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IMPACT OF ANESTHETIC PREHABILITATION ON THE RECOVERY OF PATIENTS UNDERGOING MAJOR SURGERY: A SYSTEMATIC REVIEW

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ABSTRACT

This systematic review evaluated the impact of anesthetic prehabilitation on postoperative recovery in patients undergoing major surgery, highlighting the importance of interventions aimed at optimizing both the physical and psychological aspects of patients before the procedure. We included 20 studies that investigated various perioperative strategies, covering specific interventions – such as coronary revascularization, biliary drainage, administration of gabapentin, alpha-1 blockers, and gabapentinoids – as well as integrated rehabilitation programs. The analysis considered outcomes related to the incidence of complications, length of hospital stay, morbidity, quality of life, and hospital readmission, in addition to examining the efficacy of complementary measures, such as the use of melatonin and the application of advanced techniques, such as preoperative embolization and preoperative magnetic resonance imaging. The results showed that, although several interventions have the potential to improve clinical outcomes – showing, for example, a reduction in acute myocardial infarction in the long term, a decrease in opioid consumption, and an improvement in lung function – the effects vary considerably according to the type of procedure and the patient's profile. The heterogeneity of the studies and the predominance of low- to moderate-certainty evidence reinforce the need for caution in generalizing the findings, pointing to the importance of individualized approaches and standardization of protocols. In conclusion, the integration of specific measures with multidisciplinary approaches shows promise for improving perioperative outcomes, contributing to the reduction of complications and acceleration of postoperative recovery. However, new clinical trials with methodological rigor are essential to consolidate these findings and improve anesthetic management strategies, to offer safer and more effective care to patients undergoing major surgery.

Keywords: Preoperative care. Perioperative care. Postoperative period. Surgery.

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INTRODUCTION

Performing major surgeries presents considerable challenges for health professionals, both in intraoperative and postoperative management. Patients undergoing these procedures face high risks of complications, prolonged hospitalization time, and compromised quality of life. Therefore, optimizing the patient's physical and psychological conditions before surgery is an essential strategy to improve clinical outcomes and reduce complications. In this context, anesthetic prehabilitation emerges as an integrated approach that aims to comprehensively prepare patients for the challenges imposed by surgery, to reduce morbidity and improve postoperative recovery (Costa *et al.*, 2024).

Anesthetic prehabilitation involves a set of interventions aimed at improving the patient's clinical status before surgery. These interventions may include the management of comorbidities such as diabetes and hypertension, optimization of nutritional status, physical exercise programs to increase muscle strength and cardiorespiratory capacity, and psychological support to reduce stress and anxiety associated with surgery (Kehlet; Wilmore, 2002). Studies have shown that these strategies help mitigate the adverse effects of surgical stress by improving the patient's physiological response to the procedure, which can result in a faster and safer recovery (Gustafsson *et al.*, 2011).

The importance of prehabilitation in the surgical context is even more evident with the adoption of protocols such as Enhanced Recovery After Surgery (ERAS), which emphasizes a multidisciplinary approach to preparing the patient for surgery. These protocols include, among other measures, maintaining adequate nutrition, minimizing unnecessary invasive interventions, and adequate pain control, aiming at a more efficient recovery with fewer complications (American Society of Anesthesiologists, 2025). The implementation of ERAS has shown positive results, including a reduction in the length of hospital stay, a decrease in the incidence of complications, and an improvement in postoperative quality of life, which makes its application a growing practice in referral hospitals (Ljungqvist; Scott; Fearon, 2017).

In addition, understanding the pathophysiological mechanisms of surgical stress, which involves changes in metabolism, the immune system, and the inflammatory response, underlies the need for interventions that can modulate this response effectively (Guyton and Hall, 2016). For example, early activation of physical mobilization and adequate enteral nutrition have been associated with reduced systemic inflammation and improved bowel function, which is crucial for postoperative recovery (Harrison et al., 2018).

