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ENHANCED RECOVERY AFTER SURGERY (ERAS) PROTOCOLS AND POSTOPERATIVE PAIN OUTCOMES: A LITERATURE REVIEW OF OPIOID-SPARING ANALGESIA IN ADULT SURGICAL PATIENTS

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ABSTRACT

Background: Pain management is an integral part of recovery after surgical procedures and remains one of the key components of modern perioperative care. Opioid therapy is an effective method for alleviating moderate to severe postoperative pain and has traditionally been considered a cornerstone of perioperative analgesia. However, growing evidence suggests that opioid-based pain management is associated with numerous adverse effects. In response to these concerns, Enhanced Recovery After Surgery (ERAS) protocols were introduced to optimize perioperative care and reduce the physiological stress response associated with surgical procedures.

Aim: The aim of this literature review was to evaluate the impact of Enhanced Recovery After Surgery (ERAS) protocols on postoperative pain outcomes, opioid consumption, and recovery quality in adult patients undergoing surgical procedures.

Material and methods: A literature search was performed using PubMed, Google Scholar, PMC, and ScienceDirect databases, along with a manual search of selected scientific journals to identify eligible studies.

Results: The majority of the 20 reviewed studies demonstrated that ERAS protocols reduce postoperative opioid consumption while maintaining adequate pain control. Several randomized clinical trials and cohort studies additionally showed lower pain scores, earlier mobilization, reduced postoperative nausea and vomiting, faster gastrointestinal recovery, and shorter length of hospital stay in ERAS groups compared with conventional perioperative care.

Conclusion: ERAS protocols positively influence postoperative pain outcomes and recovery quality in surgical patients. Opioid-sparing multimodal analgesia appears to reduce opioid-related complications while preserving effective postoperative pain control. Further large-scale randomized clinical trials are required to establish standardized analgesic pathways for different surgical specialties.

KEYWORDS

ERAS, Postoperative Pain, Opioids, Opioid-Sparing Analgesia, Multimodal Analgesia, Surgery

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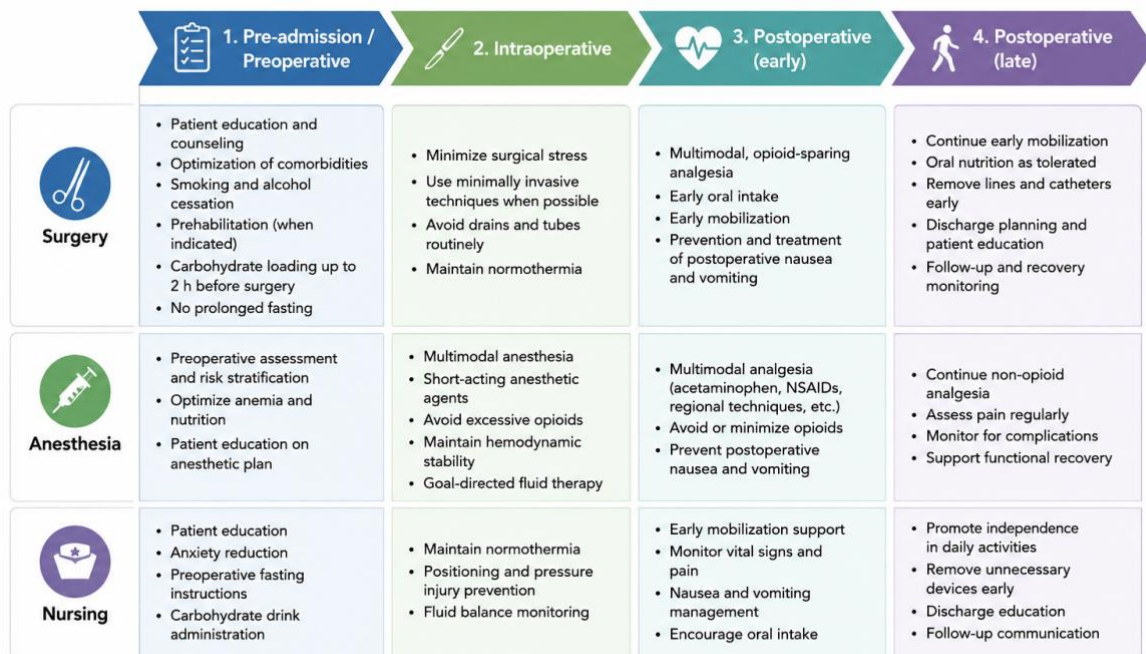
1. Introduction

