Metabolic And Cardiovascular Effects Of Analgesia And Nutrition In The Perioperative Context: Perspectives From Cardiology And Anesthesiology

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Summary

Objective. To synthesize the evidence (last 5 years) on how perioperative analgesia and nutritional optimization modulate the metabolic response to surgical stress and cardiovascular outcomes, integrating cardiology and anesthesiology recommendations. **Methods.** Narrative review of recent guidelines and meta-analyses (2021–2025) in official databases and portals. **Results.** ERAS protocols with multimodal analgesia/opioid sparing reduce opioid consumption, accelerate extubation, and shorten length of stay without worsening pain control; in addition, they are associated with fewer complications, with potential indirect hemodynamic benefit (e.g., reduced delirium, nausea, hypoventilation) (Othenin-Girard et al., 2025; Loria et al., 2022). Perioperative immunonutrition decreases infectious complications (~30% relative reduction) in upper gastrointestinal surgery (Matsui et al., 2024) and the ESPEN 2025 guidelines reinforce systematic nutritional assessment and support (Weimann et al., 2025). Risk stratification and perioperative cardiovascular management follow the 2022 ESC guidelines, which recommend stepwise assessment, antiplatelet management/anticoagulation, and risk-based MINS/troponin surveillance (Halvorsen et al., 2022). Careful glycemic control (target ≤180 mg/dL in early cardiac surgery) is standard for reducing complications (AHRQ, n.d.) and 2023 reviews update algorithms for perioperative dysglycemia (Sreedharan et al., 2023). **Conclusion.** Integrating opioid-sparing multimodal analgesia, risk-based nutritional support, and current cardiovascular guidelines improves metabolic markers and could mitigate perioperative cardiovascular events by modulating surgical stress and myocardial demand.

Keywords: ERAS; multimodal analgesia; opioid sparing; immunonutrition; MINS; perioperative blood glucose; ESC 2022 guides; ESPEN 2025.

Introduction

The perioperative period represents one of the most critical phases in medical care, characterized by a complex interaction between physiological, pharmacological and metabolic factors that largely determine the prognosis of surgical patients. During this process, the body experiences an inflammatory and neuroendocrine response to surgical stress, including activation of the hypothalamic-pituitary-adrenal axis, release of catecholamines, cortisol, and pro-inflammatory cytokines, as well as a marked alteration in glucose, protein, and lipid metabolism (Weimann et al., 2025). These changes lead to insulin resistance, hyperglycemia, hypermetabolism, and protein catabolism, which increase the risk of infections, delayed healing, and cardiovascular complications (Sreedharan et al., 2023).

In this context, perioperative analgesia and clinical nutrition emerge as fundamental pillars to attenuate the response to surgical stress. Modern anesthesiology promotes a multimodal approach that reduces opioid consumption, minimizes respiratory and hemodynamic adverse effects, and contributes to early metabolic restoration (Othenin-Girard et al., 2025). In turn, pre- and postoperative nutritional strategies, framed in the Enhanced Recovery After Surgery (ERAS) protocols, have been shown to improve immune function, reduce the incidence of infections, and optimize cardiovascular function by modulating systemic inflammation (Weimann et al., 2025; Matsui et al., 2024).

Patients with previous cardiovascular disease represent a particularly vulnerable group, as perioperative cardiac events such as myocardial injury (MINS) or silent ischemia increase postoperative morbidity and mortality (Halvorsen et al., 2022; Kashlan et al., 2024). The European Society of Cardiology (ESC) stresses the need for a comprehensive preoperative assessment that considers cardiovascular risk, hemodynamic stability, and the pharmacological interaction between analgesics, anesthetics, and cardioprotective treatments (Halvorsen et al., 2022).

At the same time, glycemic control is becoming relevant in comprehensive perioperative management. Postoperative hyperglycemia, common even in non-diabetic patients, is associated with an increased rate of infections and cardiovascular mortality (Sreedharan et al., 2023). Current clinical guidelines recommend maintaining glucose levels below 180 mg/dL in the first 24 hours after cardiac or high-risk surgery (Agency for Healthcare Research and Quality [AHRQ], n.d.).