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Considering the clinical relevance of this approach, this systematic review aims to evaluate the impact of anesthetic prehabilitation on the recovery of patients undergoing major surgery. An integrative analysis of recent studies will provide a comprehensive view of the effects of these interventions on managing complications, reducing recovery time, and improving clinical outcomes. The objective is to provide subsidies for clinical practice, based on solid evidence, to improve perioperative care strategies and thus improve patient experience and health outcomes.

OBJECTIVES

GENERAL OBJECTIVE

To evaluate the impact of anesthetic prehabilitation on postoperative recovery of patients undergoing major surgery, comparing its effects with conventional preoperative care in terms of complications, length of hospital stay, morbidity, and quality of life.

SPECIFIC OBJECTIVES

1. To analyze the efficacy of anesthetic prehabilitation in reducing postoperative complications and length of hospital stay in adult patients undergoing major surgery.
2. To investigate the effects of anesthetic prehabilitation on quality of life and postoperative hospital readmission rate.
3. To compare clinical outcomes between patients who received structured anesthetic prehabilitation protocols and those who underwent conventional preoperative care, considering morbidity and adverse events related to anesthetic management.

METHODOLOGY

The present study consists of a systematic review of the literature, conducted in January 2025, in strict accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This methodological approach ensures transparency, reproducibility, and quality in the selection, analysis, and synthesis of the data extracted from the included studies.

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SURVEY QUESTION AND PICO STRUCTURE

The central question of this review is: In adult patients undergoing major surgery, does anesthetic prehabilitation improve postoperative recovery compared with conventional preoperative care? To answer this question, the following points will be considered:

Population (P): Adult patients (≥18 years old) who undergo major or high-risk surgeries (e.g., oncological, cardiothoracic, neurological).

Intervention (I): Anesthetic prehabilitation protocols, which may include breathing exercises, management of comorbidities, and nutritional and psychological support, among other measures.

Comparator (C): Conventional preoperative care or the absence of structured protocols.

Outcomes (O):

Main: Postoperative complications, length of hospital stay, morbidity, and mortality.

Secondary: Quality of life, readmission rate, and adverse events related to anesthetic management.

SEARCH STRATEGY

The search for studies will be done in the Medline (via Pubmed), SciElo, and LILACS databases to ensure that no important studies are missed. In addition, searches in the gray literature and a manual analysis of the references of the selected studies will be included.

Below is a table with the search strategies used for PubMed/MEDLINE and LILACS/SciElo:

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Table 1 – Search strategies used.

Database	Search Strategy
PubMed/MEDLINE	(("Prehabilitation"[tiab] OR "Preoperative Care"[tiab] OR "Preoperative Optimization"[tiab] OR "Preoperative Conditioning"[tiab] OR "Preoperative Management"[tiab] OR "Multimodal Prehabilitation"[tiab]) AND ("Major Surgery"[tiab] OR "High-Risk Surgery"[tiab] OR "Surgical Procedures, Operative"[tiab] OR "Perioperative Care"[tiab] OR "Complex Surgical Procedures"[tiab] OR "Extensive Surgery"[tiab]) AND ("Postoperative Recovery"[tiab] OR "Postoperative Complications"[tiab] OR "Postoperative Period"[tiab] OR "Morbidity"[tiab] OR "Mortality"[tiab] OR "Quality of Life"[tiab] OR "Length of Stay"[tiab] OR "Enhanced Recovery After Surgery"[tiab])) OR (("Prehabilitation"[mh] OR "Preoperative Care"[mh] OR "Perioperative Care"[mh]) AND ("Surgical Procedures, Operative"[mh] OR "Major Surgery"[mh] OR "High-Risk Surgery"[mh]) AND ("Postoperative Recovery"[mh] OR "Postoperative Complications"[mh] OR "Morbidity"[mh] OR "Quality of Life"[mh]))
LILACS and SciElo	tw:(("Prehabilitation" OR "Prehabilitation" OR "Prehabilitation" OR "Preoperative Care" OR "Preoperative Care" OR "Preoperative Care" OR "Preoperative Optimization" OR "Preoperative Optimization" OR "Preoperative Preparation" OR "Preoperative Preparation" OR "Preoperative Conditioning")) AND tw:(("Major Surgery" OR "Large Surgery" OR "Major Surgery" OR "High-Risk Surgical Procedures" OR "High-Risk Surgical Procedures" OR "High-Risk Surgical Procedures" riesgo" OR "High-Risk Surgery" OR "Perioperative Care" OR "Perioperative Care" OR "Perioperative Care")) AND tw:(("Postoperative Recovery" OR "Postoperative Recovery" OR "Postoperative Complications" OR "Postoperative Complications" OR "Postoperative Complications" OR "Postoperative Period" OR "Postoperative Period" OR "Postoperative Period" OR "Morbidity and Mortality" OR "Morbidity and Mortality" OR "Morbidity and Mortality" OR "Quality of Life" OR "Calidad de Vida" OR "Quality of Life"))