Pain management is an important part of recovery after surgical procedures. Inadequately controlled postoperative pain may negatively affect patient outcomes by delaying mobilization, impairing respiratory function, prolonging hospitalization, and increasing the risk of postoperative complications. Poor pain control may also contribute to delayed gastrointestinal recovery, reduced patient satisfaction, and impaired overall quality of recovery. Opioid medication is often used to manage postoperative pain and it has been considered a very effective choice. However, it has many adverse effects including postoperative nausea and vomiting, respiratory depression, urinary retention, postoperative ileus, delayed gastrointestinal function, and prolonged hospital stay. Moreover, excessive perioperative opioid exposure may increase the risk of persistent opioid use and long-term opioid dependence after surgery. Enhanced Recovery After Surgery (ERAS) protocols have become a standard approach for promoting effective and rapid recovery.

The concept of Enhanced Recovery After Surgery (ERAS), also referred to as fast-track surgery (FTS), was first introduced in the late 1990s by Danish surgeon Professor Henrik Kehlet, who proposed that postoperative recovery could be significantly improved through a multimodal approach focused on reducing the physiological stress response to surgery. Early ERAS principles emphasized the importance of combining minimally invasive surgical techniques, optimized anesthesia, early mobilization, early enteral nutrition, and effective pain management to accelerate patient recovery and shorten the hospitalization length. (Ljungqvist et al., 2017)

The modern ERAS pathway combines preoperative, intraoperative and, postoperative periods. These protocols include: patient education, optimized nutrition, minimally invasive surgery, multimodal anesthesia, prevention of postoperative nausea, early oral feeding and early mobilization. (see Figure 1)

Figure 1. Components of the Enhanced Recovery After Surgery (ERAS) Pathway



ERAS is a multimodal, interdisciplinary approach designed to reduce surgical stress, minimize complications, and accelerate functional recovery.

Fig. 1. Components of the Enhanced Recovery After Surgery (ERAS) pathway. Authors' own elaboration based on Ljungqvist et al. (2017) and ERAS Society recommendations.

One of the key components of the ERAS pathway is multimodal pain management utilizing combinations of non-opioid analgesics, regional anesthesia techniques and non-pharmacological interventions. These techniques aim to reduce opioid consumption while ensuring adequate pain control, patient comfort and earlier restoration of physiological function. ERAS pathways combine evidence-based interventions applied during the preoperative, intraoperative, and postoperative periods, including minimally invasive surgical techniques, early mobilization, optimized nutrition, and multimodal opioid-sparing analgesia. The primary aim of ERAS-based pain management is to maintain effective postoperative analgesia while reducing opioid consumption and minimizing opioid-related complications, ultimately improving postoperative recovery and patient outcomes.

The aim of this literature review is to evaluate and compare current evidence regarding the ERAS-based pain management on postoperative pain intensity, recovery quality and length of stay in adult surgical patients. By synthesizing findings from clinical studies, randomized trials, cohort studies, and reviews, this paper aims to clarify whether ERAS-based analgesia improves postoperative pain control, reduces opioid exposure, and supports faster postoperative recovery.

2. Materials and Methods

A narrative literature review was conducted to summarize current evidence on the influence of ERAS protocols on postoperative pain outcomes and opioid consumption in adult surgical patients. The literature search was performed using PubMed, Google Scholar, PMC, ScienceDirect, and ERAS Society resources. The following keywords and combinations were used: “ERAS”, “Enhanced Recovery After Surgery”, “postoperative pain”, “opioids”, “opioid-sparing analgesia”, “multimodal analgesia”, and “surgery”.

Publications included randomized controlled trials, prospective cohort studies, retrospective clinical studies, systematic reviews, and meta-analyses published mainly between 2015 and 2025. Studies involving colorectal, thoracic, orthopedic, gynecological, cardiac, abdominal, and spine surgery were analyzed.

The eligibility criteria included:

- adult surgical patients,
- studies evaluating ERAS protocols,
- assessment of postoperative pain outcomes,
- opioid consumption data,
- postoperative recovery parameters including length of stay, mobilization, and complications.