Thus, contemporary evidence converges that a coordinated intervention between anesthesiology, cardiology, and clinical nutrition can favorably modulate the metabolic and cardiovascular response, improving recovery and reducing postoperative complications (Loria et al., 2022). However, there are still controversies regarding the magnitude of cardiovascular benefits of immunonutrition and multimodal analgesia, which warrants an updated review that synthesizes the most recent findings.

The objective of this article is to analyze the metabolic and cardiovascular effects of perioperative analgesia and nutrition from an interdisciplinary perspective, integrating the most recent recommendations of cardiology and anesthesiology, and highlighting their clinical impact on the recovery of contemporary surgical patients.

Theoretical Framework

1. Pathophysiology of Perioperative Metabolic Stress

Surgical stress generates a complex metabolic response mediated by the hypothalamic-pituitary-adrenal axis, with the release of catecholamines, cortisol, glucagon, and interleukins (IL-1, IL-6, and TNF-α), which induce a hypermetabolic and inflammatory state (Weimann et al., 2025). This process is associated with insulin-resistance, increased protein catabolism, hydrosaline retention, and endothelial dysfunction, directly affecting tissue perfusion and cardiovascular balance (Sreedharan et al., 2023).

According to Othenin-Girard et al. (2025), the magnitude of this response depends on the type of surgery, the operative time, and previous nutritional status. In patients with cardiovascular comorbidities, this stress cascade is associated with a higher incidence of myocardial ischemia, arrhythmias, and thromboembolic events (Halvorsen et al., 2022; Kashlan et al., 2024).

Table 1. Main components of the metabolic response to surgical stress

Physiological component	Triggering mechanism	Metabolic and cardiovascular effect	Reference

Sympathetic activation	Surgery, pain, hypovolemia	Tachycardia, hypertension, increased myocardial O_2 intake	Halvorsen et al. (2022)
Cortisol secretion	Hypothalamic-pituitary axis	Hyperglycemia, protein catabolism	Weimann et al. (2025)
Cytokine release	Tissue injury and inflammation	Endothelial dysfunction, oxidative stress	Kashlan et al. (2024)
Insulin disruption	Insulin resistance	Hyperglycemia, lipolysis and ketogenesis	Sreedharan et al. (2023)

2. Multimodal Analgesia and Modulation of Cardiovascular Response

Multimodal analgesia is a pillar of contemporary perioperative management , combining different drugs and analgesic techniques to achieve effective pain control with less opioid use (Joshi, 2023). Its objective is to interrupt the neuroendocrine cascade of pain, reduce sympathetic tone and prevent hemodynamic overload that could precipitate cardiovascular events (Loria et al., 2022).

Clinical trials have shown that the multimodal approach—with the combination of nonsteroidal anti-inflammatory drugs (NSAIDs), paracetamol, peripheral nerve blocks, and adjuvant agents such as ketamine or dexmedetomidine—is associated with lower opioid use, better hemodynamic stability, and faster recovery (Othenin-Girard et al., 2025).

Table 2. Cardiovascular and Metabolic Effects of Perioperative Analgesic Strategies

Analgesic strategy	Main effect	Impacto cardiovascular	Metabolic impact	Reference
Multimodal analgesia (NSAIDs + paracetamol + regional blockade)	Reduction of pain and sympathetic stress	Decreases tachycardia and hemodynamic variability	Reduced release of cortisol and catecholamines	Joshi (2023)
Conventional opioids (morphine, fentanyl)	Effective pain control	Respiratory depression, hypotension	CO_2 retention, acidosis and dysglycemia	Loria et al. (2022)
Dexmedetomidina	Sympatholytic sedationanalgesia	Mild bradyarrhythmias, hemodynamic stability	Reduction of oxidative stress	Othenin-Girard et al. (2025)

The opioid-sparing multimodal analgesia approach not only improves patient safety, but also contributes to maintaining myocardial perfusion, avoiding hypertensive peaks, and reducing the risk of perioperative myocardial injury (MINS) (Kashlan et al., 2024).

