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Optimización de los Resultados Posoperatorios en Cirugía Gastrointestinal: Enfoque Integral de Prehabilitación, Nutrición Perioperatoria, Analgesia Multimodal y Recuperación Intensificada

Optimizing Postoperative Outcomes in Gastrointestinal Surgery: An Integrated Approach to Prehabilitation, Perioperative Nutrition, Multimodal Analgesia, And Enhanced Recovery

Vicente Treviño Caballero
Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado Regional de Monterrey.
trevinoc@udem.edu
https://orcid.org/0009-0005-6918-843X

Eber Marcel Mendoza Osorio
Nuevo Hospital Civil de Guadalajara Juan I. Menchaca
eber.mendoza@udem.edu
https://orcid.org/0009-0009-1644-4427

Bricey Daniela Fonseca Aldana
Universidad de los Andes
Briceydaniela13@gmail.com
https://orcid.org/0009-0003-3694-744X

Christian Paúl Rodas Cabrera
Universidad del Azuay
rises307@gmail.com
https://orcid.org/0009-0003-1060-019X

Didier Leonidad Diaz Parra
Universidad de Antioquia
didierdiaz91@gmail.com
https://orcid.org/0009-0001-3302-3685

Dariana Jiménez Báez
Benemérita Universidad Autónoma de Puebla
darianajimenezbaez@gmail.com
https://orcid.org/0009-0002-5751-8903

Ambar Karolina Cedeño Cedeño.
Universidad Católica de Santiago de Guayaquil
ambarcedeno123@gmail.com
https://orcid.org/0009-0005-0237-1854

Natalia Carolina Herrera Castro
Universidad de Manizales
nataliaherreracc@gmail.com
https://orcid.org/0009-0000-6492-8797

Dalia Arizbeth Escobar Gómez
Instituto Mexicano del Seguro Social
arizbeth.eg7@gmail.com
https://orcid.org/0009-0001-7888-9263

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***Autor de correspondencia:** trevinoc@udem.edu

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RESUMEN

La cirugía gastrointestinal mayor continúa asociándose con una morbilidad posoperatoria considerable, retrasos en la recuperación funcional y hospitalizaciones prolongadas, lo que evidencia la necesidad de implementar estrategias perioperatorias integrales. Esta revisión narrativa tuvo como objetivo analizar la relevancia clínica de la prehabilitación multimodal y los protocolos de recuperación intensificada después de la cirugía (ERAS), con especial énfasis en la optimización nutricional perioperatoria, la analgesia multimodal y la recuperación de la función gastrointestinal. Se adoptó un enfoque descriptivo, analítico e integrador para examinar 20 publicaciones científicas, entre ellas ensayos clínicos aleatorizados, revisiones sistemáticas, metaanálisis y guías clínicas internacionales, considerando particularmente su aplicabilidad en los sistemas sanitarios latinoamericanos. La evidencia revisada mostró beneficios heterogéneos, pero clínicamente relevantes, asociados con la prehabilitación multimodal, incluidas reducciones en determinadas complicaciones posoperatorias y mejoras en la recuperación funcional. La suplementación nutricional oral preoperatoria se relacionó con una menor frecuencia de complicaciones infecciosas, mientras que la carga de carbohidratos y la alimentación oral temprana mostraron resultados favorables en la recuperación gastrointestinal y la duración de la hospitalización. Las intervenciones de analgesia multimodal, especialmente la lidocaína intravenosa y el bloqueo del plano transverso del abdomen, se asociaron con una disminución del dolor posoperatorio temprano y del consumo de opioides. Las mejoras en la recuperación gastrointestinal se reflejaron en menores tiempos para el retorno de los ruidos intestinales, la primera expulsión de gases y la primera evacuación, aunque estos resultados no demostraron de manera consistente una reducción del íleo posoperatorio clínicamente definido. Las diferencias entre pacientes, procedimientos quirúrgicos, protocolos terapéuticos y recursos institucionales limitaron las comparaciones directas entre investigaciones. Los hallazgos respaldan un modelo de atención perioperatoria coordinado, multidisciplinario y centrado en el paciente. Se requieren investigaciones adicionales para determinar las combinaciones de intervenciones más eficaces, estandarizar los indicadores de recuperación y evaluar la efectividad y viabilidad de los programas ERAS integrados en distintos sistemas sanitarios, particularmente en Latinoamérica.

PALABRAS CLAVE

prehabilitación, recuperación intensificada después de la cirugía, cirugía gastrointestinal, nutrición perioperatoria, analgesia multimodal, íleo posoperatorio, recuperación gastrointestinal, complicaciones posoperatorias, alimentación oral temprana, cirugía colorrectal

ABSTRACT

Major gastrointestinal surgery remains associated with considerable postoperative morbidity, delayed functional recovery, and prolonged hospitalization, highlighting the need for integrated perioperative strategies. This narrative review aimed to analyze the clinical relevance of multimodal prehabilitation and Enhanced Recovery After Surgery (ERAS) protocols, emphasizing perioperative nutritional optimization, multimodal analgesia, and gastrointestinal functional recovery. A descriptive, analytical, and integrative approach was adopted to examine 20 scientific publications, including randomized controlled trials, systematic reviews, meta-analyses, and international clinical guidelines, with particular consideration of their applicability to Latin American healthcare settings. The reviewed evidence demonstrated heterogeneous but clinically relevant benefits associated with multimodal prehabilitation, including reductions in selected postoperative complications and improvements in functional recovery. Preoperative oral nutritional supplementation was associated with fewer infectious complications, whereas carbohydrate loading and early oral feeding demonstrated favorable outcomes regarding gastrointestinal recovery and hospitalization

duration. Multimodal analgesic interventions, particularly intravenous lidocaine and transversus abdominis plane blocks, were associated with reduced early postoperative pain and opioid consumption. Improvements in gastrointestinal recovery were reflected in shorter times to bowel sounds, first flatus, and first defecation, although these findings did not consistently establish reductions in clinically defined postoperative ileus. Variability in patient characteristics, surgical procedures, intervention protocols, and institutional resources limited direct comparisons between studies. The findings support a coordinated, multidisciplinary, and patient-centered approach to perioperative management. Further research is necessary to determine optimal intervention combinations, standardize recovery outcomes, and evaluate the effectiveness and feasibility of integrated ERAS pathways across diverse healthcare systems, particularly in Latin America.

KEYWORDS

prehabilitation, enhanced recovery after surgery, gastrointestinal surgery, perioperative nutrition, multimodal analgesia, postoperative ileus, gastrointestinal recovery, postoperative complications, early oral feeding, colorectal surgery

INTRODUCCIÓN

Major gastrointestinal surgery remains associated with considerable postoperative morbidity, prolonged hospitalization, and delayed functional recovery despite advances in surgical techniques, anesthetic management, and perioperative care. Postoperative complications such as surgical site infections, gastrointestinal dysmotility, inadequate pain control, and nutritional deterioration can negatively affect clinical outcomes and increase healthcare costs. Consequently, perioperative management has progressively shifted from conventional approaches toward integrated strategies designed to optimize physiological reserves, minimize surgical stress, and accelerate recovery. Enhanced Recovery After Surgery (ERAS) protocols represent an important development in this transition by incorporating evidence-based interventions throughout the preoperative, intraoperative, and postoperative periods (Gustafsson et al., 2025).

Prehabilitation has emerged as a complementary strategy aimed at improving patients' functional and metabolic capacity before surgery. Unlike traditional perioperative approaches, which primarily focus on postoperative rehabilitation, prehabilitation emphasizes early identification and correction of modifiable risk factors, including physical deconditioning, malnutrition, and psychological distress. Multimodal programs combining individualized exercise, nutritional interventions, and psychological support have demonstrated improvements in functional capacity and selected postoperative outcomes among patients undergoing colorectal and other major abdominal procedures. Nevertheless, differences in intervention duration, patient characteristics, and clinical protocols continue to influence their effectiveness and reproducibility (Gillis et al., 2014; Barberan-Garcia et al., 2018; Molenaar et al., 2023).

Nutritional optimization constitutes another essential component of modern perioperative care. Patients undergoing digestive surgery frequently present with inadequate nutritional intake, systemic inflammation, or cancer-related metabolic alterations, which may compromise wound healing, immune function, and postoperative recovery. Current nutritional guidelines emphasize early nutritional screening, individualized intervention, avoidance of unnecessary fasting, and timely restoration of oral or enteral intake. Preoperative nutritional supplementation and carbohydrate loading have also been investigated as strategies to reduce metabolic stress and improve postoperative recovery, although their clinical benefits may vary according to baseline nutritional status and surgical complexity (Weimann et al., 2021; Lu et al., 2022; Zou et al., 2024).

Effective pain management is equally important because insufficient analgesia may limit early mobilization, impair respiratory function, and prolong hospitalization. Conversely, excessive opioid administration can contribute to nausea, vomiting, sedation, and delayed gastrointestinal transit. Multimodal analgesia seeks to balance adequate pain relief with reduced opioid exposure through combinations of nonopioid medications, regional anesthetic techniques, and selected intravenous adjuncts. Evidence regarding transversus abdominis plane blocks, epidural analgesia, and intravenous lidocaine supports the importance of individualized anesthetic strategies, although their relative benefits depend on surgical approach, patient characteristics, and institutional resources (Borzellino et al., 2016; Viderman et al., 2022; Dai et al., 2024).

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Recovery of gastrointestinal function represents a particularly relevant indicator of postoperative progress. Postoperative ileus remains a frequent complication following major abdominal surgery and is associated with abdominal distension, intolerance to oral intake, delayed bowel movements, and increased hospital utilization. Its pathophysiology involves complex interactions among surgical manipulation, inflammatory responses, autonomic disturbances, and perioperative medication exposure. Strategies such as early mobilization, opioid-sparing analgesia, appropriate fluid management, and early oral feeding have therefore become central elements of enhanced recovery programs. Available evidence suggests that early nutritional intake can be implemented safely in appropriately selected patients and may support faster gastrointestinal recovery without necessarily increasing postoperative complications (Chapman et al., 2018; Willcutts et al., 2016; Lee & Han, 2025).

Despite increasing international adoption of ERAS principles, implementation remains heterogeneous across healthcare systems. Differences in institutional infrastructure, multidisciplinary coordination, professional training, and access to nutritional and anesthetic resources may affect adherence to recommended interventions. These challenges are particularly relevant in Latin America, where growing interest in enhanced recovery pathways has highlighted both opportunities for improved perioperative outcomes and persistent barriers to standardized implementation (Mata-Suarez et al., 2022).

