

ERAS PROTOCOL IN CARDIAC SURGERY: AN UMBRELLA REVIEW OF SYSTEMATIC REVIEWS

FERNANDO GOMES NUNES¹, MAX MYLLER FERRAZ RIBEIRO¹, STANLEY DE OLIVEIRA LOYOLA¹, GUSTAVO SIQUEIRA ELMIRO¹,
GIULIANO GARDENGHI^{1,2}, ARTUR HENRIQUE DE SOUZA²

1. Clínica de Anestesia de Goiânia – Goiânia/GO, Brasil.

2. Hospital ENCORE – Aparecida de Goiânia/GO, Brasil.

ABSTRACT

Introduction: Enhanced Recovery After Surgery (ERAS) protocols represent a multimodal perioperative approach designed to reduce surgical stress, minimize postoperative complications, and accelerate recovery in patients undergoing cardiac surgery. **Objective:** To analyze the scientific evidence regarding the effectiveness of ERAS protocols on perioperative outcomes in cardiac surgery. **Methods:** A literature review was conducted using the PubMed database. The search strategy included the descriptors “cardiac surgery” and “ERAS protocol”, combined with the Boolean operator AND. Systematic reviews published between January 2021 and April 2026, involving adult patients undergoing cardiac surgery, were included. **Results:** Twenty-one studies were identified, of which eight systematic reviews met the eligibility criteria, comprising a total of 48,248 patients. The evidence demonstrated that ERAS protocols were associated with shorter mechanical ventilation time, reduced intensive care unit and hospital length of stay, fewer perioperative complications, and improved postoperative recovery. Multimodal analgesia and multidisciplinary care were identified as key components of successful ERAS implementation. **Conclusion:** ERAS protocols have shown the potential to improve perioperative recovery in cardiac surgery by reducing mechanical ventilation time, intensive care unit and hospital stay without increasing mortality. However, the heterogeneity of existing protocols and the low certainty of the available evidence highlight the need for well-designed multicenter randomized controlled trials to standardize their implementation and confirm their clinical benefits.

Keywords: Anesthesiology, Enhanced Recovery After Surgery, Cardiac Procedures, Perioperative Care, Thoracic Surgery.

INTRODUCTION

The implementation of Enhanced Recovery After Surgery (ERAS) protocols has become one of the fundamental pillars of contemporary perioperative care. By proposing a multimodal, interdisciplinary, and patient-centered approach, the ERAS protocol aims to attenuate the metabolic response to surgical stress, reduce complications, and accelerate functional recovery.¹ Although well established across several specialties, its application in cardiac surgery is of critical relevance, given the growing volume of procedures, combined with the profile of patients with multiple

comorbidities and high clinical complexity, which contributes to high postoperative morbidity and substantial healthcare resource utilization.²

Historically, initiatives aimed at enhanced recovery in cardiac care evolved from the Fast-track concept, initially focused on early extubation, toward an integrated care model.³ Currently, the effectiveness of these strategies depends on a structured organization encompassing the preoperative, intraoperative, and postoperative phases.⁴ In intraoperative management, the selection of the anesthetic technique plays a central role. Evidence suggests that techniques such as spinal anesthesia may offer significant benefits, including reduced bleeding, improved pain control, and decreased opioid requirements, which, consequently, may contribute to a shorter duration of mechanical ventilation.⁵

The safe transition to Fast-track extubation is determined by key factors such as hemodynamic stability, adequate reversal of neuromuscular blockade, and the patient's baseline functional status.² Meta-analyses indicate that early extubation, when appropriately indicated, is a safe technique that does not increase perioperative complication rates and has the potential to reduce hospital length of stay and operational costs.³ In this context, the role of the multidisciplinary team is essential to ensure adherence to protocols and patient safety.¹

Given the need for standardization, expert groups, including cardiovascular anesthesiologists, intensivists, and surgeons, have sought to synthesize the available evidence.⁵ It is essential to examine the literature with the aim of resolving contradictions found in randomized clinical trials and establishing consensus regarding the impact of anesthetic techniques and early extubation on clinical outcomes. Therefore, this review article aims to analyze the current state of ERAS protocols in cardiac surgery, discussing their implications for optimizing recovery and healthcare system efficiency.

