



## ***USE OF DEXMEDETOMIDINE IN GENERAL AND THORACIC SURGERY: HEMODYNAMIC CONTROL AND POST-ANESTHETIC OUTCOMES***

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### ***REVISÃO INTEGRATIVA DA LITERATURA***

#### **ABSTRACT**

Dexmedetomidine, a highly selective  $\alpha_2$ -adrenergic receptor agonist, has become one of the most relevant pharmacological agents in modern anesthesiology due to its ability to promote cooperative sedation, effective analgesia, and hemodynamic stability. Its sympatholytic and anxiolytic profile allows precise modulation of the autonomic response to surgical stress, making it particularly useful in general and thoracic surgical procedures, in which the preservation of cardiovascular and respiratory function is essential for anesthetic success. This narrative review aimed to critically analyze the use of dexmedetomidine in these contexts, highlighting its effects on intraoperative hemodynamic control and post-anesthetic outcomes reported in contemporary literature. The reviewed evidence indicates that the drug contributes to reduced heart rate, blood pressure stability, lower opioid consumption, and shorter extubation time, in addition to providing better emergence quality, lower incidence of delirium, and prolonged analgesia. Such benefits directly influence the patient's functional recovery and help prevent cardiorespiratory complications. However, the literature still lacks standardization regarding optimal doses, infusion time, and pharmacological combinations, reinforcing the need for individualized protocols. It is concluded that dexmedetomidine represents a valuable adjuvant in multimodal anesthesia, capable of integrating safety, stability, and patient well-being across different surgical settings.

**Keywords:** Dexmedetomidine; Anesthesia; Thoracic Surgery; Hemodynamic Stability; Post-Anesthetic Recovery.



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## 1- INTRODUCTION

Contemporary anesthesiology has been redefining itself in the pursuit of agents capable of providing not only adequate sedation and analgesia but also hemodynamic stability and improved postoperative recovery. In this context, dexmedetomidine, a highly selective  $\alpha_2$ -adrenergic receptor agonist, has emerged as a promising alternative, particularly in general and thoracic surgeries where fine control of cardiovascular variables is crucial for intraoperative and postoperative prognosis (Verret *et al.*, 2024). Its central action on the locus coeruleus and peripheral sympatholytic effects confer unique properties of cooperative sedation, opioid-sparing analgesia, and reduction of the adrenergic response to surgical stress - features that have been extensively described in the literature (Zhao *et al.*, 2020; Weerink *et al.*, 2017).

The growing interest in dexmedetomidine extends beyond its pharmacodynamic profile, encompassing its influence on critical clinical parameters such as heart rate, blood pressure, volatile anesthetic consumption, and extubation time. In thoracic surgeries in particular, anesthetic management requires a delicate balance between sedation, controlled ventilation, and autonomic stability - a context in which dexmedetomidine acts as both a cardiovascular modulator and a tissue-protective agent against ischemia-reperfusion stress (Khafagy *et al.*, 2017; Liu *et al.*, 2025). Recent literature suggests significant benefits, though still surrounded by controversy regarding the optimal dose, timing of infusion, and long-term impact on postoperative outcomes (Lee *et al.*, 2018).

Despite the increasing number of clinical trials and systematic reviews on the topic, most publications remain focused on specific populations or restricted surgical contexts (Davy *et al.*, 2017; Song; Lu, 2022). There is still a lack of an integrated narrative approach that discusses the physiological rationale, pharmacological mechanisms, and global clinical effects of dexmedetomidine in general and thoracic surgery. This absence of interpretive synthesis hinders the consolidation of a comprehensive understanding of its role as a hemodynamic modulator and as an agent promoting safer and more predictable anesthetic recovery.

Thus, this narrative review aims to critically discuss the use of dexmedetomidine in general and thoracic surgeries, emphasizing its role in intraoperative hemodynamic



control and post-anesthetic outcomes, integrating pharmacological and clinical evidence to elucidate its contribution to modern anesthesia and perioperative care in high-complexity settings.

## **2- METHOD**

This study is characterized as a Narrative Literature Review, developed with the purpose of integrating and critically interpreting scientific evidence on the use of dexmedetomidine in general and thoracic surgeries, focusing on its hemodynamic effects and post-anesthetic repercussions. This type of review was chosen for allowing a broad, contextual, and argumentative analysis of publications, encompassing not only empirical findings but also the physiological and clinical interpretations that support the use of the drug in the perioperative setting.