Although prehabilitation, nutritional support, multimodal analgesia, and gastrointestinal recovery have been extensively investigated as individual components of perioperative care, their integration into a coordinated clinical pathway requires further evaluation. Important uncertainties remain regarding the optimal timing of interventions, identification of patients most likely to benefit, and applicability of established protocols across different surgical procedures and healthcare environments. Addressing these questions is essential for developing efficient, individualized, and clinically feasible perioperative strategies.

Accordingly, **this narrative review aims to examine the current evidence regarding the integration of prehabilitation and enhanced recovery strategies in gastrointestinal surgery**, with particular emphasis on perioperative nutrition, multimodal analgesia, and restoration of gastrointestinal function. The review considers international clinical guidelines, randomized controlled trials, systematic reviews, and meta-analyses, while incorporating evidence relevant to Latin American healthcare settings. Its central research question is whether coordinated interventions targeting nutritional status, surgical stress, pain control, and gastrointestinal motility can improve postoperative recovery compared with conventional perioperative management. By critically examining these interconnected domains, this review seeks to identify established clinical benefits, remaining evidence gaps, and opportunities for optimizing multidisciplinary care in digestive surgery.

DESARROLLO

Integration of Prehabilitation and Enhanced Recovery Strategies in Digestive Surgery

The optimization of perioperative care in digestive surgery requires a comprehensive understanding of the physiological, nutritional, anesthetic, and functional factors influencing postoperative recovery. Major gastrointestinal procedures induce complex inflammatory, neuroendocrine, and metabolic responses characterized by increased catabolism, insulin resistance, altered immune function, and disturbances in gastrointestinal motility. Although these responses constitute physiological adaptations to surgical injury, their persistence or excessive activation can contribute to postoperative complications, delayed mobilization, and prolonged hospitalization. Consequently, contemporary perioperative management increasingly emphasizes interventions capable of reducing surgical stress while preserving functional independence and promoting early recovery (Weimann et al., 2021).

Prehabilitation and optimization of preoperative functional capacity

Prehabilitation represents a proactive approach to surgical care, focusing on strengthening physiological reserves before exposure to operative stress. Its principal components include structured physical exercise, nutritional assessment and intervention, and psychological support. These interventions are particularly relevant in patients with

colorectal malignancies, reduced exercise tolerance, sarcopenia, frailty, or significant comorbidities, whose baseline physiological limitations may increase vulnerability to postoperative complications.

Evidence from randomized clinical trials indicates that multimodal prehabilitation can improve functional capacity and may reduce postoperative complications in selected surgical populations. The PREHAB randomized clinical trial demonstrated that a structured multimodal program before colorectal cancer surgery was associated with a reduction in postoperative complications, supporting the value of targeted preoperative optimization (Molenaar et al., 2023). Similarly, previous investigations demonstrated improvements in functional recovery when prehabilitation interventions were initiated before colorectal resection rather than being restricted to the postoperative period (Gillis et al., 2014).

Nevertheless, the effectiveness of prehabilitation depends on adequate patient selection, adherence to prescribed interventions, and the time available before surgery. Patients undergoing urgent procedures may not benefit from conventional prehabilitation schedules, whereas individuals with limited functional reserves may require more individualized interventions. Therefore, prehabilitation should be integrated into the surgical pathway through early screening, functional assessment, and multidisciplinary coordination rather than applied as an isolated intervention (Barberan-Garcia et al., 2018).

Perioperative nutrition and metabolic protection

Nutritional status is a major determinant of postoperative recovery in patients undergoing digestive surgery. Malnutrition, reduced skeletal muscle mass, and inadequate protein intake may compromise immune competence, tissue repair, and physical rehabilitation. These conditions are particularly prevalent among patients with gastrointestinal malignancies or chronic digestive disorders, in whom reduced dietary intake may coexist with systemic inflammation and disease-associated metabolic disturbances.

Current evidence supports routine nutritional screening and individualized nutritional intervention before major gastrointestinal surgery. The European Society for Clinical Nutrition and Metabolism recommends identifying patients at nutritional risk, correcting significant nutritional deficiencies whenever feasible, and restoring oral or enteral intake early after surgery. Nutritional support should be adapted to the severity of malnutrition, anticipated surgical stress, and expected postoperative gastrointestinal function (Weimann et al., 2021).

Preoperative oral nutritional supplementation may provide additional benefits in patients with inadequate intake or elevated nutritional risk. However, evidence regarding its effectiveness remains heterogeneous because of differences in supplement composition, intervention duration, and patient characteristics (Zou et al., 2024). Similarly, preoperative carbohydrate loading has been incorporated into certain enhanced recovery pathways to attenuate fasting-associated metabolic disturbances and postoperative insulin resistance, although improvements in specific clinical outcomes are not consistently demonstrated across studies (Lu et al., 2022).

An essential principle of enhanced recovery is avoiding unnecessarily prolonged postoperative fasting. Early oral intake, when clinically appropriate, promotes nutritional recovery and may facilitate gastrointestinal rehabilitation. Nevertheless, feeding strategies should consider surgical complexity, anastomotic integrity, aspiration risk, and the patient's ability to tolerate gastrointestinal intake (Willcutts et al., 2016).

Multimodal analgesia and reduction of opioid-associated complications

Postoperative pain management constitutes a fundamental component of recovery following digestive surgery. Uncontrolled pain can interfere with respiratory mechanics, restrict mobilization, increase sympathetic activation, and delay rehabilitation. However, excessive dependence on systemic opioids may exacerbate nausea, vomiting, sedation, and gastrointestinal dysmotility, creating a therapeutic challenge in patients undergoing abdominal procedures.

Multimodal analgesia addresses this problem by combining pharmacological and regional anesthetic techniques that act through different pain pathways. Depending on the surgical procedure and individual contraindications, these strategies may include acetaminophen, nonsteroidal anti-inflammatory drugs, neuraxial analgesia, abdominal wall blocks, and selected intravenous adjuncts.

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Regional techniques such as transversus abdominis plane blocks have demonstrated analgesic benefits in colorectal surgery and may reduce postoperative opioid requirements in selected circumstances (Viderman et al., 2022). Epidural analgesia also remains an important option, particularly in major open abdominal procedures, although its routine use in minimally invasive surgery requires consideration of potential adverse effects and available alternatives (Borzellino et al., 2016).

Intravenous lidocaine has also been investigated for its potential analgesic and anti-inflammatory properties and its possible contribution to gastrointestinal recovery. Nevertheless, reported benefits vary across clinical studies, and administration requires appropriate patient selection, dose control, and monitoring because of the possibility of systemic toxicity (Dai et al., 2024).

The selection of an analgesic strategy should therefore reflect the surgical approach, anticipated pain intensity, comorbidities, and institutional expertise. Within enhanced recovery programs, adequate analgesia is not an isolated outcome but a prerequisite for early mobilization, respiratory rehabilitation, nutritional tolerance, and functional independence.

Gastrointestinal functional recovery and prevention of postoperative ileus

Restoration of gastrointestinal motility is a critical determinant of postoperative recovery after major digestive surgery. Postoperative ileus is characterized by transient impairment of gastrointestinal propulsion and may manifest as abdominal distension, nausea, vomiting, delayed passage of flatus or stool, and intolerance to oral feeding.

Its development involves multiple interacting mechanisms, including intestinal manipulation, activation of inflammatory pathways, sympathetic nervous system stimulation, fluid imbalances, and exposure to opioid analgesics. Consequently, prevention and management require a multifactorial approach rather than reliance on a single therapeutic intervention (Chapman et al., 2018).

Enhanced recovery pathways seek to limit these contributing factors through opioid-sparing analgesia, early mobilization, appropriate perioperative fluid administration, and timely resumption of oral intake. Evidence from systematic reviews indicates that early oral feeding after gastrointestinal procedures can support faster functional recovery without consistently increasing complication rates among appropriately selected patients (Lee & Han, 2025).

Nevertheless, recovery of bowel function should not be evaluated exclusively through the passage of flatus or stool. Clinical assessment should also consider oral intake tolerance, abdominal symptoms, nausea and vomiting, functional mobility, and the presence of complications requiring further intervention.

Multidisciplinary implementation and the Latin American context

The effectiveness of enhanced recovery pathways depends on coordinated participation among surgeons, anesthesiologists, nutrition specialists, nursing professionals, physiotherapists, and patients. Standardized protocols can improve continuity of care, but their implementation requires institutional commitment, professional training, and continuous evaluation of adherence and clinical outcomes.

In Latin America, implementation of enhanced recovery programs has progressed, although disparities in healthcare infrastructure, access to specialized nutritional care, and availability of multidisciplinary services may influence their application. Regional experience emphasizes the importance of adapting internationally developed protocols to local resources without compromising essential evidence-based principles (Mata-Suarez et al., 2022).

Standardization should therefore coexist with individualized clinical decision-making. Patients undergoing different digestive procedures may require distinct nutritional, anesthetic, and rehabilitation strategies, while individuals with frailty, malnutrition, or advanced malignancy may benefit from additional preoperative assessment and personalized interventions.

Ultimately, the clinical relevance of integrating prehabilitation and enhanced recovery lies in their shared objective: reducing physiological vulnerability before surgery, minimizing avoidable perioperative stress, and accelerating the restoration of functional autonomy. Their combined application offers a coherent framework for improving

perioperative care; however, further research is necessary to determine the most effective combinations of interventions, establish procedure-specific recommendations, and evaluate feasibility across different healthcare environments.

OBJETIVO GENERAL Y OBJETIVOS ESPECÍFICOS

General Objective

To critically analyze the integration of prehabilitation and Enhanced Recovery After Surgery (ERAS) strategies in patients undergoing major gastrointestinal surgery, focusing on perioperative nutritional optimization, multimodal analgesia, and gastrointestinal functional recovery, to evaluate their clinical effectiveness, identify opportunities for multidisciplinary implementation, and establish evidence-based considerations for improving postoperative outcomes within international and Latin American healthcare settings.

Specific Objectives

Cognitive Domain

1. To identify and describe the principal physiological, metabolic, inflammatory, and nutritional alterations associated with major gastrointestinal surgery, emphasizing their influence on postoperative complications, functional deterioration, and delayed recovery.