Source: authorship, 2025.

SELECTION OF STUDIES AND DATA EXTRACTION

The studies will be selected in two stages:

Initial screening: Two reviewers reviewed study titles and abstracts using software (such as Rayyan or EndNote) to decide which studies should be evaluated in full.

Full Reading: Studies that seem relevant will be read in full to confirm whether they meet the inclusion criteria. Any disagreement between the reviewers will be resolved by consensus or by consultation with a third reviewer.

After the final selection, the data will be extracted through a standardized form (for example, in an Excel spreadsheet). This form will gather information about the authors, year of publication, country, study type, population characteristics, intervention details, comparator, and the outcomes measured.

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RESULTS AND DISCUSSION

A total of 986 studies were found in the databases, and 20 studies were selected to compose our study, following the aforementioned screening protocol.

The systematic analysis covered a variety of perioperative strategies employed to optimize surgical outcomes, ranging from specific interventional approaches to integrated pre-rehabilitation programs. In studies investigating preoperative coronary interventions, revascularization—either by angioplasty with stent implantation or by coronary artery bypass graft surgery (CABG)—demonstrated, in three randomized controlled trials (n = 1,144), an inconclusive effect in terms of immediate reduction of acute myocardial infarction (AMI) and perioperative mortality, with relative risk (RR) values of 0.28 (95% CI: 0.02–4.57) and 0.79 (95% CI: 0.31–2.04), respectively. However, isolated findings suggest that this intervention can, in the long term, significantly reduce the incidence of AMI (RR 0.09; 95% CI: 0.03–0.28), evidencing the possibility of delayed benefits (BOTELHO et al., 2024).

Concomitantly, preoperative biliary drainage in patients undergoing pancreaticoduodenectomy presented results that contradict its therapeutic objectives. A meta-analysis consisting of 37 studies (total of 12,641 patients) revealed that, although the procedure aims to unobstructed bile flow, its performance is associated with a relevant increase in postoperative complications, including a higher rate of surgical wound infection (OR 2.2; 95% CI: 1.76–2.76) and delayed gastric emptying (OR 1.21; 95% CI: 1.02–1.43) (LI; YANG, 2024).

In another therapeutic spectrum, the perioperative administration of gabapentin was evaluated in a double-blind trial with 77 patients undergoing inguinal hernioplasty, demonstrating a significant reduction in pain scores and morphine consumption (5.3% versus 74.4% in the control group; $p < 0.001$), with no increase in common adverse events, corroborating the efficacy and safety of the use of this analgesic agent (COSTA et al., 2024). Similarly, the preoperative use of alpha-1 blockers, studied in 11 trials involving 1,074 patients undergoing ureteroscopy, was associated with a significant reduction in severe ureteral lesions (RR 0.30; 95% CI: 0.17–0.53) and improvement in ureteral sheath insertion, although without significant impact on stone clearance (VICTOR et al., 2024).

Gabapentinoids, both gabapentin and pregabalin, have also been investigated for the prevention of succinylcholine-induced myalgia. In six clinical trials (n = 481), a substantial reduction in the incidence of myalgia was observed in the first 24 hours

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postoperatively (RR 0.69; 95% CI: 0.56–0.84; p < 0.001), an effect that was maintained in the separate analysis for each drug, although there was no reduction in fasciculations associated with succinylcholine administration (VÉLEZ et al., 2024).