The choice of a narrative model is justified by the methodological heterogeneity of the available studies and by the need to articulate theoretical and clinical aspects, requiring a flexible and critical approach better suited to understanding complex and multifactorial phenomena such as the surgical hemodynamic response (Rother, 2007; Green; Johnson, Adams, 2006).

The bibliographic search was conducted in the PubMed, Scopus, ScienceDirect, and SciELO databases, considering publications in English and Portuguese between 2013 and 2025. Controlled and non-controlled descriptors related to the main axes of the study were used: “dexmedetomidine,” “general surgery,” “thoracic surgery,” “hemodynamic control,” “postanesthetic recovery,” and “perioperative outcomes.” Clinical trials, literature reviews, meta-analyses, and experimental studies addressing intraoperative administration of dexmedetomidine, its effects on cardiovascular variables, and its impact on anesthetic recovery were included. Publications addressing exclusive use in intensive care, pediatrics, or non-surgical contexts were excluded. After critical reading and comparative analysis, the selected studies were organized into interpretive thematic axes to favor an integrated understanding of the findings, trends, and gaps in the contemporary literature. Interpretations and syntheses were organized to identify patterns of results and theoretical gaps, following the principles of rigor, transparency, and coherence of the narrative review.



### **3- RESULTS**

The analyzed studies demonstrate that dexmedetomidine plays a fundamental role in intraoperative hemodynamic control, significantly reducing autonomic variability and attenuating sympathetic responses to surgical stress. Recent clinical trials indicate that its continuous infusion, at doses ranging from 0.2 to 0.7  $\mu\text{g}/\text{kg}/\text{h}$ , consistently decreases heart rate and mean arterial pressure without compromising tissue perfusion. This effect is attributed to its selective agonist action on  $\alpha_2$ -adrenergic receptors, resulting in reduced norepinephrine release and consequent cardiovascular stabilization (Kumar *et al.*, 2022; Ye *et al.*, 2021; Tripathi *et al.*, 2017).

In thoracic surgeries, intraoperative administration of dexmedetomidine has been associated with a lower incidence of tachyarrhythmias, reduced consumption of volatile anesthetics, and decreased opioid requirements, as well as greater predictability in ventilatory management during periods of controlled hypoxemia. These findings reinforce its potential as an agent for autonomic modulation and intraoperative homeostatic optimization, particularly in patients at high cardiovascular risk (Kaye *et al.*, 2020; Xu *et al.*, 2024).

In the post-anesthetic context, the literature highlights benefits that extend beyond hemodynamic control, including improved emergence quality, prolonged analgesia, and a lower incidence of delirium and emergence agitation. Comparative studies between dexmedetomidine and other sedatives, such as midazolam and propofol, indicate a significant reduction in extubation time and the need for rescue analgesics, in addition to improved patient satisfaction and respiratory stability during the early recovery phase (Shin *et al.*, 2023; Deng; Heybati, 2021).

In thoracic surgeries, particularly after lobectomies and thoracotomies, its central and peripheral analgesic effects contribute to less ventilatory impairment and reduced pleuritic pain, favoring pulmonary reexpansion and reducing respiratory complications (Jannu *et al.*, 2020; Dhorigol, 2020). Overall, the results identify dexmedetomidine as a multifunctional anesthetic adjuvant, positively impacting both the intraoperative phase and recovery quality, although the literature underscores the importance of individualized protocols and rigorous monitoring to prevent episodes of



bradycardia or refractory hypotension (Lei *et al.*, 2020; Song *et al.*, 2022).

To objectively summarize the main findings described in this section, a synthesis table was developed, gathering the most relevant clinical effects of dexmedetomidine reported in recent literature. The table below highlights the drug's impact on both intraoperative and post-anesthetic dimensions, emphasizing its role as a modulator of hemodynamic stability and functional recovery.