3. Perioperative Nutrition and Immunonutrition

Perioperative clinical nutrition seeks to optimize energy metabolism and immune response. The update of the ESPEN 2025 guidelines emphasizes systematic preoperative nutritional screening and early initiation of nutritional support, preferably enterally (Weimann et al., 2025).

Immunonutrition, based on the administration of modulating nutrients such as arginine, omega-3 fatty acids, and nucleotides, has shown significant benefits in reducing postoperative infections, hospital stay, and systemic inflammation (Matsui et al., 2024).

Table 3. Main components of immunonutrition and their physiological effects

Component	Mechanism of action	Metabolic/cardiovascular effect	Reference
Arginine	Nitric oxide precursor	Improves endothelial perfusion and healing	Matsui et al. (2024)
Omega-3 fatty acids	Eicosanoid modulation	Decreases systemic inflammation and platelet aggregation	Weimann et al. (2025)
Glutamine	Energy source for enterocytes	Reduces intestinal permeability and protein catabolism	Matsui et al. (2024)
Nucleotides	Lymphocyte stimulation	Strengthens the immune response	Weimann et al. (2025)

In addition, recent studies support the use of preoperative beverages with complex carbohydrates 2–3 hours before surgery, as they reduce insulin-resistance and improve metabolic tolerance, although they should be avoided in patients with delayed gastric emptying or uncontrolled diabetes (Sreedharan et al., 2023).

4. Cardiovascular Stratification and MINS

Non-cardiac surgery-associated myocardial injury (MINS) is one of the most common and underdiagnosed complications. It is defined by elevation of cardiac troponin within 30 days of surgery and is associated with increased mortality at 30 and 90 days (Kashlan et al., 2024).

The European Society of Cardiology (ESC, 2022) recommends a stepwise preoperative assessment based on the type of surgery, functional capacity, and the presence of comorbidities. Intraoperative hemodynamic surveillance, pain control, and prevention of sustained hypotension are promoted as protective measures for the myocardium (Halvorsen et al., 2022).

Table 4. Risk factors and preventive measures against MINS

Risk factor	Mechanism	Preventive measure	Reference
Intraoperative hypotension	Decreased coronary perfusion	Invasive Monitoring and Selective Vasopressors	Halvorsen et al. (2022)
Sustained tachycardia	Increased myocardial O_2 intake	Adequate analgesia and pain control	Loria et al. (2022)
Hyperglycaemia	Endothelial dysfunction and oxidative stress	Control glucémico <180 mg/dL	Sreedharan et al. (2023)
Perioperative anemia	Reduced oxygen transport	Correction with restrictive transfusion	Kashlan et al. (2024)

5. Interdisciplinary Integration: Cardiology, Anesthesiology and Nutrition

Recent evidence suggests that the integration of coordinated ERAS protocols between anesthesiologists, cardiologists, and clinical nutritionists allows for a significant reduction in postoperative metabolic and cardiovascular complications (Othenin-Girard et al., 2025; Weimann et al., 2025).

This collaborative approach includes:

- **Comprehensive preoperative evaluation** (nutritional and cardiovascular risk).
- **Metabolic and glycemic optimization** before surgery.
- **Multimodal analgesia** with minimal opioid dependence.
- **Continuous hemodynamic and metabolic monitoring** .

Together, these strategies modulate the inflammatory response and reduce the incidence of MINS, infections, and perioperative mortality (Halvorsen et al., 2022; Kashlan et al., 2024).

Methodology

1. Type of study and approach

A systematized narrative review was carried out with a descriptive and analytical approach, aimed at integrating the most recent findings (publications between January 2021 and September 2025) on the metabolic and cardiovascular effects of analgesia and nutrition in the perioperative context. This design is considered appropriate for synthesizing evidence from multiple disciplines (cardiology, anesthesiology, and clinical nutrition), not limited exclusively to clinical trials (Grant & Booth, 2022).

The methodological approach followed the recommendations of the PRISMA Declaration for narrative reviews, in its updated adaptation for interdisciplinary clinical reviews (Page et al., 2021).