Articles focusing exclusively on pediatric populations or lacking postoperative pain-related outcomes were excluded.

Twenty studies were included in the literature review. The collected data were critically analyzed and compared with regard to postoperative pain intensity, opioid use, recovery quality, and perioperative complications.

Table 1. Summary of selected studies included in the literature review

Study	Study design	Surgical population	Sample size	Main findings
Meyer et al. [3]	Cohort study	Open gynecologic surgery	607	ERAS implementation reduced opioid consumption by 72% and length of stay by 25% without worsening pain scores.
Brandal et al. [4]	Historical-prospective study	Colorectal surgery	439	ERAS combined with opioid-free anesthesia reduced discharge opioid prescribing and supported opioid stewardship.
Razi et al. [16]	Retrospective study	Thoracic surgery	372	In-hospital opioid use decreased significantly in robotic thoracoscopy patients; discharge opioid prescriptions were substantially reduced.
Loria et al. [17]	Retrospective cohort study	Cardiac surgery	466	ERAS protocol reduced perioperative opioid use by approximately 57% compared with standard care.

Study	Study design	Surgical population	Sample size	Main findings
Papasavas et al. [18]	Randomized controlled trial	Laparoscopic sleeve gastrectomy	130	ERAS patients required opioids less frequently, achieved earlier discharge readiness, and had shorter hospitalization.
Ali et al. [19]	Randomized controlled trial	Elective spine surgery	411	ERAS reduced long-term opioid use at 6 months and increased discharge-to-home rates.
Grasch et al. [20]	Cohort study	Cesarean delivery	128	ERAS pathway significantly reduced opioid use during the first 48 hours after surgery without worsening pain scores.
Akter et al. [9]	Systematic review and meta-analysis	Pancreatic surgery	1313	Optimal postoperative pain control in pancreatic surgery remains procedure-specific and multimodal.
Meng et al. [10]	Meta-analysis	Cesarean section	4 350	ERAS protocols reduced postoperative complications, pain scores, opioid use, hospital length of stay, and healthcare costs without increasing readmission rates.
Zhang et al. [11]	Umbrella review	Multiple surgical specialties	23 meta-analyses	ERAS protocols improved clinical outcomes, reduced hospitalization duration, opioid use, and treatment costs.
Cheung et al. [8]	Narrative review	Multiple surgical specialties	Not applicable	Multimodal analgesia reduced opioid exposure and supported enhanced postoperative recovery.
Wick et al. [1]	Review article	Multiple surgical specialties	Not applicable	Multimodal analgesia was identified as an effective strategy for limiting postoperative opioid exposure.

3. Literature review results

3.1. Postoperative pain intensity and opioid consumption

Postoperative pain management is one of the central elements of Enhanced Recovery After Surgery (ERAS) protocols. The reviewed literature consistently shows that ERAS does not simply replace one analgesic drug with another. Instead, it reorganizes perioperative care around multimodal analgesia, early mobilization, prevention of postoperative nausea and vomiting, early oral intake, and patient education. In this model, opioids remain available when clinically necessary, but they are no longer treated as the only or default method of pain control.

A recurring conclusion across the literature is that opioid reduction can be achieved without worsening pain scores. Wick et al. (2017) described postoperative multimodal analgesia as an effective method of limiting opioid exposure after surgery, particularly when non-opioid analgesics and regional techniques are used together. Tan et al. (2015) also emphasized that multimodal analgesia is a cornerstone of ERAS because it reduces opioid-related side effects such as sedation, nausea, vomiting, urinary retention, ileus and respiratory depression, all of which may delay discharge and functional recovery.

3.2 Colorectal surgery

In colorectal surgery, Simpson et al. (2019) showed that multimodal and pre-emptive analgesia within ERAS pathways supports earlier mobility and earlier return of bowel function while reducing postoperative opioid use. Brandal et al. (2017), in a colorectal surgery population, demonstrated that ERAS implementation combined with opioid-free anesthesia elements changed discharge opioid prescribing practices, although the authors also noted that prescribing culture after discharge may be slower to change than inpatient analgesic practice. This observation is important because it suggests that ERAS protocols should include not only intraoperative and ward-based pain control, but also clear discharge prescribing rules.

