Enhanced recovery after surgery: implementing a new standard of surgical care

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■ Cite as: *CMAJ* 2019 April 19;191:E469-75. doi: 10.1503/cmaj.180635

CMAJ Podcasts: author interview at https://soundcloud.com/cmajpodcasts/180635-view

Enhanced recovery after surgery (ERAS) is an evidence-based and multidisciplinary perioperative care pathway and a surgical quality improvement initiative, which has been shown to promote patient mobilization, reduce complication rates after surgery, decrease hospital length of stay and reduce costs, if carefully implemented. There is an increasing interest across Canada to implement enhanced recovery after surgery recommendations.[1] Several Canadian institutions have succeeded in implementing an official ERAS protocol. However, it can be challenging to start such a program[2] because it requires multidisciplinary effort and the buy-in of many stakeholders. Because the ERAS approach has been shown to decrease the stress of surgery[3] through its objective to maintain patients' normal physiology as far as possible, any patient undergoing surgery could benefit from the approach.

"Enhanced recovery" started with the initial work of Henrik Kehlet, a Danish colorectal surgeon, who in the early 2000s began to challenge many of the traditional surgical practices that were not supported by high-level evidence.[4] The Enhanced Recovery After Surgery Society (www.erassociety.org), an international, multidisciplinary, not-for-profit organization comprising surgeons, anesthesiologists, nurses and allied health professionals, delivers the ERAS program, and has made recommendations and developed guidelines for colorectal surgeries,[3,5] gynecologic surgeries,[6,7] pancreaticoduodenectomy,[8] hepatectomy,[9] gastrectomy,[10] urologic surgery[11] and esophagectomy,[12] all of which have been implemented with good results.[13]

The ERAS approach can be broken down into 3 main components: preoperative, intraoperative and postoperative (Box 1). However, enhanced recovery begins with optimizing a patient's physical status before surgery. Therefore, primary care physicians can support successful implementation of enhanced recovery and help to improve patient outcomes by offering preoperative education and counselling. It is also important to remember that ERAS is a multifaceted approach that should be used for all surgical patients; in other words, anyone receiving a surgical intervention should have an enhanced recovery.

KEY POINTS

- Enhanced recovery after surgery (ERAS) is an evidence-based approach to surgical care aimed at minimizing the stress of surgery and supporting patients to recover quickly through maintenance of normal physiology.
- Because the ERAS approach begins before admission for surgery and continues postoperatively, a multidisciplinary team of health care professionals must coordinate the approach to ensure the successful implementation of a protocol.
- Implementation of an ERAS protocol can be challenging; however, there are clear advantages for patients and potential savings for the health care system.
- Order sets for ERAS should be tailored to each patient as necessary.

We review evidence (Box 2) that supports the elements of the ERAS approach and discuss requirements for and barriers to implementation of an ERAS protocol.

What are the preoperative components of ERAS?

Early optimization

The ERAS guideline strongly recommends that smoking and alcohol intake be stopped 4 weeks before surgery,[6] for which support from the patient's primary care physician is essential. Family physicians can counsel patients about smoking cessation and prescribe cessation aids, counsel patients about stopping alcohol, monitor for alcohol withdrawal if appropriate, and prescribe vitamin and thiamine replacement if warranted. Preoperative guidance also recommends that patients stop oral contraceptives and hormone replacement before surgery to reduce risk of perioperative venous thromboembolism; therefore, patients may require counselling about alternative birth control methods or treatment for vasomotor symptoms with other methods (e.g., selective serotonin reuptake inhibitors, serotonin–norepinephrine reuptake inhibitors, bupropion, gabapentin or clonidine).[15]

Box 1: Enhanced recovery after surgery components[6,7,14]

Preoperative

- Preoperative counselling
- Smoking and alcohol use stopped 4 weeks before surgery
- Anemia investigated and treated
- HRT and OCP stopped
- Nutritional counselling and assessment; carbohydrate loading
- Avoidance of bowel preparation

Intraoperative

- Antibiotics
- Normothermia
- Euvolemia

Postoperative

- Extended VTE prophylaxis
- Multimodal analgesia and nausea control
- Avoidance of nasogastric suction and intraabdominal drains
- Euvolemia
- Active mobilization
- Removal of urinary catheter
- Early feeding, with high protein diet

Note: HRT = hormone replacement therapy, OCP = oral contraceptive pills, VTE = venous thromboembolism.