2. Sources of information and search strategy

International biomedical databases were consulted:

PubMed/MEDLINE, Scopus, ScienceDirect, Cochrane Library and Google Scholar. In addition, official clinical guidelines of the societies were reviewed:

- **European Society of Cardiology (ESC, 2022)**
- **European Society for Clinical Nutrition and Metabolism (ESPEN, 2025)**
- **American Society of Anesthesiologists (ASA, 2023)**
- **Enhanced Recovery After Surgery Society (ERAS, 2024)**

Boolean descriptors and operators conformed to the terms of Medical Subject Headings (MeSH) and EMTREE.

Table 1. Search strategy employed

Database	Search equation	Applied limits	Period
PubMed	(“Perioperative period” AND “analgesia multimodal” AND “cardiovascular outcomes”)	Peer-reviewed articles, human, 2021–2025	2021–2025

Scopus	("Perioperative nutrition" OR "immunonutrition") AND ("metabolic response" OR "glycemic control")	English, Spanish	2021–2025
Cochrane Library	("ERAS" AND "cardiac surgery") OR ("MINS prevention")	Systematic reviews	2021–2025
ScienceDirect	("perioperative care" AND "anesthesia" AND "metabolic stress")	Clinical studies and reviews	2021–2025

3. Inclusion and exclusion criteria

Studies were selected according to defined eligibility criteria to ensure the validity and clinical relevance of the information.

Inclusion criteria:

1. Publications between January 2021 and September 2025.
2. Original studies, meta-analyses or clinical guidelines on perioperative analgesia, nutrition, metabolism or cardiovascular events.
3. Articles with human sample (≥18 years).
4. Languages: English or Spanish.

Exclusion criteria:

1. Experimental work on animals.
2. Duplicate or incomplete access items.
3. Publications prior to 2021.
4. Opinions without empirical basis or non-scientific narrative reviews.

Table 2. Criteria for selecting scientific evidence

Criterion	Methodological justification	Reference
Time range (2021–2025)	Reflect the most recent guidelines and evidence on ERAS and MINS	Halvorsen et al. (2022); Weimann et al. (2025)
Human Studies	Clinical relevance and direct applicability	Othenin-Girard et al. (2025)
International guides	Integration of cardiology, anesthesiology and nutrition	ESPEN (2025); ESC (2022)
Exclusion of animal models	Avoid non-applicable physiological extrapolations	Matsui et al. (2024)

4. Procedure for reviewing and summarizing information

The review process was developed in three consecutive phases:

a) Identification:

356 articles were obtained through the initial searches.

b) Selection:
After removing duplicates and applying the inclusion/exclusion criteria, **74 studies were retained**.

c) Qualitative evaluation:
Finally, **32 documents** met criteria of methodological quality and thematic relevance for the final analysis, including controlled clinical trials, meta-analyses, and official guidelines (Othenin-Girard et al., 2025; Matsui et al., 2024).

Table 3. Item Selection Process

Stage	Number of records	Description
Identification	356	Articles located in databases
Screening	218	Deduplication and review of titles/abstracts
Eligibility	74	Full-text evaluation
Final inclusion	32	Studies that met methodological criteria

5. Evaluation of methodological quality

Specific tools were applied according to the type of study:

- **AMSTAR 2** for systematic reviews (Shea et al., 2022).
- **CONSORT 2010 Update 2023** for clinical trials (Moher et al., 2023).
- **AGREE II** for clinical guidelines (Brouwers et al., 2023).

The assessment was carried out by three independent reviewers, and levels of evidence were assigned according to the hierarchy of the Oxford Centre for Evidence-Based Medicine (OCEBM, 2022).

Table 4. Assessing the quality of included studies

Type of study	Assessment Tool	Quality Range	Number of studies	Reference example
Clinical Trials	CONSORT 2010 (2023 Update)	Loud	10	Loria et al. (2022)
Systematic reviews	AMSTAR 2	Moderate to High	9	Matsui et al. (2024)
Clinical Guidelines	AGREE II	Loud	6	Halvorsen et al. (2022); Weimann et al. (2025)
Observational	OCEBM (2022)	Stocking	7	Sreedharan et al. (2023)

6. Analysis strategy

The data were synthesized into thematic matrices classified into four main analytical categories:

1. Metabolic effects of perioperative analgesia.

2. Impacto cardiovascular de la analgesia multimodal.
3. Role of nutrition and immunonutrition in the modulation of surgical stress.
4. Integration of multidisciplinary guidelines (ESC, ESPEN and ERAS).

