



# Essential Elements for Enhanced Recovery After Intra-abdominal Surgery

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## Abstract

**Purpose of Review** Enhanced recovery pathways provide a framework outlining the best perioperative care for intra-abdominal surgical procedures. To date, no evidence-based umbrella guidelines exist for all intra-abdominal surgeries.

**Recent Findings** A PubMed and worldwide web search was performed with the keywords: “ERAS,” “enhanced recovery after surgery”, ± “protocol.” Manuscripts addressing intra-abdominal procedures were selected, resulting in studies with the date range: 2012–2017. The basic philosophy behind enhanced recovery is the realization that a traditional hospital works in silos that need to be broken to ensure a care protocol that follows and optimizes the journey the patient makes during the perioperative care. Enhanced recovery interventions can be categorized into preoperative, perioperative, and postoperative interventions. By design, each intervention is planned and coordinated by a multidisciplinary ERAS team. Depending on the particular procedure and patient receiving the interventions, some of the interventions below may be more or less applicable.

**Summary** In this review, the most common elements of ERAS protocols in intra-abdominal procedures are reviewed, particularly those which provided the best outcomes and are most generalizable to all intra-abdominal procedures.

**Keywords** Enhanced recovery after surgery · Intra-abdominal surgery · Pancreaticoduodenectomy · Colorectal surgery · Bariatric surgery

## Introduction

Henrik Kehlet, a Danish surgeon, was the first to introduce the concept of enhanced recovery after surgery (ERAS)<sup>®</sup> [1]. He attributed the delay of recovery to the surgical stress response, which is induced by metabolic and endocrine changes which adversely affect organ function after surgery. Henrik believes

that no single perioperative intervention can modify these changes. Acknowledging the impact of multimodality on patient recovery, Kehlet and Mogensen published a study to report the feasibility and efficacy of a multimodal rehabilitation regimen in promoting the postoperative recovery in patients undergoing open sigmoidectomy [1]. This was the breakthrough study which eventually resulted in the

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development of ERAS society and the emergence of many more procedure-specific protocols.

Evidence-based ERAS protocols have since then been published and practiced in a multitude of surgical procedures. These include pancreaticoduodenectomy, colorectal surgery, and bariatric surgery, to name a few. An understanding of the most commonly employed strategies with positive outcomes is essential for practitioners to design new ERAS protocols or pick appropriate interventions for a patient's individualized ERAS plan.

To date, no evidence-based umbrella guidelines exist for all intra-abdominal surgeries. A PubMed and worldwide web search was performed with the keywords: "ERAS," "enhanced recovery after surgery," ± "protocol." Manuscripts addressing intra-abdominal procedures were selected, resulting in studies with the date range: 2012–2017. In this review, the most common elements of ERAS protocols in intra-abdominal procedures are reviewed, particularly those which provided the best outcomes and are most generalizable to all intra-abdominal procedures.

## Preoperative Interventions

### Milestones and Discharge Criteria Counseling

Before surgery, the health care provider should discuss preoperative milestones and discharge criteria with the patient and/or the patient's family [2•, 3–5, 6•, 7, 8, 9•]. An open dialog and transparency with patients have been shown to increase positive perioperative outcomes. Patients who are prepared for what is happening to them are more likely to comply and cooperate with health care provider recommendations.

### Ileostomy (Where Applicable) and Wound Care

Ileostomy education, marking, and counseling on wound care and dehydration avoidance should be included in the preoperative setting. Ostomy is associated with prolonged length of stay in the hospital after colorectal surgery [8]. Structured patient stoma education has been shown to drastically improve patient quality of life and psychosocial adjustment, in addition to reducing hospital length of stay, and reducing hospital-associated costs. This has been affirmed in several single-center and multicenter studies, as well as a systematic review [10, 11]. Furthermore, a randomized trial reported that patient education was most effective if presented preoperatively [12].

## Preoperative Nutrition and Bowel Preparation

Presently, anesthesiology societies recommend the intake of clear fluids up to 2 h and solids 6 h before the induction of anesthesia [13]. Preoperative carbohydrate conditioning involves the use of iso-osmolar drinks consumed 2–3 h before the induction of anesthesia. This practice attenuates the development of postoperative insulin resistance, reduces postoperative nitrogen and protein losses, and maintains lean body mass [14]. This practice is also associated with a significant reduction in the length of hospital stay [15, 16].

With regard to bowel preparation, mechanical bowel preparation (MBP) plus oral antibiotic bowel preparation (OBP) prior to colorectal surgery is associated with reduced complication rates [8]. Although there appear to be no meaningful benefits of MBP when used alone with regard to complications, a 2016 meta-analysis comparing MBP coupled with OBP versus MBP alone reported a reduction in total surgical site and incisional site infection, with no reported difference in the rate of organ/space infection after the elective colorectal surgery [17].