2. To analyze and compare the available scientific evidence concerning multimodal prehabilitation, perioperative nutritional interventions, and enhanced recovery protocols, examining their effects on postoperative morbidity, gastrointestinal function, length of hospitalization, and functional rehabilitation.

3. To evaluate the effectiveness and limitations of multimodal analgesic strategies, including regional anesthesia, nonopioid pharmacological interventions, and opioid-sparing approaches, in improving postoperative pain control and facilitating gastrointestinal recovery.

Psychomotor Domain

4. To organize and integrate evidence-based perioperative interventions into a structured clinical framework encompassing preoperative assessment, nutritional preparation, anesthetic management, early mobilization, and gastrointestinal rehabilitation.

5. To develop a conceptual sequence of perioperative management activities that illustrates the practical coordination of surgical, anesthetic, nutritional, and rehabilitation interventions throughout the surgical pathway.

Affective Domain

6. To recognize and critically appraise the importance of patient-centered care, interdisciplinary communication, and individualized decision-making in the implementation of prehabilitation and enhanced recovery strategies.

7. To promote an evidence-informed approach to perioperative care that considers patient safety, equitable access to healthcare resources, professional collaboration, and the applicability of international clinical recommendations within Latin American healthcare systems.

OBJETO DE ESTUDIO

The object of study of this narrative review is the integration of multimodal prehabilitation and Enhanced Recovery After Surgery (ERAS) protocols in the perioperative management of patients undergoing major gastrointestinal surgery, with particular emphasis on nutritional optimization, multimodal analgesia, and restoration of gastrointestinal

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function. The investigation examines the physiological and clinical relationships between these interventions and their potential influence on postoperative complications, functional recovery, and healthcare utilization.

The study focuses on adult patients undergoing elective gastrointestinal procedures, including colorectal, gastric, and other major abdominal digestive surgeries. Particular attention is given to individuals presenting with nutritional deficiencies, reduced functional capacity, frailty, or chronic comorbidities, as these conditions may increase susceptibility to surgical stress and postoperative complications. The study population is defined through previously published clinical investigations rather than direct patient recruitment or individual-level data collection (Weimann et al., 2021; Molenaar et al., 2023).

The central phenomenon under investigation is the interaction between preoperative physiological preparation, intraoperative stress modulation, and postoperative rehabilitation. From this perspective, surgical recovery is understood as a multidimensional process involving metabolic regulation, inflammatory responses, pain control, gastrointestinal motility, nutritional tolerance, and restoration of physical independence. These processes are closely interconnected, and alterations in one domain may influence recovery in others (Chapman et al., 2018).

The interventions examined comprise three principal dimensions. The first includes multimodal prehabilitation programs incorporating physical conditioning, nutritional support, and psychological preparation. The second addresses perioperative nutritional strategies, including nutritional risk assessment, individualized supplementation, carbohydrate loading when appropriate, and early postoperative feeding. The third encompasses multimodal analgesic approaches involving nonopioid medications, regional anesthetic techniques, and strategies intended to minimize opioid-associated adverse effects (Gillis et al., 2014; Viderman et al., 2022).

The principal outcomes of interest include postoperative complication rates, duration of hospitalization, postoperative pain intensity, opioid consumption, gastrointestinal transit recovery, tolerance of oral intake, and restoration of functional capacity. Additional considerations include patient safety, feasibility of implementation, interdisciplinary coordination, and potential differences in clinical effectiveness between healthcare environments.

At the international level, the review considers evidence from established perioperative guidelines, randomized clinical trials, and systematic reviews. Particular consideration is given to the Latin American context, where differences in institutional resources, multidisciplinary organization, and access to perioperative services may influence the practical implementation of enhanced recovery pathways (Mata-Suarez et al., 2022).

The scope of this investigation is limited to the critical analysis and integration of existing scientific evidence. It does not involve experimental interventions, direct clinical observation, or collection of identifiable patient information. Accordingly, the review seeks to establish a comprehensive understanding of how coordinated perioperative strategies may improve recovery after digestive surgery while identifying knowledge gaps and opportunities for future clinical research.

METODOLOGÍA

Study Design and Research Approach

This study was structured as a narrative literature review with a descriptive, analytical, and integrative approach, aimed at examining the relationship between multimodal prehabilitation, perioperative nutritional optimization, multimodal analgesia, and gastrointestinal functional recovery in patients undergoing major digestive surgery. The methodological framework was based on the scientific method, incorporating problem identification, formulation of research questions, systematic organization of scientific evidence, critical analysis, and synthesis of findings.

A narrative review design was selected because it allows the integration of evidence from different methodological approaches, including randomized controlled trials, clinical practice guidelines, systematic reviews, and meta-analyses. This approach was considered appropriate for examining the interactions among physiological, nutritional, anesthetic, and organizational factors involved in enhanced postoperative recovery.

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Sources of Information and Literature Search Strategy

The literature review was based on scientific publications indexed in internationally recognized biomedical databases, principally PubMed/MEDLINE, with Scopus considered an additional source for bibliographic coverage and citation verification. The reference corpus comprised 20 previously identified publications addressing perioperative recovery in gastrointestinal surgery, including international clinical guidelines and studies relevant to Latin American healthcare settings.

A structured search framework was defined using Medical Subject Headings (MeSH) and free-text terms related to the principal research domains. The key concepts included *Enhanced Recovery After Surgery*, *prehabilitation*, *gastrointestinal surgery*, *perioperative nutrition*, *multimodal analgesia*, *postoperative ileus*, and *early oral feeding*.

The following reproducible search expression was established as a reference strategy for PubMed:

PROPOSED PUBMED SEARCH EXPRESSION

("Enhanced Recovery After Surgery" OR "ERAS" OR "prehabilitation") AND ("gastrointestinal surgery" OR "colorectal surgery" OR "abdominal surgery") AND ("perioperative nutrition" OR "nutritional support" OR "multimodal analgesia" OR "postoperative ileus" OR "gastrointestinal recovery")

[Copy]

The search framework prioritized research published between 2014 and 2026, while allowing the incorporation of earlier foundational publications when necessary. Particular attention was given to studies evaluating clinically relevant outcomes and to publications addressing implementation challenges in Latin America.

Eligibility Criteria and Evidence Selection

Publications were considered relevant when they addressed adult patients undergoing gastrointestinal or major abdominal surgery and examined at least one of the principal components of enhanced perioperative recovery. Eligible evidence included clinical practice guidelines, randomized controlled trials, systematic reviews, meta-analyses, and observational investigations providing relevant clinical or implementation findings.

The selection framework emphasized methodological quality, clinical applicability, relevance to the research objectives, and correspondence with the defined population and interventions. Studies exclusively focused on pediatric populations, unrelated surgical specialties, or interventions without a clear relationship to perioperative gastrointestinal recovery were considered outside the principal scope.

Because this investigation follows a narrative review design, evidence selection was intended to provide a clinically meaningful synthesis rather than an exhaustive quantitative assessment of all available publications. No pooled effect estimates or new statistical comparisons were calculated.

Data Organization and Critical Analysis

The scientific evidence was organized into four analytical categories: multimodal prehabilitation, perioperative nutritional management, multimodal analgesia, and gastrointestinal functional recovery. Each publication was considered according to its study design, population characteristics, interventions, principal outcomes, and methodological limitations.

The analytical process emphasized comparisons between clinical recommendations and research findings, particularly regarding postoperative complications, pain control, opioid consumption, nutritional tolerance, recovery of gastrointestinal motility, and duration of hospitalization.

Differences in surgical procedures, intervention protocols, outcome definitions, and institutional resources were considered when interpreting the applicability of reported findings. Greater interpretive weight was assigned to clinical practice guidelines supported by substantial evidence and to randomized trials and systematic reviews directly addressing the review objectives.

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Evidence Synthesis and Methodological Considerations

A qualitative thematic synthesis was adopted to integrate findings across the selected research domains. This approach enabled the identification of complementary interventions, areas of consistency, conflicting results, and limitations affecting their implementation.

The evidence was interpreted according to the distinction between demonstrated clinical benefits and outcomes that remain uncertain or heterogeneous. Particular attention was given to avoiding causal conclusions unsupported by the underlying study designs.

International recommendations were also examined in relation to their potential applicability in Latin American healthcare systems, considering differences in professional resources, institutional infrastructure, and access to specialized perioperative services.

The methodological limitations of this review include the selective nature of narrative evidence synthesis, heterogeneity among the included study designs, and the absence of quantitative meta-analysis or formal certainty-of-evidence grading. These limitations were considered when formulating clinical interpretations and recommendations.

The investigation involved secondary analysis of published scientific literature and did not require direct patient recruitment, experimental procedures, or collection of identifiable clinical information.

FASES DEL DESARROLLO

Phase 1. Identification and Delimitation of the Research Problem

The first phase focused on defining the clinical challenges associated with postoperative recovery after major gastrointestinal surgery. Particular attention was directed toward complications related to surgical stress, nutritional deterioration, inadequate pain control, gastrointestinal dysmotility, and delayed restoration of functional independence.

The research problem was delimited to the need for coordinated perioperative interventions capable of addressing these complications through an integrated approach. Current recommendations emphasize that postoperative recovery depends not only on surgical technique but also on nutritional status, anesthetic management, and early rehabilitation (Gustafsson et al., 2025).

This phase established the central problem: despite advances in perioperative medicine, inconsistencies in the implementation of prehabilitation and enhanced recovery strategies continue to limit their clinical effectiveness across different surgical populations and healthcare settings.

Phase 2. Formulation of Research Questions and Analytical Propositions

The second phase involved defining the principal research question: *How does the integration of multimodal prehabilitation, perioperative nutritional optimization, and multimodal analgesia influence gastrointestinal functional recovery and postoperative outcomes in adult patients undergoing major digestive surgery?*

Three complementary analytical propositions guided the review. First, multimodal prehabilitation may improve postoperative recovery by increasing physiological reserves before surgery. Second, individualized perioperative nutritional strategies may contribute to improved metabolic stability and gastrointestinal recovery. Third, multimodal opioid-sparing analgesia may facilitate early mobilization and reduce medication-related gastrointestinal adverse effects.

These propositions were derived from previous clinical investigations and were used to organize the subsequent analysis rather than as hypotheses subjected to original experimental testing (Carli et al., 2020; Molenaar et al., 2023).