In addition to isolated interventions, recent studies have explored integrated approaches in the perioperative context. In orthopedic surgeries, pre-rehabilitation programs have shown significant improvements in preoperative function, muscle strength, and quality of life, with moderate certainty evidence (PUNNOOSE et al., 2023). However, in frail patients undergoing colorectal cancer resection, multimodal prehabilitation programs have not demonstrated a significant impact on reducing postoperative complications, suggesting that the benefits may be specific to the type of procedure and the patient's profile (CARLI et al., 2020). In noncardiac procedures, strategies to reduce pulmonary complications, such as enhanced recovery protocols, intraoperative ventilation with lung protection, prophylactic respiratory physiotherapy, and epidural analgesia, have pointed to a likely decrease in PPCs, although the evidence is predominantly of low quality (ODOR et al., 2020). Finally, the use of melatonin as a premedication was associated with a significant reduction in preoperative anxiety scores (mean difference of –11.69 on the VAS scale) and showed similar performance to benzodiazepines, with the advantage of less impact on psychomotor and cognitive functions (MADSEN et al., 2020).

In neurosurgical procedures, preoperative embolization (PE) with Onyx™ has been highlighted as a strategy to facilitate the resection of meningiomas, by reducing tumor vascularization and minimizing intraoperative blood loss. In a systematic review and meta-analysis involving 186 patients with meningiomas classified according to WHO criteria (grade I: 80%, grade II: 16%, and grade III: 4%), an overall complication rate of 9% (95% CI: 4%–14%) was observed, with serious complications restricted to only 1% of cases (95% CI: 0%–3%). In addition, the mean blood loss recorded during surgery was approximately 668.7 mL (95% CI: 534.9–835.8 mL), suggesting that embolization may contribute to greater intraoperative safety. However, the authors emphasize the need for additional studies to improve patient selection and optimize the techniques employed (BATISTA et al., 2023).

In the oncology area, the application of preoperative magnetic resonance imaging (MRI) in breast-conserving surgery remains controversial. In a randomized phase III clinical trial involving 524 patients with stage 0–III breast cancer, the use of preoperative MRI was associated with an 8.3% increase in the rate of mastectomies, without, however, promoting

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significant improvements in local recurrence-free survival (99.2% vs. 98.9%; p = 0.7) or overall survival (95.3% vs. 96.3%; p = 0.8). In addition, the reoperation rate remained similar between the groups (8.7% in both), indicating that, although MRI can modify surgical planning, its routine use should be carefully evaluated to avoid unnecessary interventions (MOTA et al., 2023).

Regarding the optimization of the preoperative clinical condition, erythropoietin (EPO) has been investigated as an alternative for the correction of anemia, aiming to reduce the need for allogeneic transfusions. A systematic review and meta-analysis involving eight studies, with 734 patients treated with EPO compared to 716 controls, demonstrated that EPO administration significantly reduced the need for transfusions (RR 0.829; p = 0.049), without impacting 90-day mortality. These results suggest that EPO may be an effective strategy for optimizing preoperative hemoglobin levels, although the risks associated with treatment still require further investigation (ALI et al., 2022).

In gynecological surgeries, prehabilitation – which integrates medical, nutritional, physical, and psychological interventions – has been proposed to improve postoperative recovery. A randomized clinical trial of 194 patients who underwent laparotomy compared a group under standard care of the Enhanced Recovery After Surgery (ERAS) protocol with another that received an additional prehabilitation program. The primary outcome, which assessed the time to hospital discharge based on criteria of functional autonomy, ambulation, and minimum caloric intake, is under analysis, with recruitment expected to be completed in 2024. This approach aims to clarify whether prehabilitation can reduce hospital stay and improve postoperative functional capacity (LOPES et al., 2022).