Box 2: Evidence used in this review

We searched Pubmed and Medline for studies or reviews related to Enhanced Recovery After Surgery, gynecology and gynecologic oncology from 2016 to 2019. We reviewed 110 articles and evaluated their relevant references. We included representative articles to highlight current difficulties in implementation. The original ERAS guidelines examined studies based on the Grading of Recommendations Assessment, Development and Evaluation (www.gradeworkinggroup.org) approach using a multimodal team of gynecologists, oncologists and anesthesiologists.

Diet

Randomized controlled trials (RCTs), systematic reviews and meta-analyses have shown that carbohydrate loading before surgery increases insulin sensitivity, reduces postoperative inflammation, decreases length of hospital admission and improves patient-reported outcomes.[5,16–18] Prospective studies and reviews have shown that nutritional supplementation 7–10 days before surgery reduces surgical complications and appears to improve outcomes.[19–21] Although preoperative malnutrition has been associated with increased morbidity and mortality, no specific nutritional assessment has been recommended as the gold standard for preoperative evaluation.[19,20,22,23] The ERAS guidelines[6] encourage stopping solid food 6 hours and clear fluids 2 hours before surgery, which challenges historical surgical practices (e.g., nothing by mouth from midnight before the morning of surgery) and is consistent with recent guidelines from the American, Canadian and European societies of anesthesiology.[24–26]

Preoperative bowel preparation

Some current evidence suggests that bowel preparation when combined with oral antibiotics decreases the rate of surgical site infections in patients undergoing colorectal surgery.[27] However, most sites that follow ERAS protocols recommend against routine bowel preparation for pelvic surgery (e.g., gynecology and gynecologic oncology), because the rate of bowel leaks and subsequent infection has been shown to be low with gynecologic surgery.[6]

Preoperative medications

Preoperative medications are tailored by each centre for their patients based on team preference and anesthetic collaboration. Most ERAS sites do not recommend routine use of sedatives before surgery. Optimization of antiemetics may improve postoperative nausea and decrease vomiting.[6] Some centres routinely administer nonsteroidal anti-inflammatory drugs (NSAIDs) before surgery to enhance analgesia; however, evidence of an increase in risk of anastomotic leak in colorectal resections associated with administration of preoperative NSAIDs has prompted caution.[28,29]

Antibiotics and skin decontamination

Some studies have found that administration of an antibiotic — usually cefazolin because of its high efficacy and cost-effectiveness — within the hour before incision decreases the rate of postoperative infections from skin flora.[30,31] Another dose of antibiotic should be given during surgery if duration of surgery extends beyond 3 hours and in cases of massive intraoperative blood loss (> 1000 mL).[30,32] Accumulating evidence supports increased dosing of antibiotics for patients with morbid obesity.[33] A prospective study of patients undergoing gynecologic surgery found reduced infections at surgical sites and reduced costs among those who used a chlorhexidine wash on the night before surgery compared with a retrospective cohort.[34]

What are important intraoperative considerations?

Implementation of intraoperative care guidance is vital in the success of any ERAS protocol; it requires close collaboration between the surgical and anesthesia teams, particularly with respect to intraoperative normothermia and euvolemia.

Normothermia

Hypothermia is common during surgery owing to suppression of patients' normal temperature regulation, exposure of skin surface to a cold environment and cold intravenous fluids. A 2016 systematic review of 67 studies that varied as to control and intervention groups found that intraoperative warming, aimed at avoiding hypothermia, reduced infections at surgical sites (relative risk [RR] 0.36, 95% confidence interval [CI] 0.20 to 0.66), cardiovascular complications (RR 0.22, 95% CI 0.05 to 1.00) and surgical blood loss (mean difference –46.17 mL, 95% CI –82.74 to –9.59),[35] which corresponds with the findings of other systematic reviews.[36] An RCT that examined the additional effects of pre- and postoperative warming found reduced rates of intraoperative blood loss and complications.[37] Techniques to achieve normothermia include

increasing the ambient room temperature, systemic warming devices, forced air warming blankets and warmed intravenous fluids.