Phase 3. Identification and Organization of Scientific Evidence

The third phase consisted of establishing the bibliographic framework and organizing relevant scientific publications into thematic categories. The reference corpus included 20 identified publications comprising clinical practice guidelines, randomized controlled trials, systematic reviews, meta-analyses, and regional implementation studies.

The proposed literature search strategy incorporated biomedical terminology associated with ERAS, prehabilitation, gastrointestinal surgery, perioperative nutrition, multimodal analgesia, and postoperative ileus. PubMed/MEDLINE was established as the principal bibliographic source, with Scopus considered complementary.

Scientific evidence was classified into four principal domains: preoperative functional optimization, perioperative nutritional management, anesthetic and analgesic interventions, and gastrointestinal recovery. This organization allowed findings from different investigations to be examined according to their clinical relevance and methodological characteristics.

Phase 4. Critical Appraisal and Comparative Analysis

The fourth phase focused on critically examining the relationships between perioperative interventions and postoperative outcomes. Evidence concerning prehabilitation was considered in relation to functional capacity, postoperative complications, and recovery trajectories, while nutritional interventions were assessed according to their potential influence on metabolic response, feeding tolerance, and clinical recovery.

The analysis of analgesic strategies emphasized postoperative pain control, opioid consumption, and gastrointestinal adverse effects. Regional anesthetic techniques and intravenous adjuncts were considered according to their demonstrated benefits, limitations, and suitability for different surgical approaches (Borzellino et al., 2016; Dai et al., 2024).

Gastrointestinal recovery was evaluated through clinically relevant outcomes, including postoperative ileus, tolerance of oral intake, and restoration of bowel function. Particular consideration was given to differences in outcome definitions and intervention protocols, which may explain variations between published findings (Chapman et al., 2018).

Because the review integrates heterogeneous evidence, the comparative assessment was qualitative and did not involve independent statistical pooling or the generation of new clinical effect estimates.

Phase 5. Integration and Interpretation of Findings

The fifth phase involved constructing a unified conceptual framework connecting preoperative preparation, intraoperative management, and postoperative rehabilitation.

Prehabilitation was considered the initial component of this continuum, aimed at improving baseline physical and nutritional reserves. Intraoperative management was examined as an opportunity to minimize physiological stress and optimize analgesic strategies. Postoperative interventions were subsequently integrated around early mobilization, nutritional recovery, gastrointestinal motility, and restoration of independence.

This framework emphasized the interdependence of perioperative interventions. Effective analgesia may facilitate mobilization, while nutritional optimization may support physical rehabilitation and tissue recovery. Similarly, reducing opioid exposure and promoting early feeding may contribute to gastrointestinal recovery.

The interpretation also considered the feasibility of implementing these strategies within Latin American healthcare institutions, where variations in resources, specialized personnel, and perioperative organization may influence protocol adherence (Mata-Suarez et al., 2022).

Phase 6. Synthesis, Clinical Implications, and Identification of Research Gaps

The final phase focused on consolidating the scientific evidence into an integrated interpretation of perioperative recovery strategies. The synthesis was directed toward identifying interventions supported by consistent clinical findings, recognizing areas of uncertainty, and establishing priorities for future investigation.

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Particular attention was given to the need for individualized protocols according to nutritional risk, functional status, surgical complexity, and healthcare resources. The importance of multidisciplinary collaboration was also examined as a determinant of successful ERAS implementation.

Remaining research needs include establishing optimal prehabilitation duration, identifying effective combinations of nutritional and analgesic interventions, standardizing gastrointestinal recovery outcomes, and evaluating the sustainability of enhanced recovery programs in resource-constrained settings.

RESULTADOS Y DISCUSIÓN

Figure 1.

Effects of multimodal prehabilitation on postoperative complications in major gastrointestinal surgery.

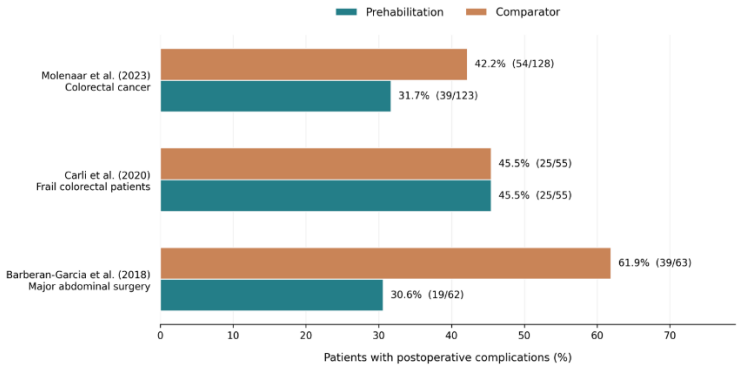


Figure 1 presents a comparative analysis of the incidence of postoperative complications reported in three randomized clinical trials investigating multimodal prehabilitation in patients undergoing major abdominal or colorectal surgery. The studies conducted by Barberan-Garcia et al. (2018), Carli et al. (2020), and Molenaar et al. (2023) included 486 patients across their respective analyzed populations. Although all three investigations examined preoperative interventions intended to improve physiological readiness for surgery, differences were observed in the magnitude and statistical significance of the reported outcomes.

In the randomized trial conducted by Barberan-Garcia et al. (2018), involving high-risk patients undergoing elective major abdominal surgery, postoperative complications occurred in 30.6% of patients receiving personalized prehabilitation (19 of 62), compared with 61.9% of patients receiving conventional care (39 of 63). This represented an absolute difference of approximately 31.3 percentage points between intervention groups, with a statistically significant difference reported in the original investigation ($p = .001$). These findings demonstrated a lower frequency of postoperative complications among patients participating in the structured preoperative intervention program.

The investigation by Carli et al. (2020) presented a different pattern. Among frail patients undergoing colorectal cancer resection, the incidence of postoperative complications was identical between the prehabilitation and postoperative rehabilitation groups, with 25 of 55 patients (45.5%) experiencing complications in each group. The adjusted odds ratio was 0.9 (95% CI, 0.4–2.2; $p = .90$), indicating no statistically significant difference in overall complications. Severe complications were reported in 12.7% of the prehabilitation group and 20.0% of the comparison group; however, this difference was also not statistically significant ($p = .23$). The trial was conducted within established enhanced recovery pathways, and minimally invasive procedures represented a substantial proportion of surgical interventions. These characteristics distinguished its clinical setting from investigations involving broader high-risk abdominal surgical populations (Carli et al., 2020).

The PREHAB randomized clinical trial conducted by Molenaar et al. (2023) evaluated 251 patients undergoing colorectal cancer surgery. Overall postoperative complications occurred in 31.7% of patients receiving multimodal prehabilitation (39 of 123), compared with 42.2% of those receiving standard care (54 of 128). Although the absolute

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difference was approximately 10.5 percentage points, the comparison did not reach conventional statistical significance (OR, 0.62; 95% CI, 0.37–1.05; p = .07).

However, analysis of complication severity demonstrated statistically significant differences. Severe complications, defined using a Comprehensive Complication Index score greater than 20, were documented in 17.1% of patients undergoing prehabilitation compared with 29.7% of controls (OR, 0.47; 95% CI, 0.26–0.87; p = .02). Medical complications were also less frequent in the prehabilitation group, occurring in 15.4% compared with 27.3% of patients receiving standard care (OR, 0.48; 95% CI, 0.26–0.89; p = .02). These findings established a distinction between the overall frequency of complications and the occurrence of clinically more severe postoperative events (Molenaar et al., 2023).

Across the three trials, postoperative complication proportions ranged from approximately 30.6% to 45.5% in the prehabilitation groups and from 42.2% to 61.9% in the comparison groups. The magnitude of the differences varied considerably, with one investigation demonstrating a substantial reduction in overall complications, another reporting no between-group difference, and a third demonstrating statistically significant reductions in severe and medical complications without a statistically significant reduction in the overall complication rate.

The studies also differed in their populations and comparator interventions. Barberan-Garcia et al. (2018) investigated high-risk patients undergoing major abdominal surgery, whereas Carli et al. (2020) specifically recruited frail individuals undergoing colorectal cancer resection. Molenaar et al. (2023) evaluated colorectal cancer patients receiving multimodal prehabilitation or standard care. Differences in baseline functional status, surgical approach, intervention structure, and perioperative pathways therefore accompanied the variation observed in postoperative outcomes.

Importantly, Figure 1 displays the published proportions of patients experiencing overall postoperative complications rather than pooled estimates. The bars represent the original trial groups independently, and the figure does not assign a common effect size to heterogeneous interventions or populations. Statistical significance must consequently be interpreted according to the analyses reported within each individual study.

Figure 2.

Perioperative nutritional interventions and postoperative clinical outcomes.

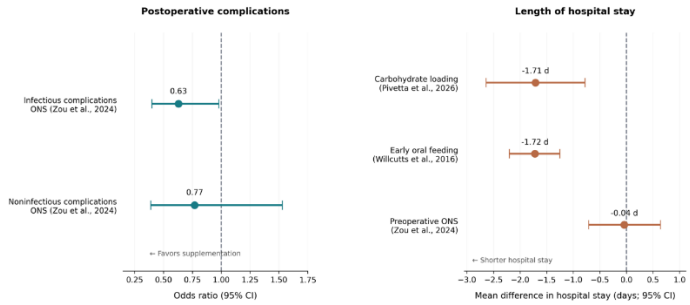


Figure 2 presents a comparative synthesis of the clinical outcomes associated with perioperative nutritional interventions in patients undergoing gastrointestinal surgery. The analysis incorporates findings from three published systematic reviews and meta-analyses examining preoperative oral nutritional supplementation, carbohydrate loading, and early postoperative oral feeding. The graphical representation distinguishes postoperative complication outcomes, expressed as odds ratios, from differences in hospitalization duration, expressed as mean differences in days. This separation allows the findings to be presented according to their original statistical measures without combining clinically distinct outcomes.

The first component of the figure examines the association between preoperative oral nutritional supplementation and postoperative complications. Zou et al. (2024) conducted a systematic review and meta-analysis involving 12

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randomized controlled trials and 1,201 patients undergoing surgery for gastrointestinal malignancies. Of these, 600 received preoperative oral nutritional supplements, while 601 were allocated to control interventions. The investigators evaluated infectious complications, noninfectious complications, nutritional biomarkers, inflammatory parameters, and postoperative hospital stay.