METHOD

A literature review was conducted in the PubMed database. The keywords used for the search were "cardiac surgery" and "ERAS protocol". The keywords were combined using the Boolean operator AND (for different terms).

The articles were selected when they met the following inclusion criteria: publication between January 2021 and April 2026, in English; a methodological design comprising a systematic review with a human sample, involving adult patients aged at least 18 years.

Studies that did not address the use of the ERAS protocol in cardiac surgery and studies for which full-text access was not possible were excluded.

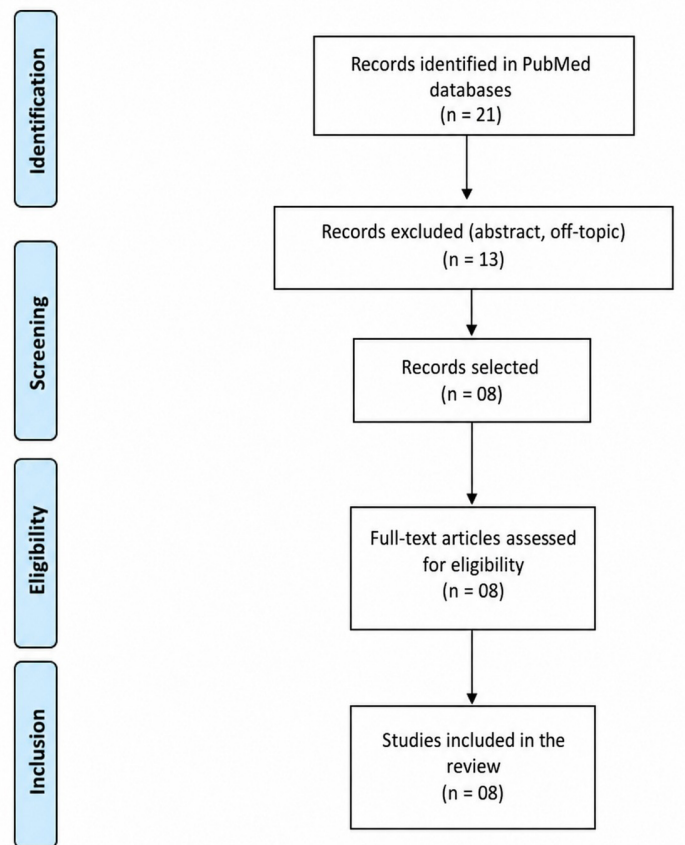


Figure 1 : Flowchart demonstrating the selection of articles.

RESULTS

Initially, 21 articles were found. After reading the abstracts, 13 articles that did not meet the inclusion criteria were excluded. The remaining 8 articles (comprising a total of 48,248 patients) were assessed for eligibility and subsequently included in the review.

Data regarding the included articles can be seen in Table 1.

Figure 1 : Summary of the included articles, with their objectives and main conclusions.
ERAS: Enhanced Recovery After Surgery; FT: Fast-Track; RCTs: randomized clinical trials.