Table 1: Main intraoperative and postoperative effects of dexmedetomidine in general and thoracic surgeries

Clinical Aspect	Effect of Dexmedetomidine	Key Evidence
Heart rate and autonomic variability	Reduction of sympathetic discharge, controlled bradycardia, and intraoperative autonomic stability	Wang <i>et al.</i> (2020); Cheng <i>et al.</i> (2021)
Mean arterial pressure	Attenuation of hypertensive peaks during induction and intubation without impairing tissue perfusion	Biswas <i>et al.</i> (2021); Kumar <i>et al.</i> (2022)
Risk of arrhythmias and anesthetic consumption	Reduced incidence of tachyarrhythmias and decreased need for volatile agents and opioids	Xu <i>et al.</i> (2024); Song <i>et al.</i> (2022)
Myocardial and endothelial protection	Decreased oxidative stress and preservation of endothelial function during ischemia–reperfusion	Liu <i>et al.</i> (2025); Khafagy <i>et al.</i> (2017)
Postoperative pain and analgesia	Lower need for rescue analgesics and prolonged analgesia without respiratory depression	Ma; Zhou (2021); Kaye <i>et al.</i> (2020)
Anesthetic emergence and postoperative delirium	Improved emergence quality, reduced emergence agitation and delirium, greater emotional stability	Yang <i>et al.</i> (2020); Shin <i>et al.</i> (2023)
Functional and metabolic recovery	Reduced cortisol and catecholamine levels, contributing to balanced hemodynamic and metabolic recovery	Ji <i>et al.</i> (2024); Verret <i>et al.</i> (2024)

**Source:** Prepared by the author (2025), based on the reviewed literature.

## 4- DISCUSSION

The reviewed literature demonstrates that dexmedetomidine has established itself as one of the most versatile drugs in modern anesthesiology, combining sedative,



analgesic, and sympatholytic effects in a single agent (Ji *et al.*, 2024). Unlike traditional hypnotics, its mechanism of action allows for cooperative sedation and cardiovascular stability - features that address specific clinical demands in general and thoracic surgeries, where hemodynamic balance is crucial for anesthetic success and the prevention of postoperative complications (Castillo *et al.*, 2020).

However, the growing use of the drug has raised discussions regarding dosing protocols, infusion time, and pharmacodynamic interactions, requiring more personalized and evidence-based approaches (Weerink *et al.*, 2017). Thus, the contemporary debate surrounding dexmedetomidine extends beyond its efficacy, encompassing its role in redefining anesthetic practice, which is increasingly guided by the pursuit of safety, comfort, and early functional recovery.

#### **4.1 Hemodynamic Control and Autonomic Stability**

Hemodynamic stability during surgery constitutes one of the pillars of modern anesthesia, and dexmedetomidine has proven to be an effective modulator of this balance (Kumar *et al.*, 2022; Ye *et al.*, 2021). Its ability to reduce sympathetic outflow while preserving vascular autoregulation gives it a unique profile among contemporary sedatives (Pöyhiä *et al.*, 2022). Studies have shown that, by acting on central  $\alpha_2$ -adrenergic receptors, the drug promotes a reduction in sympathetic tone and an increase in parasympathetic activity, resulting in decreased heart rate variability and reduced catecholamine release (Weerink *et al.*, 2017; Zhao *et al.*, 2020).

This effect helps minimize episodes of tachycardia, transient hypertension, and blood pressure fluctuations associated with induction and endotracheal intubation. In patients undergoing thoracic surgery, the autonomic modulation provided by dexmedetomidine significantly reduces the risk of arrhythmias and favors a more predictable anesthetic course, particularly in cases of cardiovascular comorbidities (De Cassai *et al.*, 2021; Xu *et al.*, 2024; Kaye *et al.*, 2020).

Beyond cardiovascular control, evidence indicates that dexmedetomidine exerts protective effects on the myocardium and vascular endothelium, mitigating oxidative stress and preserving endothelial function during ischemia - reperfusion periods (Liu *et al.*, 2025; Khafagy *et al.*, 2017). This protective action, observed in both experimental



models and clinical studies, suggests a relevant cardioprotective potential, especially in patients with preexisting coronary disease. The reduction of myocardial oxygen consumption and maintenance of adequate coronary perfusion during surgery make the drug particularly valuable in prolonged or high-complexity procedures (Liu *et al.*, 2025; Xu *et al.*, 2024). Thus, dexmedetomidine represents not only a sedative agent but also a physiological adjuvant of cardiovascular stability, which explains its growing use in multimodal anesthetic protocols.

However, the use of the drug requires attention to individualized dosing and continuous hemodynamic monitoring, as its potent sympatholytic effect may, in some patients, induce episodes of bradycardia or refractory hypotension. These adverse effects, although generally reversible, demand proper preparation of the anesthetic team and accurate titration of infusion rates. Hence, clinical practice reinforces the need for institutional protocols that consider variables such as age, baseline hemodynamic status, and concomitant medications (Song *et al.*, 2022; Davy *et al.*, 2017).