In the analysis of infectious complications, which included five studies and 471 participants, the incidence was 21.5% among patients receiving nutritional supplementation compared with 27.8% in control groups. The pooled odds ratio was 0.63 (95% CI, 0.40–0.98; p = .04), indicating a statistically significant reduction in the odds of postoperative infectious complications associated with preoperative supplementation. Statistical heterogeneity was relatively low (I^2 = 23%), suggesting limited variability in this particular pooled outcome. These findings constituted one of the principal statistically significant clinical results reported in the nutritional supplementation analysis (Zou et al., 2024).

By contrast, the same meta-analysis did not demonstrate a statistically significant difference in noninfectious postoperative complications. This outcome was evaluated in three studies comprising 287 patients, with complications reported in 12.1% of supplemented patients and 14.9% of controls. The pooled odds ratio was 0.77 (95% CI, 0.39–1.53; p = .46). The confidence interval crossed the null value of 1.0, and the observed difference was not statistically significant. The distinction between infectious and noninfectious complications was therefore maintained in the graphical representation (Zou et al., 2024).

Additional biochemical findings from this investigation demonstrated significant differences in selected nutritional and inflammatory indicators. Preoperative supplementation was associated with higher postoperative albumin concentrations (mean difference, 1.71; 95% CI, 0.97–2.46) and prealbumin concentrations (mean difference, 24.80; 95% CI, 1.72–47.88). Differences were also observed in C-reactive protein, white blood cell count, immunoglobulin G, and selected lymphocyte parameters. These biochemical outcomes were not incorporated into Figure 2 because they were measured on different scales and could not be represented directly alongside complication odds ratios or hospitalization duration without additional graphical panels (Zou et al., 2024).

The second component of Figure 2 evaluates postoperative length of hospital stay. Preoperative carbohydrate loading was examined in the updated meta-analysis by Pivetta et al. (2026), which included 20 randomized controlled trials involving 1,387 patients undergoing colorectal surgery. The intervention consisted of preoperative administration of carbohydrate-containing beverages, compared with control strategies used in the included trials.

The pooled analysis demonstrated a mean reduction in hospitalization duration of 1.71 days in the carbohydrate-loading groups (mean difference, −1.71 days; 95% CI, −2.64 to −0.78; p = .0015). The confidence interval did not cross the null value, indicating a statistically significant difference between the intervention and comparison groups. The investigators also reported earlier postoperative defecation, with a mean difference of −0.95 days (95% CI, −1.72 to −0.19; p = .02).

However, carbohydrate loading did not demonstrate statistically significant changes in perioperative glucose or insulin concentrations at the evaluated time points. This distinction was relevant because the observed differences in hospitalization duration and gastrointestinal recovery were not accompanied by consistent improvements in the measured glycemic outcomes (Pivetta et al., 2026).

Early postoperative oral feeding was evaluated using the systematic review and meta-analysis conducted by Willcutts et al. (2016), which included 15 studies and 2,112 adult patients undergoing upper gastrointestinal surgery. The investigators compared early initiation of oral feeding with traditional delayed feeding schedules and evaluated hospital stay, anastomotic leakage, pneumonia, reoperation, readmission, and mortality.

The pooled results demonstrated that early oral feeding was associated with a shorter overall hospital stay, with a weighted mean difference of −1.72 days (95% CI, −2.20 to −1.25; p < .01). A reduction in postoperative length of stay was also identified, with a mean difference of −1.44 days (95% CI, −2.20 to −0.68). No statistically significant increases in anastomotic leakage, nasogastric tube reinsertion, reoperation, readmission, or mortality were identified in the randomized controlled trial analyses. These findings are represented in the figure through the reported overall hospitalization outcome (Willcutts et al., 2016).

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In contrast to carbohydrate loading and early oral feeding, preoperative oral nutritional supplementation did not demonstrate a statistically significant reduction in hospitalization duration in the meta-analysis by Zou et al. (2024). The reported mean difference was −0.04 days (95% CI, −0.71 to 0.64; p = .92), indicating no meaningful difference between intervention and control groups for this specific outcome. Thus, nutritional supplementation was associated with favorable findings for selected infectious and biochemical outcomes without a corresponding statistically significant difference in hospital stay.

The comparison of hospitalization outcomes demonstrates variation according to the type of nutritional intervention evaluated. Carbohydrate loading was associated with a mean reduction of 1.71 days, while early postoperative oral feeding was associated with a reduction of 1.72 days. In contrast, the pooled difference following preoperative oral nutritional supplementation was close to zero. These estimates originated from separate meta-analyses involving different surgical populations, comparison groups, and intervention protocols. Accordingly, their numerical proximity or differences should not be interpreted as evidence of comparative superiority between interventions.

The graphical findings further demonstrate that perioperative nutritional research encompasses outcomes extending beyond nutritional biomarkers alone. Infectious morbidity, gastrointestinal recovery, and duration of hospitalization were evaluated using different statistical approaches, reflecting the multidimensional nature of postoperative recovery. The available quantitative evidence therefore describes intervention-specific effects rather than a single uniform response to perioperative nutritional management.

Figure 3.

Multimodal analgesia and opioid-sparing outcomes in gastrointestinal surgery.

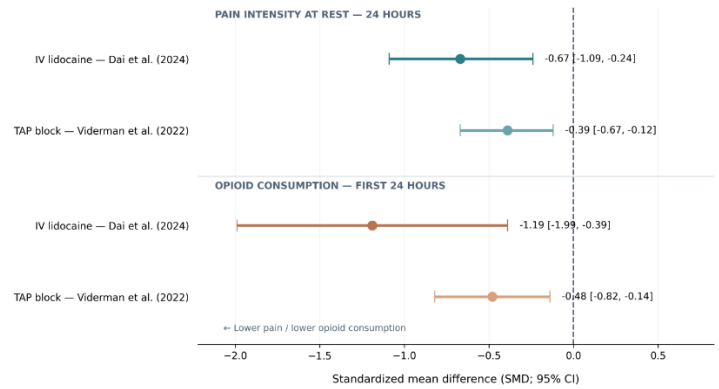


Figure 3 illustrates the quantitative findings of two systematic reviews and meta-analyses evaluating the effectiveness of intravenous lidocaine and transversus abdominis plane (TAP) block in postoperative analgesia following gastrointestinal surgery. The analysis focuses on two clinically relevant outcomes: pain intensity at rest 24 hours after surgery and cumulative opioid consumption during the first 24 postoperative hours. Effect estimates are presented as standardized mean differences (SMDs) with their corresponding 95% confidence intervals, allowing the direction and magnitude of the reported effects to be described using a common statistical scale.

The findings are derived from investigations conducted by Dai et al. (2024) and Viderman et al. (2022). Although both studies examined perioperative analgesic interventions, their populations, intervention protocols, and clinical settings differed. Consequently, the reported estimates represent separate comparisons against their respective control groups rather than direct comparisons between intravenous lidocaine and TAP block.

Postoperative pain intensity following intravenous lidocaine administration

The meta-analysis conducted by Dai et al. (2024) included 24 randomized clinical trials comprising 1,533 patients undergoing gastrointestinal surgery. Of these, 20 trials contributed to the analysis of resting pain intensity at 24 hours after surgery.

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The pooled results demonstrated a statistically significant reduction in postoperative pain among patients receiving intravenous lidocaine compared with control groups (SMD = −0.67; 95% CI: −1.09 to −0.24; p = .002). The negative effect estimate indicated lower pain scores in the intervention groups, while the confidence interval remained entirely below the null value.

However, substantial statistical heterogeneity was identified (I^2 = 90%), reflecting considerable variability in the magnitude of the reported effects. The included investigations differed in surgical procedures, lidocaine administration protocols, treatment duration, and perioperative analgesic regimens. This variation was reflected in the relatively wide confidence interval surrounding the pooled estimate.

Additional analyses reported reduced pain intensity at earlier postoperative intervals, including 1, 2, 4, and 12 hours. Thus, the reported analgesic differences were not restricted to the 24-hour measurement, although the magnitude of the effect varied across assessment periods (Dai et al., 2024).

Postoperative pain intensity following transversus abdominis plane block

The second pain-related estimate was obtained from the meta-analysis conducted by Viderman et al. (2022), which incorporated eight randomized controlled trials involving 615 patients undergoing colorectal surgery.

The analysis of resting pain intensity at 24 hours after laparoscopic colorectal surgery included four trials, with 149 patients in TAP block groups and 145 patients in control groups.

The pooled standardized mean difference was −0.39 (95% CI: −0.67 to −0.12), indicating significantly lower resting pain scores among patients receiving TAP block. Although the confidence interval excluded zero, the magnitude of the standardized effect was smaller than the estimate reported for intravenous lidocaine in the separate meta-analysis.

The investigators also observed reduced pain intensity during coughing, an outcome particularly relevant to postoperative movement and respiratory activity. Nevertheless, sensitivity analyses demonstrated that the resting-pain estimate was influenced by the exclusion of individual studies, indicating some instability in the pooled result.

The findings were derived predominantly from laparoscopic colorectal procedures, and the intervention was compared with the absence of TAP block or control injections. Therefore, the reported effect should be interpreted within that specific surgical and anesthetic context (Viderman et al., 2022).

Opioid consumption following intravenous lidocaine administration

The second component of Figure 3 evaluates opioid consumption during the first 24 postoperative hours.

In the meta-analysis by Dai et al. (2024), 11 randomized trials contributed to this outcome. Intravenous lidocaine administration was associated with a statistically significant reduction in postoperative opioid consumption compared with control interventions.

The pooled standardized mean difference was −1.19 (95% CI: −1.99 to −0.39; p = .003). This estimate represented the largest absolute standardized effect displayed in the figure. Its confidence interval was comparatively wide, indicating uncertainty regarding the precise magnitude of the reduction.

The outcome was expressed as a standardized mean difference because opioid consumption was assessed across trials using different agents and measurement approaches. Accordingly, the value of −1.19 should not be interpreted as a reduction of 1.19 milligrams of morphine or any other specific opioid.

The analysis also reported differences in postoperative gastrointestinal recovery, including earlier bowel sounds, passage of flatus, and first defecation. These gastrointestinal outcomes are not displayed in Figure 3 because they represent time-based measures rather than standardized analgesic outcomes and will be examined in Figure 4 (Dai et al., 2024).

Opioid consumption following transversus abdominis plane block

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Viderman et al. (2022) also evaluated postoperative opioid requirements among patients receiving TAP block during colorectal surgery.