Maintaining euvolemia

Providing insufficient fluids during surgery can be harmful. A 2018 RCT that compared a restrictive fluid regimen with a liberal regimen found that hypovolemia was associated with a higher rate of acute kidney injury.[38] Maintaining optimal fluid balance during surgery can be difficult. The benefit of goal-directed fluid therapy, defined as the use of cardiovascular monitoring to determine patient fluid, pressor and inotrope needs during surgery, is not clear for fit patients undergoing uncomplicated elective surgery within an ERAS protocol;[39] however, for patients undergoing surgery for advanced cancer, benefits have been shown to include an earlier return to bowel function and reduced length of hospital stay after surgery.[40]

Avoidance of nasogastric tubes and peritoneal drains

Nasogastric intubation is not routinely recommended for bowel surgery as it is known to be associated with increased risk of postoperative pneumonia (3.2% v. 1.7%; $p = 0.01$; RR 0.59) and has not been associated with a reduction in wound dehiscence or anastomotic leak.[41] Historically, surgeons have placed peritoneal drains (e.g., Jackson–Pratt drain) within the surgical bed for monitoring. However, this practice has not been shown to prevent anastomotic leaks or improve overall outcomes.[42,43]

Which postoperative components of ERAS optimize recovery?

Diet

Early oral feeding has been shown to be associated with accelerated return of bowel function and reduced length of hospital stay with no increase in rate of complications for most surgeries.[44] Randomized controlled trials of early postoperative feeding in gynecologic oncology surgery, including surgery that involves bowel resection, have shown early oral intake to be beneficial.[44,45] Most studies have defined this concept as intake of food within 24 hours of surgery and used a protocol of clear fluids immediately after surgery, with timely advance to standard diet as tolerated.[46]

A systematic review of 81 studies found that patients who chewed gum postoperatively had a decreased time to first flatus and first bowel movement, as well as reduced length of hospital stay.[47] As such, chewing gum after surgery has been actively incorporated in many ERAS protocols because it is a relatively low-risk intervention, and patients and staff are usually willing to support it. A 2018 RCT of gum chewing after abdominal surgery ~~has~~ contradicted previous findings,[48] and meta-analysis of currently available RCT data is needed.

Intravenous fluids

Postoperative fluids should be used to maintain euvolemia. With rapid progression to oral intake and acceptance of lower postsurgical urine outputs, it is reasonable to stop intravenous fluids on postoperative day 1 to avoid fluid overload and improve mobilization.[49]

Activity

Mobilization and a return to normal functioning is a crucial part of ERAS and requires an integrated team effort. Early mobilization helps prevent compromised pulmonary function, promotes faster recovery, decreases thromboembolic complications and ileus, and reduces muscle atrophy.[7,50,51] Many protocols include actively mobilizing the patient within 24 hours of surgery, and most suggest mobilizing for a minimum of 2 hours on the day of surgery, followed by 6 hours on all subsequent hospital days.[7] Early mobilization may require increased support from nursing, health care aids and physiotherapy.

Prophylaxis for venous thromboembolism

Postoperative thromboprophylaxis is a critical consideration for any patient's surgical care. Many ERAS centres now use a combination of mechanical (sequential compression devices) and medical methods (e.g., heparin, low molecular weight heparin and direct oral anticoagulants) for intraoperative and immediate postoperative prophylaxis. Extended prophylaxis for 28 days has been well studied in multiple RCTs, systematic reviews and meta-analyses in patients with cancer; this intervention should be considered in patients undergoing gynecologic oncology treatment and in patients who have high-risk features (i.e., previous thromboembolism, family history of venous thromboembolism, immobility, elevated body mass index and laparotomy).[52–56] The Caprini risk score calculator[57] can help the clinician assess the risk of postoperative venous thromboembolism and decide whether extended prophylaxis is warranted.[58]