Author/Year	No. of participants	Objective	Conclusion
Hoogma et al. / 2025 (3)	2625	To compare whether ERAS is superior to FT in cardiac surgery, especially regarding length of hospital stay and patient recovery.	ERAS programs may reduce ICU and hospital length of stay, as well as the duration of mechanical ventilation. ERAS programs that include preoperative, intraoperative, and postoperative interventions are superior to fast-track strategies that act only during the intraoperative period.
Spadaccio, et al. / 2024 (6)	1.704	To analyze all randomized studies applying ERAS-like protocols in cardiac surgery with regard to perioperative outcomes.	ERAS-like protocols have no impact on short-term survival after cardiac surgery, but allow earlier hospital discharge while reducing surgical complications. However, this study demonstrates non-adherence and heterogeneity regarding the entirety of ERAS protocols, which justifies the need for further RCTs in this area, including a greater number of reference elements.
Aguero-Martins, et al. / 2021 (7)	5.059	To estimate the effectiveness of enhanced recovery protocols on the perioperative course of patients undergoing cardiac surgery.	Enhanced recovery protocols in cardiac surgery improve the quality of care, as evidenced by a reduction in perioperative complications and a decrease in the incidence of hospital readmission in the month following surgery.
Goecke et al. /2025 (8)	1287	To analyze how ERAS protocols are applied in minimally invasive valve surgery and assess their impact on perioperative outcomes and patient recovery.	ERAS protocols and minimally invasive valve surgery act synergistically to improve recovery and reduce hospital length of stay. Standardization of ERAS protocols for minimally invasive valve surgery may enhance these benefits and increase their adoption.
Malvindi et al. / 2024 (9)	5142	To reduce postoperative complications and promote earlier recovery. The aim is to assess the current status and implementation of ERAS protocols in patients undergoing heart valve surgery and to summarize	The adoption of structured ERAS protocols has the potential to improve outcomes in patients undergoing heart valve surgery. Further evidence with larger populations is needed, including more homogeneous protocols and the assessment of additional outcomes, such as patient satisfaction, recovery, and quality of life after surgery.

		the associated clinical outcomes.	
Heybati, et. al. / 2023 (10)	26.257	To compare the relative efficacy of non-opioid adjuvant analgesic regimens in adult patients undergoing cardiac surgery.	The data suggest broader use of non-opioid adjuvants to minimize pain and improve recovery.
Zhang et al. / 2021 (11)	1705	To assess the current evidence on the efficacy of ERAS protocols in cardiac surgery, determining whether they improve patient outcomes.	The evidence is limited by the lack of high-quality randomized clinical trials. The absence of implementation of Class I interventions recommended by the ERAS Cardiac Society was observed.
Diz-Ferreira, et al. / 2025 (12)	4.469	To assess the impact of ERAS programs in cardiac surgery on hospital length of stay, mortality, atrial fibrillation, and quality of life.	ERAS programs have been associated with reduced hospital length of stay and have not demonstrated differences in mortality or atrial fibrillation; the quality of the evidence was considered very low. To recommend the implementation of ERAS programs in cardiac surgery, randomized studies providing evidence of their efficacy are needed, as well as studies that include quality of life and other outcomes centered on patient recovery.

DISCUSSION

The findings accumulated in the recent literature demonstrate that the implementation of ERAS protocols in cardiac surgery has shown highly promising results. A significant reduction in intensive care unit (ICU) length of stay, overall hospital length of stay, and the incidence of postoperative complications has been consistently observed, without this implying an increase in mortality rates.⁶⁻⁷ However, although such clinical benefits are reported with relative consistency, the literature still suffers from important methodological limitations that prevent definitive conclusions regarding the actual impact of the protocol in its entirety.

The main obstacle to the consolidation of this evidence lies in the marked lack of standardization of the clinical care protocols used. Under the ERAS acronym, a large proportion of studies group markedly heterogeneous institutional strategies, with the isolated adoption of only some perioperative components being frequent, to the detriment of the complete and systematic implementation of the guidelines proposed by the ERAS Society.^{6,8,9,10} This conceptual and methodological disconnect not only hinders direct comparability among clinical trials but also makes it difficult to isolate and identify which specific interventions are effectively responsible for the favorable outcomes observed.

It therefore becomes evident that the therapeutic success of ERAS is intrinsically linked to the synergistic and simultaneous combination of multiple evidence-based interventions, going beyond the mere application of fragmented measures. From this perspective, the protocol differs substantially from traditional Fast-Track strategies, whose scope is frequently restricted to optimization of the intraoperative period focused on early extubation.³⁻⁷ Although reducing the duration of mechanical ventilation represents a relevant outcome, it is insufficient, in isolation, to mitigate overall surgical stress and accelerate patient recovery. It is the cumulative and multimodal effect resulting from the integration of preoperative education, opioid-sparing multimodal analgesia, early mobilization, early feeding, anesthetic optimization, and rehabilitation that culminates in substantial improvement in clinical outcomes.³⁻⁷