For laparoscopic procedures, the meta-analysis of opioid consumption within the first 24 postoperative hours included 184 patients, of whom 97 received TAP block and 87 were allocated to comparison groups.

The pooled standardized mean difference was −0.48 (95% CI: −0.82 to −0.14), indicating significantly lower opioid consumption among patients receiving TAP block. Statistical heterogeneity was relatively low ($I^2 = 23\%$).

When laparoscopic and open colorectal procedures were combined, the pooled estimate was −0.94 (95% CI: −1.65 to −0.23), although heterogeneity increased substantially ($I^2 = 84\%$). Figure 3 presents the laparoscopic-only estimate to maintain consistency with the corresponding resting-pain analysis.

Despite the reduction in opioid requirements during the first postoperative day, the investigators did not identify statistically significant differences in total opioid consumption across the entire hospital stay or in length of hospitalization following laparoscopic surgery. Similarly, the pooled analysis did not establish a statistically significant reduction in postoperative nausea and vomiting (Viderman et al., 2022).

Comparative description of the reported outcomes

The graphical distribution shows that all four displayed effect estimates favored the respective analgesic interventions, with confidence intervals excluding zero.

For resting pain intensity, intravenous lidocaine was associated with an SMD of −0.67, whereas TAP block was associated with an SMD of −0.39. For postoperative opioid consumption, the corresponding estimates were −1.19 and −0.48, respectively.

However, differences in these numerical estimates cannot establish superiority of one technique over the other. The two meta-analyses involved different surgical populations, intervention regimens, comparator treatments, and outcome measurement protocols. Furthermore, the studies were not designed as head-to-head comparisons between intravenous lidocaine and TAP block.

Variability was especially evident in the lidocaine meta-analysis, where substantial heterogeneity was reported for resting pain scores. In contrast, the laparoscopic TAP block analysis showed lower heterogeneity for early opioid consumption, although sensitivity analyses indicated that the results were influenced by selected contributing trials.

The temporal characteristics of the outcomes are also important. Figure 3 specifically examines pain intensity at 24 hours and opioid consumption accumulated during the first postoperative day. These results do not necessarily describe analgesic effectiveness beyond the early postoperative period.

Figure 4.

Gastrointestinal functional recovery following enhanced recovery interventions.

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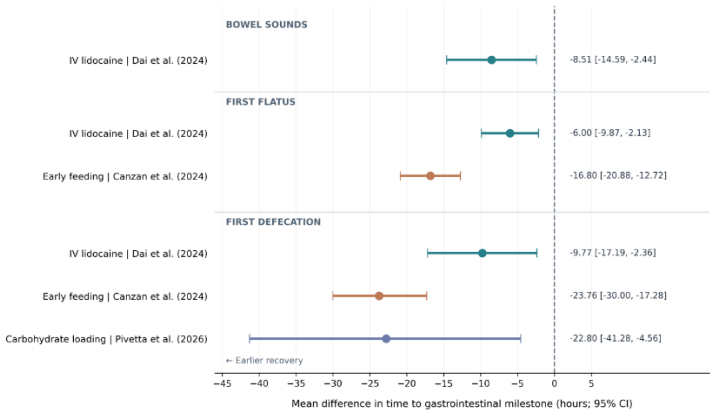


Figure 4 presents a quantitative synthesis of gastrointestinal functional recovery outcomes reported in three systematic reviews and meta-analyses evaluating intravenous lidocaine, early postoperative oral feeding, and preoperative carbohydrate loading. The analysis examines three postoperative milestones: the return of audible bowel sounds, the first passage of flatus, and the first defecation. These variables represent different aspects of gastrointestinal recovery and were examined independently to preserve their clinical and methodological distinctions.

The results are expressed as mean differences (MDs) in hours, accompanied by their corresponding 95% confidence intervals. Negative values indicate that the gastrointestinal recovery milestone occurred earlier in the intervention group than in the corresponding control group. Estimates originally reported in days were converted to hours using a conversion factor of 24, without modifying the underlying statistical comparisons. The findings originate from separate meta-analyses and therefore do not constitute direct comparisons between the interventions.

Return of bowel sounds following intravenous lidocaine administration

The first outcome displayed in Figure 4 concerns the time required for postoperative bowel sounds to return. Dai et al. (2024) conducted a meta-analysis including 24 randomized controlled trials and 1,533 patients undergoing gastrointestinal surgical procedures. In addition to postoperative pain and opioid consumption, the investigators evaluated several measures of gastrointestinal functional recovery.

Intravenous lidocaine was associated with an earlier return of bowel sounds compared with control interventions, with a pooled mean difference of −8.51 hours (95% CI: −14.59 to −2.44; p = .006). The entire confidence interval remained below zero, indicating a statistically significant difference favoring the lidocaine groups.

The reported effect corresponds to an average reduction of approximately eight and a half hours in the time to the assessed milestone. However, the width of the confidence interval indicates variability in the estimated effect, with its limits extending from approximately 2.4 to 14.6 hours earlier.

Although bowel sounds were evaluated as a marker of postoperative gastrointestinal activity, the original analysis also included other functional endpoints, allowing the recovery of intestinal motility to be examined through more than one outcome (Dai et al., 2024).

Time to first passage of flatus

The second group of outcomes examines the time to first passage of flatus, a commonly reported marker of postoperative bowel function.

Dai et al. (2024) reported that intravenous lidocaine shortened the time to first flatus by a mean of 6.00 hours compared with control treatment (95% CI: −9.87 to −2.13; p = .002). The confidence interval excluded zero, demonstrating a statistically significant difference between the groups included in the analysis.

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A separate systematic review by Canzan et al. (2024) evaluated early postoperative oral feeding and gastrointestinal motility recovery across 34 randomized studies. Of these, 13 randomized controlled trials involving 2,496 participants contributed to the pooled analysis of time to first flatus.

The investigators reported a mean difference of −0.70 days (95% CI: −0.87 to −0.53), equivalent to −16.80 hours (95% CI: −20.88 to −12.72). The certainty of evidence for this outcome was classified as moderate, while substantial statistical heterogeneity was observed ($I^2 = 85\%$).

The pooled analysis included investigations of early feeding as an independent intervention and studies incorporating early feeding within multimodal or ERAS pathways. Consequently, its estimate reflects a broader set of clinical interventions and postoperative management protocols than the pharmacological analysis of intravenous lidocaine.

The figure demonstrates that both interventions were associated with statistically significant earlier passage of flatus in their respective comparisons. The numerical differences between their effect estimates reflect separate study populations and comparison conditions rather than a direct measurement of their relative effectiveness (Canzan et al., 2024).

Time to first defecation following intravenous lidocaine

The third component of Figure 4 examines postoperative time to first defecation, another frequently evaluated indicator of gastrointestinal functional recovery.

In the meta-analysis conducted by Dai et al. (2024), intravenous lidocaine administration was associated with an earlier first defecation, with a pooled mean difference of −9.77 hours (95% CI: −17.19 to −2.36; $p = .01$).

The confidence interval remained entirely below zero, supporting a statistically significant difference between lidocaine and control groups. However, the interval extended across approximately 15 hours, indicating uncertainty regarding the exact magnitude of the reported reduction.

This finding was consistent in direction with the results for bowel sounds and first passage of flatus within the same meta-analysis. All three gastrointestinal milestones demonstrated shorter recovery times in patients receiving intravenous lidocaine, although the estimated reductions differed across outcomes.

The reported results were obtained from trials involving heterogeneous gastrointestinal procedures and lidocaine administration protocols. They describe differences in measured recovery times rather than directly establishing the incidence or resolution of clinically defined postoperative ileus (Dai et al., 2024).

Time to first defecation following early oral feeding

Canzan et al. (2024) also examined the time to first postoperative stool passage. Twelve randomized controlled trials involving 2,112 patients contributed to the pooled analysis of this outcome.

Early oral feeding, either as an individual intervention or as part of a multimodal recovery pathway, was associated with a reduction of 0.99 days in the time to first stool passage (MD = −0.99 days; 95% CI: −1.25 to −0.72). Converted into hours, this corresponds to a mean difference of −23.76 hours (95% CI: −30.00 to −17.28).

The confidence interval excluded zero, and the certainty of evidence was classified as moderate. However, substantial statistical heterogeneity was reported ($I^2 = 88\%$), indicating considerable variation in effect estimates among the contributing trials.

The investigators additionally examined postoperative complications, hospitalization duration, and vomiting. Early oral feeding was associated with a lower overall risk of postoperative complications (RR = 0.69; 95% CI: 0.59–0.80), whereas the difference in vomiting risk was not statistically significant (RR = 0.90; 95% CI: 0.68–1.18).

These findings provided complementary clinical information regarding gastrointestinal recovery and feeding-related outcomes, while the figure specifically represents the quantitative difference in time to first defecation (Canzan et al., 2024).

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Time to first defecation following preoperative carbohydrate loading

The final outcome displayed in Figure 4 was obtained from the updated systematic review and meta-analysis by Pivetta et al. (2026), which included 20 randomized controlled trials involving 1,387 patients undergoing colorectal surgery.

The investigators compared preoperative carbohydrate-containing beverages with conventional fasting or placebo. In addition to metabolic outcomes, they evaluated postoperative hospitalization duration, time to first defecation, and other clinical recovery measures.

The pooled analysis demonstrated an earlier first defecation among patients receiving carbohydrate loading, with a mean difference of −0.95 days (95% CI: −1.72 to −0.19; p = .02). Expressed in hours, the estimate corresponds to −22.80 hours (95% CI: −41.28 to −4.56).

Although the confidence interval excluded zero, it was comparatively wide, extending from approximately 4.6 to 41.3 hours earlier than the comparator. The breadth of this interval indicates substantial uncertainty concerning the precise size of the effect.

The same meta-analysis reported a reduction in hospital length of stay of 1.71 days (95% CI: −2.64 to −0.78), while no statistically significant differences were identified in the principal perioperative plasma glucose and insulin measurements.

These results document earlier first defecation and shorter hospitalization in the carbohydrate-loading groups, without corresponding statistically significant changes in the reported glycemic outcomes (Pivetta et al., 2026).

Comparative description of gastrointestinal recovery outcomes

Across the three meta-analyses, all six gastrointestinal recovery estimates displayed in Figure 4 favored the respective intervention groups, with confidence intervals remaining below the null value.