Analgesia

Management of postoperative pain following laparotomy using opiate analgesics — frequently patient-controlled analgesia — has been the traditional approach. However, adverse effects of opiate analgesia include postoperative ileus, constipation and nausea, as well as drowsiness, confusion and bradypnea, which limits progression to early feeding and mobilization. Epidural analgesia may be a useful alternative following extended laparotomy incisions to limit opiate use, improve mobilization through improved pain control and decrease nausea through decreased levels of opiates. However, epidural analgesia may contribute to hypotension secondary to peripheral vasodilatation, delay removal of a urinary catheter, limit ability to mobilize because of overly extensive epidural blocks and affect postoperative diet because of prolonged nausea caused by episodes of hypotension.[14] Many ERAS protocols now routinely advocate for a narcotic-sparing approach with regular scheduled doses of NSAIDs and acetaminophen, which has been shown in audits of gynecologic ERAS protocol implementation to decrease opioid consumption and associated adverse effects.[59,60]

Urinary drainage

Several small studies have recommended early urinary catheter removal[61,62] to reduce rates of urinary tract infection and facilitate early mobilization. Centres have interpreted these results in many ways, from intraoperative removal to 6 hours postoperative to removal on the first postoperative day. Early catheter

removal in patients with epidurals has been studied in small case series,[63,64] which found no difference in rates of recatheterization between early and late catheter removal, with no long-term urinary concerns. Various cut-offs have also been recommended for urinary output, usually 20–30 mL/h of urine, compared with the standard cut-off of 30–50 mL/h, before catheter removal.

Antiemetics

Postoperative nausea and vomiting pose barriers to early mobilization, feeding and a return to normal function. Every effort should be made to prevent and treat nausea early and efficiently. A multimodal approach should target different receptors with each intervention. Minimizing narcotics during and after surgery will also decrease the risks of postoperative nausea and ileus. Patients at high risk of nausea may be considered for scheduled preventive antiemetics.[65]

Bowel management

Many centres have implemented routine postoperative laxatives with their ERAS protocols. This recommendation is based on an older study with magnesium hydroxide and bisacodyl suppositories, showing a modest decrease in hospital stay and time to first stool.[66]

What are some of the challenges to implementing an ERAS protocol?

In Box 3, we outline how to go about starting and implementing an ERAS program. Challenges to implementation may be encountered in preoperative, intraoperative or postoperative phases.

Box 3: How to start an enhanced recovery after surgery program[2,67,68]

- Build an enhanced recovery after surgery (ERAS) team — select champions from different disciplines: surgery, anesthesia, nursing, physiotherapy and nutrition.[2]
- Work as a team to develop the ERAS protocol and define an implementation timeline.[54]
- Apply the protocol to as many surgery types as possible; ERAS benefits not just laparotomy but minimally invasive surgery as well.[55] Some teams have found it easier to implement this program for all their patient population at once, simplifying teaching to patients and care providers.
- Develop training sessions for health care professionals across the continuum of care (preoperative and admissions, operating room and postanesthesia care unit, and postoperative care) and encourage their feedback.
- Develop educational material for patients and provide adequate preoperative information.
- Ensure that a system is put in place to measure and audit compliance to ERAS elements.
- Be aware that the program will require adjustments with time.
- Stay abreast of the evidence to ensure evidence-based adjustments to the protocol.

Preoperative oral intake leading to cancelled cases

If a surgical list is running ahead of schedule or if the order of surgeries is altered, some patients may not have had the guideline-recommended 6 hours of fasting from solids and 2 hours without liquids for their surgery to proceed and surgeries may be cancelled. Certain centres have thus chosen to extend their recommended fasting time to 8 hours for solids and recommend that patients take no liquids for 3–4 hours before scheduled surgery. However, extending the fasting period beyond this increases the risk of hypoglycemia and raised insulin levels.[69]

Venous thromboembolism prophylaxis in conflict with local guidance

The timing of medications can cause dilemmas for the surgical team. A study of venous thromboembolism prophylaxis in gynecologic oncology found that heparin dosing that began before surgery decreased the rate of postoperative deep vein thrombosis and deaths related to deep vein thrombosis.[70] However, American and European anesthesia guidelines recommend that epidural catheters should not be placed or removed until 12 hours after the last dose of low molecular weight heparin or 2 hours after the last dose of unfractionated heparin, and that prophylactic subcutaneous heparin should be initiated intraoperatively 1–2 hours after placement of the epidural — a recommendation that was based on less than 10 reported cases of bleeding for prophylactic doses.[71,72] Many anesthesiologists do not feel comfortable administering any venous thromboembolism prophylaxis for 1–2 hours after regional anesthesia including epidural; thus, the surgical team should discuss their proposed approach with the anesthetic team, and the need for an epidural or spinal anesthetic should be carefully assessed for every surgical case.

