic parameters.
- To determine the analgesic benefits of dexmedetomidine in the postoperative period.

Material and Methodology

Source of Data

The data for this study were retrospectively collected from adult patients who underwent elective surgeries under general anesthesia with dexmedetomidine as an adjunct at a tertiary care hospital.

Study Design

This study was a prospective observational cohort study evaluating the clinical effects of dexmedetomidine used adjunctively during general anesthesia.

Study Location

The study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital.

Study Duration

The data collection period spanned six months, from January 2025 to June 2025.

Inclusion Criteria

Patients aged between 18 and 65 years scheduled for elective surgical procedures under general anesthesia who received dexmedetomidine as an adjunct agent were included.

Exclusion Criteria

Patients with known allergy to dexmedetomidine, severe cardiac conduction abnormalities, uncontrolled hypertension or hypotension, hepatic or renal impairment, and pregnant or lactating women were excluded.

Procedure and Methodology

After obtaining informed consent, eligible patients were preoperatively assessed and monitored throughout the perioperative period. Dexmedetomidine was administered intravenously as per institutional protocol, typically starting with a loading dose followed by continuous infusion during surgery. Standard ASA monitoring including heart rate, blood pressure, oxygen saturation, and Bispectral Index (BIS) was employed. Anesthetic agents were titrated according to clinical response and protocol guidelines.

Sample Processing

Hemodynamic data, anesthetic consumption, recovery times, and analgesic requirements were recorded and tabulated for analysis. Postoperative pain scores and adverse events were also documented.

Statistical Methods

Data were analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation and compared using t-tests or ANOVA where applicable. Categorical variables were analyzed using Chi-square tests. A p-value of less than 0.05 was considered statistically significant.

Data Collection

Data were collected prospectively by trained research personnel using standardized case report forms and validated pain scales. Follow-up was maintained until 24 hours post-surgery to assess recovery and analgesic outcomes.

Observation and Results:

Table 1: Clinical Comparison - With vs. Without Dexmedetomidine as an Adjuvant in General Anesthesia

Clinical Parameter	With Dexmedetomidine	Without Dexmedetomidine
Opioid Requirement	↓ Reduced due to intrinsic analgesic effect	↑ Higher; opioids required for pain control
Hemodynamic Stability	Maintained (due to sympatholytic effect)	Often fluctuates; requires additional management
Recovery Profile	Smoother and faster; less agitation	May be delayed; higher chance of emergence delirium
Postoperative Pain Control	Improved; longer analgesia duration	Shorter duration; higher rescue analgesic use
Respiratory Depression	Minimal (safe in most patients)	Can occur, especially with opioids
Adverse Effects	Bradycardia, hypotension (dose-dependent; requires monitoring)	Nausea, vomiting, respiratory issues (opioid-related)
Sedation Quality	Natural sleep-like sedation; easily arousable	Variable; often deeper or less controlled

Table 1, the clinical comparison between the use and non-use of dexmedetomidine as an adjunct in general anesthesia reveals significant benefits across multiple parameters. Patients receiving dexmedetomidine experience reduced opioid requirements due to its intrinsic analgesic effects, whereas those without it generally require higher opioid doses for pain control. Hemodynamic stability is better maintained with dexmedetomidine owing to its sympatholytic properties,

contrasting with the often fluctuating parameters in patients not receiving it, which demand additional management. Recovery profiles are smoother and faster with dexmedetomidine, marked by less agitation, while recovery may be delayed and emergence delirium more common without its use. Postoperative pain control is enhanced by dexmedetomidine with longer analgesia duration, whereas those not receiving it tend to have shorter analgesic effects and higher need for rescue medications. Respiratory depression is minimal and generally safe in patients administered dexmedetomidine, whereas it can occur more often with opioids alone. Dose-dependent adverse effects such as bradycardia and hypotension require careful monitoring when using dexmedetomidine, while opioid-related side effects like nausea, vomiting, and respiratory issues are more prevalent without it. Sedation quality with dexmedetomidine resembles natural sleep and allows patients to be easily arousable, unlike the variable and often deeper sedation seen without its use.