3.3 Gynecologic oncology surgery

Gynecologic and gynecologic oncology surgery provides similarly strong evidence. Meyer et al. (2018) evaluated and compared clinical outcomes among 607 women undergoing open gynecology surgery. They reported that implementation of an ERAS program in open gynecologic surgery significantly decreased postoperative opioid use and improved patient-reported recovery outcomes without compromising pain scores. LOS decreased by 25%, ($p < .001$) Opioid consumption decreased by 72% ($p < .001$) McCall et al. (2022) also found that ERAS guidelines supported lower postoperative pain and reduced perioperative opioid consumption through increased use of multimodal analgesics and regional anesthesia.

Grasch et al. (2023) later showed that an ERAS pathway for cesarean delivery reduced both inpatient and outpatient opioid use without increasing pain scores. The study included 128 individuals. The ERAS group had a significantly lower opioid use in the first 48hrs after the surgery. 9.4 vs 21.4 morphine milligram equivalents. Although these studies concern different operations, both support the same broader conclusion: ERAS pain management works best when adapted to procedure-specific pain mechanisms and recovery barriers.

3.4 Cardiothoracic surgery

Evidence from thoracic and cardiac surgery provides mixed results on the opioid-sparing role of ERAS. Thompson et al. (2018) described thoracic ERAS pain management as dependent on multimodal analgesia, regional anesthesia and early transition to oral medication.

Razi et al. (2021) showed that an enhanced recovery protocol after thoracic surgery was associated with lower postoperative opioid use in a retrospective analysis of 310 robotic thoracoscopy and 62 thoracotomy patients. Median of in-hospital opioid use was reduced from 30 to 18.36 mg/day $P = .009$ for the robotic thoracoscopy group. Although there was a slight increase from 15.48 to 21.0 mg/day for the thoracotomy patients. ($P = .27$). More importantly, the post discharge opioid prescription rate decreased: 480.0 to 150.0 ($P < .001$) and 887.5 to 150.0 ($P < .001$) for the thoracoscopy and thoracotomy groups, respectively.

A single-center retrospective study including 466 patients performed by Loria et al. (2022) demonstrated that enhanced recovery after cardiac surgery with multimodal analgesia reduced perioperative opioid requirements. The ERAS group had a significantly lower (57%) opioid use 259 morphine mg equivalents versus 452mg.

3.5 Bariatric surgery

In bariatric surgery, Papasavas et al. (2023) conducted a randomized controlled trial in patients undergoing laparoscopic sleeve gastrectomy. The final analysis included 130 patients (65 for SOC and 65 for ERAS). Compared with standard care, ERAS patients required opioids less often (72.3% vs. 95.4%; $p < .001$), had lower peak pain scores and achieved readiness for discharge earlier. 38.5% of patients in the ERAS group were discharged on day one in comparison to SOC group 15.4% ($p < .05$)

3.6 Orthopedic surgery

Spine surgery studies show more mixed but still useful results. Ali et al. (2023) conducted a randomized controlled trial in elective spine surgery and did not find a significant difference in short-term opioid use between ERAS and standard care. However, the ERAS group was less likely to use opioids at six months (ERAS 11.4% vs SOC 20.6% $P = 0.046$.) and more likely to be discharged home. (ERAS 91.5% vs SOC 81.0%, $P = 0.015$).

Liu et al. (2019) similarly showed that postoperative opioid use is strongly influenced by previous opioid exposure, which means ERAS protocols may be most effective when combined with preoperative risk assessment and opioid stewardship.

3.7 Pancreatic surgery

The pancreatic surgery literature highlights the importance of procedure-specific analgesia. A systematic review, that included 1313 patients by Akter et al. (2021) reviewed pain relief after pancreatic resection and compared different analgesic modalities, confirming that optimal postoperative pain control in pancreatic surgery remains complex.

3.8 Other evidence

Kaye et al. (2019) described multimodal analgesia as an essential component of ERAS programs. Their review demonstrated that standardized perioperative analgesic regimens based on epidural anesthesia, peripheral nerve blocks, NSAIDs, and acetaminophen effectively reduced opioid administration and facilitated faster recovery after surgery. Importantly, the authors stressed that ERAS protocols should be individualized depending on procedure type and patient comorbidities.