Postoperative enforced feeding

Many ERAS protocols specify a standard diet to start as early as the evening after surgery; however, patients will not enjoy enhanced recovery if they force themselves to eat food that they cannot tolerate.[7] It is important to clarify for patients that they should eat as long as they are tolerating the diet well.

Staffing requirements for early mobilization

Orders for patients to engage in activity as tolerated are unlikely to result in adequate early mobilization without dedicated staff to encourage and supervise the activity, without clear instructions, and without adequate staffing support to ensure control of associated pain, nausea and vomiting. Many surgical units have found that increased staffing of assistants and nurses is required to achieve early mobilization.

Resistance to early removal of urinary catheters

Although early postoperative removal of a urinary catheter is frequently appreciated by patients, it may increase workload for nursing staff — especially night staff — who must help patients to mobilize to void urine. Thus, early catheter removal may be resisted or not facilitated by staff.

How should an ERAS protocol be monitored and evaluated?

Because the goal of the enhanced recovery process is to refine usual procedure throughout a continuum of care delivered by multiple disciplines of health care providers, careful ongoing audit and assessment is necessary.[73] Audits of procedures have been published by groups in the United Kingdom, the Netherlands and Alberta.[74–76] However, ERAS itself does not serve as an assessment tool. The National Surgical Quality Improvement Program (American College of Surgeons) is a tool used in many surgical centres to audit surgical care; however, it is limited in its assessments of counselling and preoperative education. The ERAS Interactive Audit System (EIAS) was developed by the Enhanced Recovery After Surgery Society to audit the quality of care within units that adopt an ERAS protocol.[76] An ongoing cycle of evaluation of process, delivery of feedback to inform implementation of systemic changes and reaudit should be used to drive continuous improvement in care.

Is implementing an ERAS protocol cost-effective?

The intent of implementing enhanced recovery is to reduce patients' length of stay in hospital, promote their return to mobility and function, and decrease rates of postsurgical complications, all of which are also likely to reduce costs associated with surgery. Based on cost data collected in trials of the enhanced recovery approach for colorectal and gynecologic surgery, it appears that the implementation of an ERAS protocol can lead to savings of US$2200–$2500 per patient treated.[77,78] The authors of an economic evaluation of the ERAS multi-site colorectal surgery program in Alberta estimated that every $1 invested in the ERAS protocol delivered a savings of $3.8 (range $2.4–$5.1) in return.[79] Further evaluation of ERAS protocols and implementation are necessary to continue assessing the true effect of cost and length of stay.[80]

Conclusion

Because the basic principles of ERAS are to decrease the stress of surgery[3] and to maintain normal physiology, these principles should ideally be applied to all patients undergoing surgery.[1]

Box 4: Unanswered questions

- What is the optimal timing of urinary catheter removal?
- What agent and timing is ideal for preoperative venous thromboembolism prophylaxis?
- What is the ideal combination of medications and modalities for postoperative analgesia?
- What is the preferred combination of antiemetics in the postoperative period?
- Is extended postoperative thromboembolic prophylaxis needed for minimally invasive procedures?

Despite the challenges of implementing such a protocol, there are clear advantages for patients and the health care system, although some questions remain unanswered (Box 4). A multidisciplinary health care team — including family physicians before patients are admitted for surgery and after discharge — must be involved in ensuring the successful implementation of an ERAS approach.

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Competing interests: Alon Altman has received speaker fees from AstraZeneca and Sanofi. He has also received research grants as a principal investigator for clinical trials from AstraZeneca, Pfizer, Array Biopharmaceutical and the Canadian Partnership Against Cancer. Jacob McGee has received a research grant from the Canadian Partnership Against Cancer, and speaker fees and reimbursement for travel from AstraZeneca. He is also a member of the drug advisory board of AstraZeneca. No other competing interests were declared.

This article has been peer reviewed.

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Contributors: All the authors were involved in initial conception of the paper, interpreted the evidence involved in the review, drafted and critically revised the manuscript, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

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