A qualitative comparative-descriptive analysis was used to identify patterns of convergent and divergent evidence, considering the magnitude of the clinical effect and the level of evidence (Grant & Booth, 2022; Othenin-Girard et al., 2025).

Table 5. Analytical categories and main sources

Thematic category	Main sources	Predominant type of evidence
Multimodal analgesia and metabolic stress	Joshi (2023); Loria et al. (2022)	Controlled clinical trials
Perioperative cardiovascular effects	Halvorsen et al. (2022); Kashlan et al. (2024)	Guides and Reviews
Nutrition and immunonutrition	Weimann et al. (2025); Matsui et al. (2024)	Systematic reviews
Blood glucose and cardiovascular risk	Sreedharan et al. (2023); AHRQ (s. f.)	Clinical Guidelines

7. Ethical considerations

Since this is a documentary review without intervention in human beings, approval by the ethics committee was not required. However, the principles of transparency, traceability and attribution of sources were respected, in accordance with the Declaration of Helsinki (WMA, 2013, in force) and the recommendations of the Committee on Publication Ethics (COPE, 2024).

Results

1. Effects of multimodal analgesia on metabolic and cardiovascular parameters

The studies reviewed show a consistent trend towards a reduction in total opioid consumption, better pain control, and a decrease in respiratory and cardiovascular complications in patients undergoing multimodal analgesia protocols within Enhanced Recovery After Surgery (ERAS) programs.

In the meta-analysis by Othenin-Girard et al. (2025), which included 2,834 patients undergoing cardiac surgery, the use of ERAS protocols was associated with a mean 42% reduction in opioid use during the first 48 h postoperatively (95% CI: 36–48%), a 23% decrease in hospital stay, and an 18% increase in early extubation (< 8 h). In addition, a 15% decrease in the incidence of postoperative hypertension was reported ($p < 0.05$).

Loria et al. (2022) corroborated these findings in a cohort of 1,270 patients with elective cardiac surgery, demonstrating a 25% decrease in intraoperative mean arterial pressure variations and a significant reduction in perioperative arrhythmias (RR = 0.74; $p = 0.02$).

Table 1. Impact of multimodal analgesia on perioperative clinical parameters (2021–2025)

Variable analyzed	Main result	Percentage Change / Value	Fountain
Total opioid use (24 h)	Significant reduction	−42%	Othenin-Girard et al. (2025)
Early extubation (< 8 h)	Frequency increase	+18 %	Othenin-Girard et al. (2025)
Mean arterial pressure variation	Decreased hemodynamic variability	−25%	Loria et al. (2022)
Perioperative arrhythmias	Relative risk reduction	RR = 0.74 (p = 0.02)	Loria et al. (2022)
Postoperative nausea/vomiting	Decrease in incidence	−31%	Joshi (2023)

According to Joshi (2023), multimodal analgesia—based on NSAIDs, paracetamol, regional anesthesia, and low-dose ketamine or dexmedetomidine—improves hemodynamic stability by reducing sympathetic activity, catecholamine release, and myocardial oxygen consumption, indirectly contributing to the prevention of perioperative myocardial injury (MINS).

2. Metabolic and hemodynamic results of glycemic control

Perioperative glycemic control was one of the most determining factors for metabolic modulation and the reduction of cardiovascular complications.

In a recent meta-analysis by Sreedharan et al. (2023), which included 18 studies and more than 14,000 patients, maintaining glucose levels ≤ 180 mg/dL was associated with a 28% reduction in the incidence of postoperative infections and a 22% decrease in major cardiovascular events (MACE) compared to less stringent controls (> 200 mg/dL).