For the return of bowel sounds, intravenous lidocaine was associated with an 8.51-hour reduction. For first passage of flatus, the reductions were 6.00 hours with intravenous lidocaine and 16.80 hours with early oral feeding. For first defecation, the reported differences were 9.77 hours with intravenous lidocaine, 23.76 hours with early oral feeding, and 22.80 hours with preoperative carbohydrate loading.

The distribution of effect estimates demonstrates variation across both interventions and the gastrointestinal milestones assessed. First defecation generally showed larger absolute differences than the return of bowel sounds in the selected analyses. Nevertheless, the underlying studies differed in surgical procedures, intervention timing, outcome definitions, and comparator regimens.

Substantial heterogeneity was explicitly reported in the early-feeding meta-analysis for first flatus and stool passage. The broad confidence interval associated with carbohydrate loading also indicates uncertainty in its estimated effect on time to first defecation.

Importantly, earlier passage of flatus or stool and an earlier return of bowel sounds are surrogate measures of gastrointestinal recovery. They are not interchangeable with the incidence of clinically defined postoperative ileus, which requires consideration of symptoms, feeding intolerance, and other clinical findings.

Figure 5.

Integration of prehabilitation and ERAS components across the perioperative pathway.

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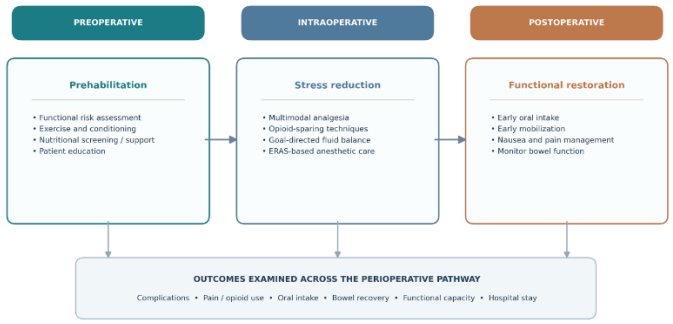


Figure 5 presents an integrated representation of the principal components of multimodal prehabilitation and Enhanced Recovery After Surgery (ERAS) pathways in gastrointestinal surgery. Unlike the preceding figures, which summarized quantitative outcomes from randomized controlled trials and meta-analyses, this figure organizes the interventions identified in the reviewed literature according to their position within the perioperative continuum. Three interconnected stages were distinguished: preoperative physiological optimization, intraoperative surgical stress reduction, and postoperative functional restoration. The representation additionally identifies six principal outcome domains used to evaluate perioperative recovery: postoperative complications, pain and opioid consumption, oral intake, bowel function, functional capacity, and hospital length of stay.

The preoperative stage encompasses interventions intended to assess and improve patients' physiological condition before gastrointestinal surgery. Functional risk assessment, structured exercise, nutritional screening, individualized nutritional support, and patient education were identified as principal components of multimodal prehabilitation. These interventions correspond to the approaches evaluated in randomized clinical trials involving patients undergoing colorectal cancer resection and other major abdominal procedures. Gillis et al. (2014) investigated the relationship between preoperative conditioning and functional recovery, while Barberan-Garcia et al. (2018) evaluated personalized prehabilitation among high-risk surgical patients. More recently, Molenaar et al. (2023) examined the effects of multimodal prehabilitation on postoperative complications and functional capacity following colorectal cancer surgery.

Within this preoperative domain, nutritional assessment constitutes a distinct but closely related component. The ESPEN practical guideline emphasizes nutritional risk identification, individualized nutritional support, avoidance of unnecessarily prolonged preoperative fasting, and appropriate preparation for postoperative nutritional recovery. These recommendations establish nutritional management as an intervention extending across the perioperative period rather than an activity restricted to the days immediately preceding surgery (Weimann et al., 2021).

The intraoperative stage is organized around strategies intended to limit avoidable physiological stress and maintain conditions favorable to postoperative recovery. Multimodal analgesia, opioid-sparing techniques, appropriate fluid management, and anesthetic care aligned with ERAS principles constitute the principal interventions identified in this phase. Their inclusion reflects the multidisciplinary nature of perioperative management, in which anesthetic decisions, surgical technique, fluid administration, and postoperative recovery objectives are interconnected (Gustafsson et al., 2025).

Evidence concerning analgesic interventions was particularly relevant to this stage. Borzellino et al. (2016) examined the role of epidural analgesia within enhanced recovery pathways following laparoscopic colorectal surgery, whereas Viderman et al. (2022) evaluated the analgesic effects of transversus abdominis plane blocks. Dai et al. (2024) additionally reported outcomes associated with intravenous lidocaine administration, including postoperative pain intensity, opioid consumption, and selected gastrointestinal recovery measures. These studies represent different approaches to perioperative analgesic management, with variations in effectiveness according to the surgical population, anesthetic technique, and measured outcome.

The postoperative stage emphasizes the restoration of gastrointestinal and physical function. Early oral intake, mobilization, adequate control of pain and nausea, and monitoring of bowel function were identified as central components of this phase. These interventions correspond to the clinical outcomes examined in systematic reviews of early feeding, postoperative ileus, and enhanced recovery pathways. Willcutts et al. (2016) evaluated early oral feeding

after upper gastrointestinal surgery, while Chapman et al. (2018) described the clinical characteristics and pathophysiological complexity of postoperative ileus following major colorectal procedures.

The figure also demonstrates that individual interventions may extend beyond the stage in which they are first introduced. Nutritional optimization may begin before surgery and continue throughout hospitalization. Similarly, analgesic planning is initiated preoperatively, implemented during surgery, and adjusted during postoperative recovery. Functional rehabilitation may begin with prehabilitation and subsequently continue through early mobilization and progressive restoration of physical activity. Therefore, the three stages represent an organizational framework rather than mutually exclusive periods of clinical intervention.

The lower section of Figure 5 identifies the principal outcomes examined in the selected literature. Postoperative complications were assessed in prehabilitation trials, whereas pain intensity and opioid consumption were central to investigations of regional anesthetic and pharmacological interventions. Oral intake tolerance, bowel sounds, passage of flatus, and first defecation represented gastrointestinal recovery outcomes. Functional capacity and hospitalization duration were also repeatedly evaluated across clinical investigations (Carli et al., 2020; Molenaar et al., 2023).

An additional finding emerging from the thematic synthesis was the importance of institutional implementation. The ERAS pathway requires coordinated participation among surgical, anesthetic, nutritional, nursing, and rehabilitation professionals. The Latin American perspective was represented by Mata-Suarez et al. (2022), who examined the regional development and adoption of enhanced recovery principles. This dimension introduces organizational considerations relevant to the interpretation of clinical evidence across healthcare systems with differing levels of infrastructure and multidisciplinary resources.

The arrows connecting the three perioperative stages indicate the chronological and organizational sequence of interventions. Likewise, the arrows directed toward the outcome domains indicate the clinical variables examined across the reviewed research. They do not represent estimated causal effects, statistical associations, or experimentally validated pathways.

DISCUSIÓN

The findings of this narrative review highlight the multidimensional nature of postoperative recovery following major gastrointestinal surgery and demonstrate the relevance of integrating prehabilitation, nutritional optimization, multimodal analgesia, and gastrointestinal rehabilitation within coordinated perioperative pathways. Although the reviewed evidence generally supports several components of Enhanced Recovery After Surgery (ERAS) protocols, considerable variability exists in the magnitude and consistency of their clinical effects. These differences emphasize the importance of interpreting perioperative interventions as complementary strategies rather than assuming that their individual benefits will necessarily produce equivalent outcomes across surgical populations, procedures, and healthcare settings (Gustafsson et al., 2025).

One of the principal findings concerns the effects of multimodal prehabilitation on postoperative morbidity. The randomized trial conducted by Barberan-Garcia et al. (2018) demonstrated a substantial reduction in postoperative complications among high-risk patients undergoing major abdominal surgery, whereas Molenaar et al. (2023) reported a reduction in severe and medical complications following colorectal cancer surgery. Conversely, Carli et al. (2020) did not identify a significant difference in overall postoperative complications among frail patients receiving prehabilitation compared with postoperative rehabilitation. These discrepancies suggest that the effectiveness of prehabilitation may depend on baseline physiological vulnerability, intervention intensity, preoperative duration, and the characteristics of the comparison group. Importantly, the absence of a statistically significant reduction in overall morbidity does not necessarily exclude improvements in functional performance or specific categories of postoperative complications.

The relationship between prehabilitation and functional recovery also deserves consideration. Surgical stress induces metabolic and inflammatory disturbances that may be particularly pronounced in individuals with limited physiological reserves. Multimodal interventions combining physical exercise, nutritional support, and psychological preparation provide an opportunity to address several modifiable factors before surgery. Gillis et al. (2014) demonstrated that initiating rehabilitation before colorectal surgery could improve functional recovery compared with approaches

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concentrated exclusively on the postoperative period. However, the available evidence remains heterogeneous regarding the optimal duration, intensity, and composition of prehabilitation programs. These uncertainties are particularly relevant in oncological surgery, where prolonged preparation must be balanced against the clinical importance of timely cancer treatment.

Perioperative nutritional management emerged as another essential determinant of recovery. Malnutrition and reduced skeletal muscle reserves are associated with impaired tissue repair, altered immune responses, and diminished tolerance to surgical stress. The ESPEN recommendations emphasize nutritional screening, individualized support, and early restoration of nutritional intake as fundamental components of perioperative care (Weimann et al., 2021). Nevertheless, the reviewed findings indicate that different nutritional interventions produce distinct clinical outcomes. Zou et al. (2024) reported a reduction in infectious complications associated with preoperative oral nutritional supplementation but did not demonstrate a significant reduction in hospital length of stay. This distinction suggests that improvements in selected clinical or biochemical parameters should not automatically be interpreted as evidence of accelerated overall recovery.

The findings concerning preoperative carbohydrate loading further illustrate the complexity of nutritional interventions. The meta-analysis by Lu et al. (2022) examined carbohydrate administration before colorectal surgery, while the updated analysis by Pivetta et al. (2026) reported reductions in hospitalization duration and time to first defecation. These findings suggest potential benefits for selected recovery endpoints. However, the absence of consistent improvements in perioperative glucose and insulin concentrations indicates that the relationship between metabolic interventions and postoperative recovery may involve mechanisms that are not fully captured by conventional biochemical measurements. Differences in carbohydrate formulations, fasting practices, surgical techniques, and perioperative protocols further complicate comparisons between studies.