Another strategy aimed at reducing perioperative complications involves preoperative physical therapy in cancer patients. In a randomized study with 30 patients, the groups undergoing kinesiotherapy and inspiratory muscle training had a significantly lower incidence of postoperative complications (20% and 30%, respectively) compared to the control group (90%). In addition, significant improvements were observed in maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) measurements, suggesting that respiratory training contributes to better lung function and reduced risk of complications (PIMPÃO et al., 2021).

Finally, in the approach to laparoscopic cholecystectomy, preoperative CT angiography has been incorporated as a tool to identify anatomical variations of the cystic artery and thus reduce complications related to vascular and biliary anatomy. In a study

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with 60 patients, the implementation of CT angiography allowed the early identification of anatomical variations, resulting in lower rates of intraoperative bleeding, as well as a reduction in the incidence of ileus and surgical wound infection. These findings highlight the potential of this tool to improve surgical planning and minimize the risks associated with laparoscopic cholecystectomy (COELLO; DEL SOL, 2020).

The results obtained show that the efficacy of perioperative interventions varies according to the modality, the patient's profile, and the outcome evaluated. The preoperative coronary approach, for example, does not present a consensus regarding the immediate reduction of adverse events, although there are indications of long-term benefits, which highlights the complexity in the management of patients with coronary artery disease undergoing non-coronary surgeries. This heterogeneity is also reflected in clinical practice, where the careful selection of individuals becomes imperative to obtain favorable results (BOTELHO et al., 2024; ODOR et al., 2020).

In the setting of digestive surgery, preoperative biliary drainage demonstrates that, despite the therapeutic intent, the intervention may inadvertently increase the risk of complications, such as infection and delayed gastric emptying. This finding reinforces the need to establish stricter indication criteria, especially in patients with significant elevations in bilirubin levels, to mitigate unnecessary risks (IL; YANG, 2024).

On the other hand, interventions aimed at pain management and tissue protection, such as the administration of gabapentin and the use of alpha-1 blockers, showed promising results. The reduction in opioid consumption and the reduction of lesions during minimally invasive procedures illustrate the importance of analgesic and protective strategies, which can even improve postoperative recovery and reduce the length of hospital stay (COSTA et al., 2024; VICTOR et al., 2024). In addition, the use of gabapentinoids to prevent succinylcholine-induced myalgia highlights the potential of neuromuscular activity-modulating agents, although the effects on fasciculations remain limited (VÉLEZ et al., 2024).

The integration of rehabilitation and prehabilitation programs also stands out as a multidisciplinary approach that can positively modulate surgical outcomes. Recent studies have shown that pre-admission interventions, both in cardiac surgeries and in major elective procedures, are associated with improved preoperative functional capacity and reduced postoperative complications (Punnoose et al., 2023; Carli et al., 2020; Steinmetz et al., 2023; Perry et al., 2021). Additionally, evidence suggests that in high-risk patients

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undergoing abdominal surgery, especially oncology, multimodal programs – which integrate exercise, nutritional support, and sometimes psychological interventions – can significantly decrease the incidence of complications and accelerate recovery (Skořepa et al., 2024; Lambert et al., 2021; Yin; Zhang, 2023).

The breadth of results observed in interventions aimed at reducing PCPs and modulating anxiety with the use of melatonin also highlights the relevance of approaches that, even with low- to moderate-quality evidence, point to the possibility of improvements in clinical outcomes, stimulating the review of current perioperative protocols (Odor et al., 2020; Madsen et al., 2020).

CONCLUSION

In summary, this systematic review showed that specific perioperative interventions – such as coronary revascularization, biliary drainage, the use of gabapentin, alpha-1 blockers, and gabapentinoids – as well as integrated prehabilitation programs, can improve surgical outcomes, although their effects vary according to the procedure and the patient's profile.

However, the heterogeneity of studies and the predominance of low- to moderate-certainty evidence limit the generalizability of findings, reinforcing the need for robust clinical trials and standardized protocols to validate benefits and optimize patient selection.

In conclusion, the integration of specific measures with multidisciplinary approaches shows promise for improving perioperative outcomes, but clinical practice must be individualized, and further research is essential to consolidate and improve management protocols.

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