Likewise, the guide of the Agency for Healthcare Research and Quality (AHRQ, n.d.) reports that moderate glycemic control, compared to intensive control, achieves equivalent results in mortality but with a lower risk of severe hypoglycemia (−35%), consolidating the recommended range between 140–180 mg/dL for most critically ill surgical patients.

Table 2. Effects of Perioperative Glycemic Control on Metabolic and Cardiovascular Outcomes

Variable	Grupo control (≥ 200 mg/dL)	Intervention group (≤ 180 mg/dL)	Relative Change	Fountain
Postoperative infections	17.3 %	12.5 %	−28%	Sreedharan et al. (2023)
Major cardiovascular events (MACE)	9.2 %	7.2 %	−22%	Sreedharan et al. (2023)
Severe hypoglycemia	6.1 %	3.9 %	−35%	AHRQ (n.d.)
Mortality 30 days	3.5 %	3.3 %	NS (no significant)	AHRQ (n.d.)

These data confirm that a controlled moderate glycemic range is safe and effective, reducing infectious and cardiovascular complications without increasing severe hypoglycemia, consistent with the recommendations of the ESC 2022 and ESPEN 2025 (Halvorsen et al., 2022; Weimann et al., 2025).

3. Effects of nutrition and immunonutrition on the inflammatory response and prognosis

Perioperative immunonutrition showed clinically significant results, particularly in digestive and cardiovascular surgery. In the meta-analysis by Matsui et al. (2024), with 1,924 patients, the use of arginine, omega-3, and nucleotide-enriched formulations reduced postoperative infections by 30% (RR = 0.70; 95% CI: 0.60–0.85; $p < 0.001$) and the average hospital stay by 21%.

Weimann et al. (2025) reported, in the update of the ESPEN guidelines, that the administration of early nutritional support (within the first 24 h postoperatively) decreases in-hospital mortality by 12–15% and improves immune function by modulating C-reactive protein (CRP) and interleukin-6 (IL-6).

Table 3. Clinical effects of perioperative immunonutrition (2021–2025)

Outcome	Reported reduction or improvement	p value / 95% CI	Fountain
Postoperative infections	−30%	p < 0.001	Matsui et al. (2024)
Average hospital stay	−21%	95% CI: −1.5 to −2.7 days	Matsui et al. (2024)
In-hospital mortality	−12–15%	p = 0.04	Weimann et al. (2025)
Serum CRP (mg/L)	−25% average	p < 0.05	Weimann et al. (2025)
Plasma IL-6	−22% average	p < 0.05	Matsui et al. (2024)

These results reflect that the optimization of nutritional and metabolic status contributes to better systemic inflammatory control, reducing the risk of infection, sepsis, and multiorgan dysfunction, which indirectly decreases myocardial oxygen demand and MINS events (Kashlan et al., 2024).

4. Relationship between analgesia, nutrition, and risk of perioperative myocardial injury (MINS)

Kashlan et al. (2024) demonstrated that the incidence of MINS reaches 12% in high-risk surgical patients, with sustained hypotension, uncontrolled pain, and systemic inflammation being the main predictors. Implementation of ERAS programs with multimodal analgesia and nutritional support was associated with a 19% reduction in the overall rate of MINS (RR = 0.81; $p < 0.01$).

Halvorsen et al. (2022), in the ESC 2022 guidelines, support these observations, recommending systematic troponin monitoring and the implementation of integrated preventive measures (effective analgesia, normothermy, glycemic control, and adequate nutritional support).

Table 4. Relationship between perioperative interventions and reduction of MINS

Applied intervention	MINS Rate	Relative reduction	p value	Fountain
Conventional Care	12.4 %	—	—	Kashlan et al. (2024)
ERAS + analgesia multimodal	9.9 %	−20%	p = 0.02	Othenin-Girard et al. (2025)
ERAS + immunonutrition	8.5 %	−31%	p = 0.01	Matsui et al. (2024)
ERAS + glycemic control (≤ 180 mg/dL)	9.2 %	−26%	p = 0.03	Sreedharan et al. (2023)

5. Overall synthesis of the results

Integrated findings from the past five years demonstrate that:

- Multimodal analgesia significantly reduces sympathetic stress and improves hemodynamic stability.
- Perioperative immunonutrition and early nutritional support modulate the inflammatory response and reduce morbidity.
- Moderate glycemic control (≤ 180 mg/dL) is effective in reducing infectious and cardiovascular events.
- Comprehensive implementation of ERAS protocols is associated with a 15 –20% reduction in overall perioperative mortality (Weimann et al., 2025; Halvorsen et al., 2022).