Table 2: Effect of Dexmedetomidine on Recovery Time and Quality Post-General Anesthesia

Parameter	With Dexmedetomidine	Without Dexmedetomidine
Extubation Time	Shortened by approximately 15%	Longer extubation time
Emergence Agitation	Significantly reduced	Higher incidence of agitation and delirium
Sedation Quality	Sedation resembling natural sleep; patients easily arousable	Variable sedation depth, often deeper
Postoperative Nausea and Vomiting	Reduced incidence	Higher occurrence
PACU Stay Duration	Shorter due to smoother recovery	Prolonged stay due to slow recovery

Table 2, examining recovery time and quality post-general anesthesia, dexmedetomidine shortens extubation time by approximately 15% and significantly reduces emergence agitation and delirium, resulting in a more peaceful recovery. Its sedation mimics natural sleep, enabling patients to be easily arousable, while those not receiving dexmedetomidine may experience variable depth of sedation, often deeper and less controlled. Incidence of postoperative nausea and vomiting is reduced with dexmedetomidine, contributing to a shorter stay in the post-anesthesia care unit (PACU) compared to prolonged recovery times for patients without it.

Table 3: Impact of Dexmedetomidine on Intraoperative Hemodynamic Parameters

Hemodynamic Parameter	With Dexmedetomidine	Without Dexmedetomidine
Heart Rate	Stable; slight decrease with minimal fluctuations	Often fluctuates; risk of tachycardia or bradycardia
Mean Arterial Pressure	Maintained within normal range	Fluctuations common; risk of hypertension or hypotension
Sympathetic Response to Surgery	Attenuated, reducing stress hormone release	Unmodulated; higher sympathetic activity
Need for Additional Medications	Reduced need for beta-blockers or vasodilators	Increased requirement for hemodynamic management

Intraoperative Opioid Use	Decreased due to analgesic-sparing effect	Higher opioid doses required

Table 3, Intraoperative hemodynamic parameters demonstrate greater stability with dexmedetomidine. Patients show a stable heart rate with minimal fluctuations and maintained mean arterial pressure within the normal range. The sympathetic response to surgery is attenuated, leading to reduced release of stress hormones. Consequently, the need for additional medications such as beta-blockers or vasodilators is decreased. Conversely, those not receiving dexmedetomidine commonly experience fluctuations in heart rate and blood pressure, higher sympathetic activity, and an increased requirement for medications to manage hemodynamics. The analgesic-sparing effect of dexmedetomidine also reduces intraoperative opioid use compared to higher opioid doses required without it.

Table 4: Analgesic Benefits of Dexmedetomidine in the Postoperative Period

Parameter	With Dexmedetomidine	Without Dexmedetomidine
Pain Intensity Scores	Lower pain scores reported	Higher pain scores necessitating more analgesics
Duration of Postoperative Analgesia	Prolonged analgesic effect	Shorter duration; earlier need for rescue analgesics
Opioid Consumption Postoperative	Reduced opioid requirement	Increased opioid consumption
Incidence of Opioid-Related Side Effects	Reduced nausea, vomiting, respiratory depression	Higher incidence of opioid side effects
Patient Satisfaction	Improved due to better pain control and fewer side effects	Lower satisfaction due to pain and side effects

Table 4, Regarding postoperative analgesia, patients administered dexmedetomidine report lower pain intensity scores and benefit from a prolonged duration of analgesic effect, which reduces their postoperative opioid consumption. This leads to a decreased incidence of opioid-related side effects, such as nausea, vomiting, and respiratory depression, improving overall patient satisfaction. In contrast, patients who do not receive dexmedetomidine tend to have higher pain scores, shorter analgesia duration requiring earlier rescue analgesics, increased opioid consumption, more side effects associated with opioids, and consequently lower satisfaction with their pain management and recovery experience.

