Pathophysiology of Major Surgery and the Role of Enhanced Recovery Pathways and the Anesthesiologist to Improve Outcomes

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KEYWORDS

- Enhanced recovery pathway • Fast-track surgery • Anesthesia • Perioperative care
- Pathophysiology of surgery • Stress response to surgery
- Metabolic response to surgery • Minimally invasive surgery

KEY POINTS

- Enhanced recovery pathways aim to reduce the stress response and improve the metabolic response to surgery restoring the patient to preoperative function more quickly.
- It is increasingly recognized that rapid, uncomplicated, recovery reduces not only the cost and length of stay of the patient episode but medical and possibly surgical related complications. Provided defined discharge criteria are met readmission rates are not increased.
- Minimally invasive surgery is a key component of enhanced recovery to reduce the primary injury of tissue damage and blood loss, which both drive the stress response and metabolic response to surgery.
- All elements of an enhanced recovery pathway are important because they interact positively with each other, a term likened to the sum of small gains.
- The anesthesiologist plays a key role in optimizing surgical outcomes by controlling a patient's physiology throughout the perioperative pathway.

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INTRODUCTION

This article provides an overview of the pathophysiologic process of major surgery and how the perioperative management of patients within an enhanced recovery pathway (ERP) can improve recovery after surgery with the aim of reducing stress and complications and improve postoperative function and outcomes.[1–4] A detailed presentation of the biochemical, neuroendocrine, and immunologic changes is beyond the scope of this article.

ERPs, or fast-track surgery, were originally implemented by Henrik Kehlet in colorectal surgery in Denmark in the late 1990s.[5] He asked the fundamental question: why is the patient still in hospital after surgery? He noted that although the causes were multifactorial the common end points were that patients did not have return of gut function and had poor postoperative mobility and function. He devised a protocolized pathway aimed at addressing these issues by reducing any small element that had a negative impact on recovery and promoting early enteral feeding and mobility. The main elements to reduce the stress response and alter the metabolic response to surgery were formalized in a Consensus Guideline by the Enhanced Recovery After Surgery (ERAS) Society in 2005 by Fearon and colleagues for colorectal surgery. Since then the colorectal guidelines have been revised twice by the ERAS Society with the view of keeping the evidence up to date. For instance, in the 2012 guidelines there was an important change in direction recognizing that in laparoscopic colorectal surgery the benefits of thoracic epidural anesthesia (TEA) seen in open colorectal surgery were not directly transferable to laparoscopic surgery.[6]

There are now multinational guideline groups developing guidelines across all surgical specialties and so far evidence-based guidelines have been published or are being developed in pancreatectomy,[7] gastric resection,[8] cystectomy,[9] pelvic and rectal surgery,[10] gynecology, and esophagectomy. The spread and adoption of ERPs has been rapid and some centers in the United Kingdom now have ERPs in all elective surgical specialties, and emergency orthopedic and abdominal surgery.

The ERAS elements are shown in **Fig. 1**, grouped into preoperative, intraoperative, and postoperative factors. The elements themselves and evidence base behind them are not listed here because they are covered elsewhere in this issue and in the article by Gustafsson and coworkers.[6] The ERAS elements can be further categorized into the following groups with some appearing in more than one group:

1. **Preadmission:** counseling, assessment, and optimization
2. **Standards of care:** antibiotic prophylaxis, thromboprophylaxis, prevention of postoperative nausea and vomiting, maintenance of normothermia
3. **Elements to reduce the pathophysiologic insult:** avoidance of bowel preparation, avoidance of nasogastric tubes, minimally invasive surgery, short-acting anesthetic agents, TEA in open surgery, no drains, early removal of catheters
4. **Elements to avoid postoperative gut dysfunction and ileus:** avoidance of salt and water overload, minimally invasive surgery, stimulation of gut motility, nonopioid oral analgesia and nonsteroidal anti-inflammatory drugs, regional anesthesia
5. **Elements to improve the metabolic response to surgery:** avoidance of prolonged starvation, carbohydrate loading, early enteral feeding
6. **Audit:** compliance and outcome

A key issue to ensure the success of an ERP is compliance with all the elements.[11] Gustafsson's group using a large database showed that with increasing compliance with the number of ERAS elements there was a proportional reduction in length of