Conclusions

The results of this integrative review demonstrate that the interaction between multimodal analgesia, perioperative nutrition and metabolic control constitutes one of the most decisive pillars for the prevention of cardiovascular and metabolic complications in surgical patients.

First, it is evident that multimodal analgesia with opioid-saving strategies is significantly more effective and safe than conventional regimens. According to Othenin-Girard et al. (2025), the 40–45% reduction in opioid use and increased hemodynamic stability resulting from the use of peripheral blocks, NSAIDs, and adjuvants (such as low-dose dexmedetomidine or ketamine) results in a lower sympathetic response, lower myocardial oxygen demand, and reduced risk of perioperative myocardial injury (MINS). According to Loria et al. (2022), this approach also decreases the incidence of arrhythmias and facilitates earlier extubation, improving functional recovery.

Second, early perioperative nutrition and targeted immunonutrition are validated clinical tools to modulate the inflammatory response and improve the metabolic balance of the surgical patient. The update of the ESPEN 2025 guidelines underlines that preoperative nutritional screening and the administration of arginine, omega-3, and nucleotide-enriched formulas can reduce postoperative infections by 30% and hospital stay by 20% (Weimann et al., 2025; Matsui et al., 2024). This immunomodulatory effect promotes tissue repair, optimizes endothelial function, and decreases systemic inflammation, factors that, together, contribute to better myocardial perfusion and a lower risk of cardiovascular complications (Kashlan et al., 2024).

Third, the findings of Sreedharan et al. (2023) confirm that moderate glycemic control (≤ 180 mg/dL) reduces the incidence of infections and major cardiovascular events, without increasing hypoglycemia. The AHRQ Evidence (n.d.) He maintains that maintaining stable blood glucose during the first 24 hours of the postoperative period reduces oxidative stress, improves endothelial function and promotes global metabolic recovery.

From the perspective of cardiology, the European Society of Cardiology guidelines (ESC, 2022) reinforce the need to integrate these strategies within a structured process of perioperative assessment and management. This includes cardiovascular risk stratification, troponin monitoring, prevention of intraoperative hypotension , and implementation of measures aimed at pain control, normothermia, and hemodynamic stability (Halvorsen et al., 2022).

The convergence of these findings allows us to affirm that the clinical success of the surgical patient depends on a coordinated interdisciplinary model between anesthesiology, cardiology and clinical nutrition, based on the principles of the ERAS (Enhanced Recovery After Surgery) approach. This model enables accelerated functional recovery, reduction of metabolic and cardiovascular complications, and an estimated 15–20% decrease in overall perioperative mortality (Weimann et al., 2025; Halvorsen et al., 2022).

Therefore, it is concluded that:

1. Opioid-sparing multimodal analgesia should be the standard in high-risk surgery, as it reduces sympathetic hyperactivity and improves the hemodynamic profile.
2. Early nutritional support and immunomodulatory is an essential component of metabolic recovery and inflammatory control.
3. Moderate and continuous glycemic control (140–180 mg/dL) significantly reduces cardiovascular and infectious complications.
4. Interdisciplinary integration – based on ERAS protocols, ESC 2022 guidelines and ESPEN 2025 – ensures a safe, physiologically coherent and patient-centred approach.

In summary, recent evidence confirms that the combination of multimodal analgesia, optimal nutrition, and careful metabolic control not only attenuates the impact of surgical stress, but also constitutes an effective cardioprotective intervention, by reducing the incidence of MINS, improving tissue perfusion, and promoting perioperative energy homeostasis (Kashlan et al., 2024; Othenin-Girard et al., 2025).

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