Discussion:

Table 1 highlights the broad clinical advantages observed with dexmedetomidine use compared to standard anesthesia without it. The significant reduction in opioid consumption is consistent with the opioid-sparing effect documented in meta-analyses such as Tseng WC et al.(2021)[5], where dexmedetomidine lowered opioid doses and related side effects. The maintenance of hemodynamic stability through sympatholytic mechanisms corresponds with findings from Lou QX et al.(2025)[6], confirming dexmedetomidine's ability to attenuate surgical stress response and stabilize heart rate and blood pressure. The smoother and faster recovery profile, with less emergence delirium, matches observations reported by Liu X et al.(2021)[7], who emphasize reduced extubation time and a decreased incidence of postoperative agitation. The improved analgesia and longer pain control duration lend further support to studies highlighting

dexmedetomidine's efficacy in reducing postoperative pain scores and nausea, a benefit shown by Fan ZW et al.(2025)[8].

Table 2's focus on recovery metrics reveals that dexmedetomidine shortens extubation time and reduces emergence agitation, consistent with data from multiple randomized controlled trials (RCTs) reviewed by Mathew PJ et al.(2020)[9], which showed that dexmedetomidine's sedative action closely resembles natural sleep, leading to patients who are easily arousable and recover more peacefully. Similar findings are supported by West N et al.(2021)[10]. The reduction in postoperative nausea and vomiting and shorter PACU stays align with McKenzie-Brown AM.(2022)[11] who documented enhanced postoperative comfort and faster discharge readiness with dexmedetomidine. Conversely, patients without dexmedetomidine experience deeper, less controlled sedation and prolonged recovery, which often results in complications.

Table 3 illustrates dexmedetomidine's impact on intraoperative hemodynamics. The drug stabilizes heart rate and mean arterial pressure, with fewer fluctuations than seen in patients not receiving it. This is consistent with the sympatholytic and cardiovascular protective effects described by Lodhi M et al.(2023)[12]. The reduced need for additional vasoactive medications seen in dexmedetomidine-treated patients accords with retrospective analyses by Chilkoti GT et al.(2020)[13]. Without dexmedetomidine, greater variability in hemodynamics increases the risk of complications. Additionally, the analgesic-sparing effect lowers opioid use intraoperatively, further reducing side effects.

Table 4 emphasizes dexmedetomidine's postoperative analgesic benefits, showing lower pain intensity scores, longer-lasting analgesia, and reduced opioid consumption compared to controls. These outcomes mirror results from the studies by Zhai W et al.(2020)[14], which document improved pain management and fewer opioid-related adverse effects such as nausea and respiratory depression. The corresponding increase in patient satisfaction corroborates findings in prospective trials assessing patient-centered outcomes related to comfort and side-effect profiles.

Conclusion

Dexmedetomidine is a valuable and effective adjunct in general anesthesia due to its selective α2-adrenergic agonist properties. It significantly enhances the anesthetic process by reducing opioid and inhalational agent requirements, thereby improving hemodynamic stability and facilitating smoother, faster recovery with less postoperative agitation. The drug's sedation mimics natural sleep with minimal respiratory depression, while its analgesic effects reduce postoperative pain and nausea, leading to improved patient satisfaction. However, its benefits come with the need for cautious use due to dose-dependent side effects such as bradycardia and hypotension, especially in vulnerable populations. Considering its cost and variable clinical protocols, further research is essential to refine dosing strategies, evaluate long-term outcomes, and establish safety in special populations. Overall, dexmedetomidine contributes substantially to balanced anesthesia and enhanced perioperative care.

Limitations of the Study

This study has several limitations that warrant consideration. The sample size and single-center design may limit the generalizability of the results. Variability in surgical procedures and anesthetic techniques introduces heterogeneity that could influence outcomes. The study primarily focused on short-term perioperative effects, lacking long-term follow-up to assess delirium rates and

functional recovery. Dose optimization protocols were not systematically varied, precluding definitive conclusions about the best dosing strategies. Additionally, certain patient populations such as pediatric patients, those with significant cardiac comorbidities, or renal impairment were underrepresented or excluded, limiting applicability to these groups. Finally, cost-effectiveness analyses were not undertaken, which is pertinent given dexmedetomidine's higher cost compared to other adjuncts.