Systematic and umbrella reviews confirm the overall direction of the evidence. Meng et al. (2021) found that ERAS protocols applied to cesarean section significantly reduced postoperative complications, postoperative pain scores, opioid use, hospital length of stay, and healthcare costs without increasing readmission rates. The study included randomized controlled trials and observational studies evaluating ERAS implementation in cesarean section.

Zhang et al. (2020) reported that ERAS improved multiple clinical outcomes, decreased duration of the hospitalization and decreased costs associated with the treatment. 23 meta-analyses were included in the umbrella review. Meta-analytic evidence presented by Zhang et al. further demonstrated that opioid-sparing analgesic strategies were associated with significantly lower postoperative morphine consumption, lower pain scores within the first 24 hours after surgery, decreased incidence of pruritus and PONV, and higher patient satisfaction compared with traditional opioid-based regimens.

Cheung et al. (2022) concluded that enhanced recovery pathways use multimodal postoperative pain strategies to minimize opioid use while supporting recovery. Grossi et al., reviewing orthopedic ERAS, noted that opioid-free or opioid-sparing strategies may reduce postoperative pain and opioid consumption in selected settings, but the evidence in orthopedics remains less standardized than in colorectal, gynecologic or thoracic surgery.

Overall, the reviewed studies indicate that ERAS protocols positively influence postoperative pain outcomes mainly by improving analgesic efficiency. The most consistent finding is not always a dramatic fall in pain scores, but a reduction in opioid exposure while maintaining acceptable or improved pain control. This distinction is important. ERAS-based analgesia should be evaluated not only by pain intensity, but also by opioid consumption, opioid-related adverse effects, gastrointestinal recovery, mobilization, length of hospital stay, patient satisfaction and persistent opioid use after discharge.

3.9. Recovery quality and postoperative outcomes

Echeverria-Villalobos et al. (2020) emphasized that multimodal analgesia constitutes one of the central components of ERAS pathways. Their review demonstrated that combinations of non-opioid analgesics, regional anesthesia techniques, and perioperative patient optimization were associated with lower postoperative pain scores and reduced opioid requirements. The authors additionally emphasized that reducing perioperative opioid exposure may contribute to improved postoperative safety and lower risk of persistent opioid use.

The reviewed publications suggest that the analgesic component of ERAS has consequences beyond pain relief alone. Better pain control with fewer opioids supports earlier mobilization, faster gastrointestinal recovery and earlier transition to oral intake. These outcomes are particularly relevant because pain, immobility and opioid adverse effects often reinforce one another: poorly controlled pain limits mobilization, while excessive opioid use may delay bowel function and increase nausea, sedation and respiratory risk.

ERAS pathways therefore improve recovery through a combined mechanism. Multimodal analgesia reduces opioid exposure; early feeding and mobilization improve functional recovery; and standardized discharge planning may reduce unnecessary opioid prescriptions after hospital discharge. Across surgical specialties, the strongest evidence supports ERAS as a structured approach that allows effective pain control while reducing treatment-related harms.

However, the available evidence remains heterogeneous. Differences in surgical specialty, ERAS protocol components, analgesic regimens, baseline opioid exposure, and pain assessment methods limit direct comparison between studies. While some studies demonstrated both lower opioid consumption and lower pain scores, others mainly reported improved analgesic efficiency without major differences in pain intensity alone. Therefore, ERAS should be understood as a procedure-specific perioperative strategy that may improve postoperative recovery primarily through opioid-sparing multimodal analgesia and reduction of opioid-related adverse events.

4. Conclusions

The findings of this literature review indicate that ERAS protocols positively influence postoperative pain outcomes in surgical patients. Multimodal opioid-sparing analgesia appears to enable effective pain control while simultaneously reducing opioid consumption and opioid-related adverse events. Current evidence suggests that ERAS implementation contributes to earlier mobilization, faster gastrointestinal recovery, shorter hospital stay, and improved overall postoperative rehabilitation. Protocols may result from improved analgesic efficiency and reduction of opioid-related complications rather than from dramatic reductions in pain scores alone.

Although the majority of studies support the benefits of ERAS-based pain management, heterogeneity in study design, surgical populations, analgesic protocols, and pain assessment methods limits direct comparison between studies. Further large-scale randomized clinical trials with standardized outcome measures are required to determine the most effective multimodal analgesic strategies for specific surgical procedures and patient populations.

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