## Preoperative Order Entry

Preoperative order entry may be utilized in the management of postoperative nausea and vomiting prophylaxis, surgical site infection prevention, and multimodal opioid-sparing pain management plans. If modification of an anticoagulation regimen is necessary secondary to the planned use regional or neuraxial anesthesia, such changes may be made in advance in the perioperative evaluation clinic.

## Perioperative Interventions

### Nausea and Vomiting Prophylaxis

Surgical patients experience as high as 25–35% incidence of postoperative nausea and vomiting (PONV) [4]. PONV is associated with major abdominal surgery for colorectal disease [18]. Prophylactic antiemetics can reduce PONV by 40% [19]. The patient, under this model, arrives for his surgery with an electronic order set containing appropriate premedication already in his chart. Risk stratification and order entry is performed during the preoperative evaluation clinic visit. Timely delivery and administration of premedication for PONV prophylaxis (as well as anxiolysis, multimodal analgesia, etc.) is important and requires collaboration between anesthesiology, pharmacy, and preoperative area nursing personnel.

## Multimodal Analgesia

Minimizing opioid consumption is associated with an earlier return of bowel function and a shorter length of hospital stay [20, 21••, 22, 23]. The most common and simple strategy to limit patient opioid intake is to utilize opioid alternatives including acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and gabapentin as the first line of treatment [24]. Although many health care centers choose to begin a multimodal analgesic regimen preoperatively, the efficacy of preemptive analgesia remains controversial (due to lack of statistically significant data) and mainly limited to epidural blockade and the transverse abdominis plane (TAP) blocks [9••].

A T6–T12 thoracic epidural is considered the gold standard in open abdominal procedures opioid-sparing regimens. However, despite the significant analgesic benefit of thoracic epidural analgesia, it was found to have either no impact or even cause a delay in hospital discharge after laparoscopic procedures.

## Goal-Directed Fluid Therapy

Both IV fluid overload and extreme fluid restriction can significantly impair organ function, increase postoperative morbidity, and prolong hospital stay [25, 26]. In high-risk patients or patients undergoing major abdominal surgery, the use of objective parameters such as stroke volume or cardiac output, or dynamic fluid responsiveness measures such as stroke volume variation and pulse pressure variation allows for more accurate, patient-specific fluid resuscitation. Goal-directed fluid therapy (GDFT) reduces postoperative morbidity and the length of hospital stay, particularly in high-risk patients undergoing major surgery [27, 28].

## Postoperative Interventions

### Early Ambulation

Prolonged immobility can lead to the following complications: skeletal muscle loss and weakness, atelectasis, insulin resistance, thromboembolic disease, and a decreased exercise capacity. Bedrest-associated deconditioning can be reduced with early onset physical activity [10]. Few studies investigate the impact of specific strategies to increase mobilization versus allowing early ambulation ad libitum.

### Ileus Prevention

Immediately after elective colorectal surgery patients should be offered a regular diet. Multiple randomized studies, meta-

analyses, and observational studies demonstrate that early (< 24 h) feeding accelerated gastrointestinal recovery and decreased hospital length of stay. The rate of complications and mortality (OR = 0.41; 95% CI, 0.18–0.93) are also decreased with early feeding. ERAS consensus guidelines support early feeding in patients; however, providers must be cognizant that the risk of vomiting in these patients will increase [10]. Therefore, prophylactic PONV care should be administered.

## Multimodal Analgesia in the Postoperative Phase

Beginning with PACU admission, acute pain service teams would be expected to continue to manage the patient's multimodal analgesia regimen. This allows for continuity of pain treatment care from the preoperative admission (epidural/TAP block placement) until hospital discharge. Institutions with an existing perioperative surgical home initiative are able to routinely employ this intervention.

## Summary

In the bundled payments and outcome-driven compensation models being used in the USA today, it is integral for institutions to be cognizant of these factors and employ evidence-based strategies to achieve the outcomes being pursued. Although ERAS protocols address most of these issues so effectively that it may soon become the standard of care, it must be noted that the initiative is still in its nascent stages. Prior to universal adoption, more high-quality data supporting ERAS protocols will certainly be needed. As it is currently a "hot topic," many academic institutions are currently studying various implementation of the ERAS initiative and the next few years are expected to provide a wealth of high-quality data from RCTs and meta-analyses.

## Compliance with Ethical Standards

**Conflict of Interest** Amir Elhassan, Ihab Elhassan, Amjad Elhassan, Krish D. Sekar, Ryan E. Rubin, Elyse M. Cornett, and Alan David Kaye declare no conflict of interest. Alan Kaye is on the speaker bureau for Merck and Depomed, Inc. Richard D. Urman received honoraria from Merck, 3M and Medtronic.

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