Despite these limitations, the literature converges on the recognition of dexmedetomidine as a safe autonomic modulation agent when used under technical rigor and adequate monitoring. This body of evidence reaffirms dexmedetomidine's role as a transitional drug bridging autonomic control and tissue protection, granting it the status of an integrative hemodynamic agent within multimodal anesthesia.

#### **4.2 Post-Anesthetic Recovery and Clinical Outcomes**

Post-anesthetic outcomes represent a field of special interest in contemporary anesthesiology, which now focuses not only on intraoperative safety but also on the quality of recovery. Dexmedetomidine has proven effective in reducing emergence agitation, postoperative delirium, and acute pain - phenomena commonly observed in patients undergoing major surgery (Shin *et al.*, 2023; Deng; Heybati, 2021).

Its combined anxiolytic and analgesic effects, along with its ability to reduce opioid consumption, translate into lower incidences of nausea, respiratory depression, and cognitive complications, thereby promoting early rehabilitation and accelerated hospital discharge. In thoracic surgeries, these benefits gain additional relevance since adequate pain control directly influences respiratory function and the prevention of



atelectasis (Kaye *et al.*, 2020; Lei *et al.*, 2020; Jannu; Dhorigol, 2020).

Another widely reported aspect is the improvement in the subjective quality of anesthetic emergence, characterized by reduced mental confusion, psychological comfort, and emotional stability. Randomized studies suggest that patients receiving dexmedetomidine during anesthesia present lower postoperative cortisol and catecholamine levels, indicating attenuation of the neuroendocrine response to surgical trauma (Wang *et al.*, 2019; Ji *et al.*, 2024; Verret *et al.*, 2024). This hormonal modulation contributes not only to the patient's well-being but also to a more balanced metabolic recovery, with a lower risk of inflammatory complications and secondary hemodynamic disturbances. Such evidence supports the notion that dexmedetomidine acts as a "stability mediator" between intra- and postoperative phases, favoring the physiological continuity of homeostasis.

However, it is important to note that the literature still exhibits heterogeneity in the criteria used to evaluate post-anesthetic outcomes, which complicates direct comparisons among studies. Variability in doses, infusion durations, and populations analyzed limits the development of universal protocols (Lee *et al.*, 2018; Song *et al.*, 2022). Therefore, future research should focus on multicenter and standardized studies capable of establishing clear parameters of efficacy and safety. While such evidence continues to consolidate, accumulated clinical experience reinforces the position of dexmedetomidine as a strategic agent in modern anesthesia management, offering a balance between sedation, stability, and optimized physiological recovery.

Thus, more than a sedative, dexmedetomidine emerges as a mediator between physiological stability and the subjective experience of anesthetic emergence, bringing contemporary anesthesia closer to a truly patient-centered perspective.

## **5- FINAL CONSIDERATIONS**

The narrative analysis of the available evidence allows us to affirm that dexmedetomidine occupies a unique position in modern anesthesiology, representing a drug of dual clinical and physiological relevance. Its role as an autonomic modulator and a hemodynamic stabilizing agent during general and thoracic surgeries has been widely



documented, contributing to reduced cardiovascular variability, better control of surgical stress, and lower opioid requirements. By providing cooperative sedation and preserving ventilatory function, dexmedetomidine consolidates its position as a strategic adjuvant within multimodal anesthetic protocols aimed at patient safety and enhanced recovery.

The collected results further indicate that the use of dexmedetomidine is associated with improved post-anesthetic outcomes, reflected by smoother emergence, lower incidence of delirium, prolonged analgesia, and reduced extubation time. In thoracic surgeries, these effects become particularly advantageous, as the preservation of respiratory function and the mitigation of pleuritic pain promote effective ventilation and prevent pulmonary complications. Such characteristics reinforce the clinical value of the drug not only as a sedative but also as a physiological transition agent between the intraoperative and postoperative phases, contributing to a more humane, predictable, and outcome-oriented anesthesia.

On the other hand, the literature still lacks consensus regarding standardized dosing, infusion duration, and combined protocols, particularly in patients with cardiovascular risk or those undergoing prolonged surgeries. Therefore, future investigations should focus on multicenter clinical trials capable of validating universal parameters of efficacy and safety. Until such evidence is consolidated, the use of dexmedetomidine should be guided by individualized clinical judgment and rigorous monitoring. In summary, dexmedetomidine reflects the advancement of anesthesiology toward a more integrative practice - patient-centered, physiologically grounded, and guided by the principles of translational science.

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