Early postoperative feeding represents a particularly important component of enhanced recovery because it challenges historical practices involving prolonged gastrointestinal rest after surgery. Willcutts et al. (2016) reported shorter hospitalization associated with early oral feeding following upper gastrointestinal procedures without demonstrating consistent increases in major postoperative adverse outcomes. Similar findings concerning postoperative recovery have been described in more recent investigations involving colorectal surgery (Lee & Han, 2025). Nevertheless, early feeding should not be understood as an indiscriminate intervention applicable to every patient. Surgical anatomy, gastrointestinal continuity, aspiration risk, clinical stability, and postoperative complications must be considered when determining the appropriate timing and progression of nutritional intake.

The findings concerning multimodal analgesia reinforce the close relationship between adequate pain control and functional rehabilitation. Opioid-based analgesia remains effective for acute postoperative pain, but excessive opioid exposure can contribute to nausea, vomiting, sedation, and gastrointestinal dysmotility. Regional anesthetic techniques and nonopioid pharmacological interventions have therefore become important components of contemporary perioperative management. Viderman et al. (2022) demonstrated reductions in early postoperative pain and opioid consumption associated with transversus abdominis plane blocks, while Dai et al. (2024) reported favorable outcomes following intravenous lidocaine administration. However, the substantial heterogeneity identified in selected analyses limits the certainty with which these findings can be generalized to all gastrointestinal procedures.

The clinical relevance of opioid-sparing approaches extends beyond the reduction of analgesic consumption. Effective pain management can facilitate mobilization, respiratory exercises, and participation in rehabilitation activities, while limiting medication-related gastrointestinal adverse effects. Nevertheless, the selection of analgesic techniques requires consideration of their specific risk profiles. Epidural analgesia may provide effective pain control after major open abdominal procedures, but potential hypotension, urinary retention, and technical considerations may influence its suitability within particular ERAS pathways. Similarly, intravenous lidocaine requires careful assessment of dosing, contraindications, and monitoring because of the possibility of systemic toxicity. Consequently, multimodal analgesia should be individualized rather than implemented through a uniform pharmacological regimen (Borzellino et al., 2016).

The gastrointestinal recovery outcomes identified in this review demonstrate the importance of evaluating multiple indicators of postoperative intestinal function. Earlier passage of flatus, first defecation, and restoration of bowel

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sounds were reported following selected nutritional and analgesic interventions. However, these outcomes are not interchangeable with clinically diagnosed postoperative ileus. Chapman et al. (2018) emphasized the multifactorial nature of postoperative ileus, involving inflammatory activation, intestinal manipulation, autonomic disturbances, and perioperative medication exposure. Therefore, isolated improvements in gastrointestinal transit markers should be interpreted alongside feeding tolerance, abdominal symptoms, vomiting, and other clinically meaningful outcomes.

Another relevant issue concerns the relationship between accelerated gastrointestinal recovery and duration of hospitalization. Although some studies demonstrated reductions in both gastrointestinal recovery times and hospital stay, these outcomes are influenced by different clinical and organizational factors. Hospital discharge depends not only on bowel function but also on pain control, physical independence, postoperative complications, social circumstances, and institutional discharge criteria. Thus, a reduction in time to first defecation does not necessarily translate into an equivalent reduction in hospitalization duration. Future investigations should prioritize standardized definitions of gastrointestinal recovery and clinically meaningful discharge readiness to improve comparability between studies.

The combined interpretation of the reviewed interventions supports a broader understanding of perioperative recovery as an interconnected physiological process. Prehabilitation addresses functional vulnerability before surgery, nutritional optimization supports metabolic and immunological requirements, multimodal analgesia facilitates early rehabilitation, and gastrointestinal recovery strategies promote restoration of feeding and bowel function. Nevertheless, the evidence does not establish that combining all interventions necessarily produces additive or synergistic benefits in every surgical population. Such conclusions would require appropriately designed comparative studies evaluating integrated perioperative programs rather than individual interventions examined independently.

Multidisciplinary collaboration constitutes a central organizational requirement for implementing these strategies. Successful ERAS programs depend on coordinated participation among surgeons, anesthesiologists, nutrition specialists, nurses, and rehabilitation professionals, supported by standardized protocols and continuous monitoring of adherence. Differences in institutional practices may explain part of the variability observed in clinical outcomes, particularly when evidence-based interventions are implemented inconsistently. The updated ERAS recommendations emphasize standardized perioperative management while recognizing the importance of adapting specific measures to surgical procedures and patient characteristics (Gustafsson et al., 2025).

The applicability of these findings to Latin American healthcare systems represents an additional consideration. Mata-Suarez et al. (2022) described the regional development of enhanced recovery initiatives, highlighting the importance of institutional organization and multidisciplinary engagement. Although international recommendations provide a useful framework, variations in access to specialized nutritional services, rehabilitation programs, regional anesthetic techniques, and postoperative monitoring may influence their implementation. Consequently, effective adaptation requires identifying interventions that are clinically valuable, feasible, and sustainable within local healthcare environments.

From a regional perspective, strategies such as nutritional screening, avoidance of unnecessary fasting, structured patient education, early mobilization, and appropriate opioid-sparing analgesia may offer opportunities for improvement without necessarily requiring extensive technological resources. More complex interventions, including supervised multimodal prehabilitation programs and specialized anesthetic techniques, may require additional personnel, equipment, or institutional coordination. Economic evaluations and pragmatic implementation studies are therefore particularly relevant for determining which combinations of interventions provide the greatest clinical value in resource-constrained settings.

Several limitations should be acknowledged. First, the narrative review design does not provide the exhaustive evidence identification or formal risk-of-bias assessment characteristic of a systematic review. Second, the included literature encompasses heterogeneous surgical populations, intervention protocols, and outcome definitions, which limits direct comparisons. Third, several findings were derived from previously published meta-analyses rather than independent reanalysis of primary patient-level data. Fourth, differences in statistical heterogeneity and confidence interval precision affect the strength of conclusions regarding specific interventions. Finally, the limited availability of

region-specific comparative studies restricts the extent to which international findings can be generalized to diverse Latin American healthcare settings.

An additional methodological consideration is the inclusion of studies examining individual perioperative interventions alongside investigations of comprehensive ERAS pathways. Although both sources contribute relevant information, their findings address different levels of clinical organization. Evidence demonstrating the effectiveness of a single analgesic or nutritional intervention cannot automatically establish the effectiveness of an integrated perioperative program. Maintaining this distinction is essential when interpreting the relationship between intervention-specific outcomes and broader recovery objectives.

Future research should prioritize multicenter randomized trials evaluating standardized multimodal prehabilitation programs, particularly among patients with frailty, malnutrition, or reduced functional capacity. Additional investigations are needed to determine optimal intervention duration, identify clinically meaningful nutritional targets, and establish procedure-specific analgesic strategies. Standardized assessment of postoperative ileus, gastrointestinal recovery, patient-reported outcomes, and functional independence would also improve comparability across investigations. In Latin America, implementation studies incorporating clinical effectiveness, resource utilization, protocol adherence, and cost-effectiveness are particularly necessary.

CONCLUSIÓN

The findings of this narrative review demonstrate that prehabilitation and Enhanced Recovery After Surgery (ERAS) strategies constitute complementary components of contemporary perioperative management in major gastrointestinal surgery. The integration of nutritional optimization, multimodal analgesia, and gastrointestinal rehabilitation provides a comprehensive framework for addressing physiological vulnerability, minimizing surgical stress, and supporting postoperative functional recovery. Nevertheless, the magnitude and consistency of the reported benefits vary according to patient characteristics, surgical procedures, intervention protocols, and institutional conditions.

Multimodal prehabilitation was associated with improvements in selected postoperative outcomes, particularly among patients undergoing major abdominal and colorectal surgery. Although some randomized clinical trials demonstrated reductions in postoperative complications, others reported no significant differences in overall morbidity. These findings underscore the importance of individualized preoperative assessment and highlight the need to consider functional status, frailty, nutritional risk, and intervention duration when evaluating the effectiveness of prehabilitation programs.

Perioperative nutritional management emerged as a fundamental component of enhanced recovery. Preoperative nutritional supplementation was associated with a reduction in infectious complications, while carbohydrate loading and early oral feeding demonstrated favorable results for selected gastrointestinal recovery outcomes and hospitalization duration. However, the absence of consistent benefits across all evaluated endpoints indicates that nutritional interventions should be selected according to individual clinical requirements rather than implemented uniformly.

Multimodal analgesia demonstrated relevant benefits in early postoperative pain control and opioid reduction. Intravenous lidocaine and transversus abdominis plane blocks were associated with favorable analgesic outcomes in the reviewed investigations, although differences in surgical populations, intervention protocols, and statistical heterogeneity limited direct comparisons. These findings support the role of individualized opioid-sparing strategies within coordinated perioperative pathways while emphasizing the importance of safety assessment and procedure-specific selection.

Recovery of gastrointestinal function represented a central outcome of enhanced perioperative care. Early oral feeding, selected analgesic interventions, and preoperative carbohydrate loading were associated with reductions in the time required for the return of bowel sounds, passage of flatus, or first defection. Nevertheless, improvements in individual gastrointestinal recovery milestones should not be interpreted as equivalent to a demonstrated reduction in clinically defined postoperative ileus.

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The integration of these strategies requires multidisciplinary collaboration, standardized clinical pathways, and continuous evaluation of patient outcomes. Within Latin American healthcare systems, their implementation should consider institutional resources, access to specialized services, professional training, and local feasibility. Adapting international recommendations to regional conditions may facilitate broader application while maintaining the principles of patient safety and evidence-based care.

Despite these findings, methodological heterogeneity, differences in outcome definitions, and the selective nature of narrative evidence synthesis limit the generalizability of the conclusions. Further multicenter investigations are necessary to establish optimal intervention combinations, identify patients most likely to benefit, evaluate long-term functional outcomes, and determine the clinical and economic effectiveness of integrated perioperative programs, particularly in Latin America.

In conclusion, prehabilitation and enhanced recovery strategies represent an evidence-supported approach to improving perioperative care in digestive surgery. Their clinical value lies in the coordinated application of individualized nutritional, anesthetic, and rehabilitation interventions rather than reliance on isolated measures. A multidisciplinary, patient-centered approach remains essential for optimizing postoperative recovery, while continued research is required to strengthen clinical recommendations and support equitable implementation across diverse healthcare environments.

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