This operational divergence between Fast-Track and ERAS represents a true paradigm shift in perioperative care.³⁻⁷ While the former aims to accelerate linear and specific stages of recovery, the ERAS model advocates an integrated and continuous approach that interconnects the preoperative, intraoperative, and postoperative periods.³⁻⁷ The central objective shifts toward attenuating the inflammatory and metabolic response resulting from surgical trauma, aiming to preserve physiological homeostasis and promote early functional recovery of the individual.³⁻⁷

In the context of minimally invasive cardiac surgery, this conceptual correlation reaches an even more significant level. The reduced tissue trauma inherent to these surgical approaches acts synergistically with ERAS measures, enhancing the reduction in ICU and ward length of stay, enabling early hospital discharge, and promoting substantial optimization of healthcare system operating costs.⁸ Despite the relevance of these findings, the available body of evidence remains limited due to the predominance of studies with small population samples, heterogeneous methodological designs, and disparities in practical implementation processes, highlighting the urgent need for multicenter investigations with greater scientific robustness.⁸⁻⁹

ERAS protocols in cardiac surgery have shown an association with reduced hospital length of stay, although the certainty of the evidence was considered very low. No significant differences were observed in perioperative mortality or in the incidence of postoperative atrial fibrillation.¹²

Alongside logistical and organizational adjustments, optimization of pain management emerges as one of the most critical pillars for the success of the protocol. The implementation of multimodal analgesic regimens, characterized by a drastic restriction in opioid use, has provided solid benefits in pain control, reduction in the duration of ventilatory support, and acceleration of functional rehabilitation. Adjuvant drugs such as acetaminophen, magnesium, dexmedetomidine, gabapentin, clonidine, ketamine, and hydrocortisone have become key elements in achieving these goals.¹¹

Despite the theoretical robustness and favorable results, the translation of ERAS into everyday clinical practice remains one of the greatest contemporary challenges. Cultural barriers, expressed as resistance to change among healthcare teams, the requirement for highly integrated multidisciplinary coordination, limitations in healthcare service infrastructure, and disparities in the allocation of financial and material resources impose severe obstacles to the establishment of the protocol. Thus, it can be inferred that the main current bottleneck does not lie in the validity or efficacy of the ERAS concept itself, but rather in the ability of healthcare services to ensure its systematic and uniform application.⁷⁻⁸

Given this scenario, a clear consensus emerges in the literature regarding the urgent need for new randomized, multicenter clinical trials based on strictly standardized protocols that encompass all recommendations issued by the ERAS Society. In addition to measuring classical clinical and surgical outcomes, future investigations need to incorporate indicators centered on patients'

perspectives, such as quality-of-life scales, speed of functional recovery, satisfaction levels, and time to return to usual activities. Only through this expansion of the evaluative scope will it be possible to accurately quantify which specific ERAS components exert the greatest detrimental or beneficial impact on the recovery journey after cardiac surgery.^{6, 9, 10}

CONCLUSION

The implementation of the ERAS protocol in cardiac surgery represents a consistent evolution in perioperative care, demonstrating efficacy in optimizing relevant clinical outcomes, such as reducing the duration of mechanical ventilation, ICU length of stay, and hospital length of stay, as well as mitigating postoperative complications without compromising safety or increasing mortality rates. The success of this strategy lies in its multimodal and synergistic nature, overcoming the limitations of traditional Fast-Track approaches. However, the consolidation of the protocol as the gold standard of care faces critical challenges, centered on the methodological heterogeneity of current studies and low adherence to the entirety of international guidelines. For the benefits of ERAS to be widely validated and replicated in routine surgical practice, high-quality multicenter randomized clinical trials are needed. These studies should focus on the standardization of perioperative interventions and include outcomes centered on the patients' own experience, such as quality of life and early functional recovery.

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MAILING ADDRESS

GIULLIANO GARDENGHI

CET – CLIANEST, R. T-32, 279 – St, Bueno, Goiânia – GO, Brazil.

E-mail: coordenacao.cientifica@ceafi.edu.br

EDITORIAL AND REVIEW

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