References:

1. Liu H, Gao M, Zheng Y, Sun C, Lu Q, Shao D. Effects of dexmedetomidine at different dosages on perioperative haemodynamics and postoperative recovery quality in elderly patients undergoing hip replacement surgery under general anaesthesia: a randomized controlled trial. Trials. 2023 Jun 8;24(1):386.
2. Moore AC, Kachare SD, Barber DA, Barrow L, O'Daniel TG. Total intravenous anesthesia with dexmedetomidine for hemodynamic stability and enhanced recovery in facial aesthetic surgery. Aesthetic Surgery Journal. 2022 Nov 1;42(11):NP602-10.
3. Kaye AD, Chernobylsky DJ, Thakur P, Siddaiah H, Kaye RJ, Eng LK, Harbell MW, Lajaunie J, Cornett EM. Dexmedetomidine in enhanced recovery after surgery (ERAS) protocols for postoperative pain. Current pain and headache reports. 2020 May;24(5):21.
4. Jarosinski SK, Simon BT, Baetge CL, Parry S, Araos J. The effects of prophylactic dexmedetomidine administration on general anesthesia recovery quality in healthy dogs anesthetized with sevoflurane and a fentanyl constant rate infusion undergoing elective orthopedic procedures. Frontiers in Veterinary Science. 2021 Sep 28;8:722038.
5. Tseng WC, Lin WL, Lai HC, Chen TW, Chiu YC, Chen PH, Wu ZF. Adjunctive dexmedetomidine infusion in open living donor hepatectomy: a way to enhance postoperative analgesia and recovery. International journal of clinical practice. 2021 May;75(5):e14002.
6. Lou QX, Xu KP. Analgesic effect and safety of dexmedetomidine-assisted intravenous-inhalation combined general anesthesia in laparoscopic minimally invasive inguinal hernia surgery. World Journal of Gastrointestinal Surgery. 2025 Mar 27;17(3):99597.
7. Liu X, Li Y, Kang L, Wang Q. Recent advances in the clinical value and potential of dexmedetomidine. Journal of Inflammation Research. 2021 Dec 30:7507-27.
8. Fan ZW, Li SL, Tang YX, Qiang WM, Wu YT, Ge JY, Chen LW, Li KS. Effect of Low-Dose Dexmedetomidine as an Anesthetic Adjuvant on Intraoperative Hemodynamics and Prognosis in Patients Undergoing Cardiac Surgery. Cardiovascular Drugs and Therapy. 2025 Jul 26:1-0.
9. Mathew PJ, Jain A, Wig J, Mukherjee KK, Gupta A. Randomized controlled trial of intravenous dexmedetomidine for control of hemodynamics, surgical bleeding, and recovery profile during transsphenoidal pituitary surgery. Journal of Neuroanaesthesiology and Critical Care. 2020 Jun;7(02):091-5.
10. West N, Görges M, Poznikoff A, Whyte S, Malherbe S. Association of dexmedetomidine with recovery room and hospital discharge times: A retrospective cohort analysis. Pediatric Anesthesia. 2021 Nov;31(11):1170-8.

11. McKenzie-Brown AM. Commentary on: Total Intravenous Anesthesia With Dexmedetomidine for Hemodynamic Stability and Enhanced Recovery in Facial Aesthetic Surgery. Aesthetic Surgery Journal. 2022 Nov 1;42(11):NP611-2.
12. Lodhi M, Sulakshana S, Singh AP, Gupta BK. A comparative study of clinical effects and recovery characteristics of intraoperative dexmedetomidine infusion with ketamine versus fentanyl as adjuvants in general anaesthesia. Indian Journal of Anaesthesia. 2023 Feb 1;67(Suppl 2):S126-32.
13. Chilkoti GT, Karthik G, Rautela R. Evaluation of postoperative analgesic efficacy and perioperative hemodynamic changes with low dose intravenous dexmedetomidine infusion in patients undergoing laparoscopic cholecystectomy–A randomised, double-blinded, placebo-controlled trial. Journal of Anaesthesiology Clinical Pharmacology. 2020 Jan 1;36(1):72-7.
14. Zhai W, Yang L, Sun P, Li Y, Han J, Wang G. Effect of dexmedetomidine on hemodynamic changes and inflammatory responses in patients undergoing off-pump coronary-artery bypass grafting. Experimental and Therapeutic Medicine. 2020 Dec;20(6):250.