Enhanced Recovery After Surgery: The Future of Improving Surgical Care

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KEYWORDS

• Enhanced recovery • Surgery • Fast track • Colorectal surgery • Outcome • Hospital stay • Complications • Traditional care

Enhanced recovery after surgery (ERAS) is a multimodal perioperative care pathway designed to attenuate the stress response during the patients' journey through a surgical procedure (**Fig. 1**) to facilitate the maintenance of preoperative bodily compositions and organ function and in doing so achieve early recovery. The concept of multimodal surgical care was pioneered in the late 1990s by Professor Henrik Kehlet in Copenhagen. He envisaged the need for improvement in various elements of hospital health care systems, targeted at specific medical concerns of various subsets of patients and all patients undergoing surgery, so that the overall outcome could be improved.[1] This process was initially thought to be a radical move away from tradition and dogma to a fundamental change in the perioperative management of patients and struggled to gain wider acceptance. However, with accumulating evidence from several randomized controlled trials (RCTs), systematic reviews,[2] and meta-analyses of the effects of the individual elements of ERAS pathway,[3–5] significant benefits of the individual elements were identified and an evidence-based consensus protocol for perioperative care in patients undergoing colonic surgery was drafted by

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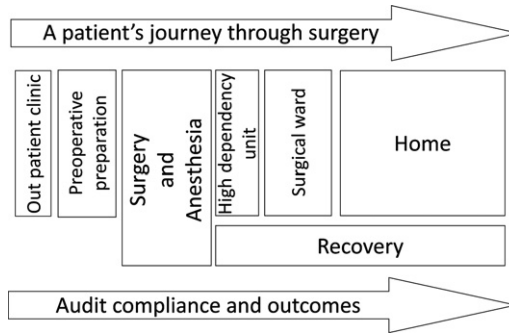

Fig. 1. A patient's journey through an operative procedure.

the ERAS Group in 2005.[6] This document ushered in a paradigm shift in perioperative care and the evidence base was updated in 2009[7] to include rectal surgery. The key factors that keep patients in the hospital after uncomplicated major abdominal surgery include the need for parenteral analgesia, intravenous fluids secondary to persistent gut dysfunction, and bed rest caused by lack of mobility. These factors often overlap and interact to delay recovery and discharge from the hospital. The key elements of the ERAS pathways are aimed to address these issues and the interventions that facilitate early recovery cover all three phases of the perioperative period during the patients' journey. They also provide clear guidance to all members of the clinical team, namely anesthetists, surgeons, physiotherapists, dietitians, and nursing staff.

HISTORY AND PHILOSOPHY OF ENHANCED RECOVERY AFTER SURGERY

The main philosophy of the ERAS protocol is to reduce the metabolic stress caused by surgical trauma and at the same time support the return of functions that allow patients to get back to normal activities rapidly (**Fig. 2**).

The work by Henrik Kehlet in 1997[1] proposed a multimodal approach to perioperative care to achieve this goal. A couple of years later, the same group published a paper reporting median length of stay of 2 days following colonic resections using this philosophy.[8] These were followed by similar reports from the United States.[9]

In 2001 Fearon and Ljungqvist assembled leading surgical groups to form the Enhanced Recovery After Surgery Study Group. The idea was to further develop the protocol initiated by Kehlet and coworkers and to also have several international surgical units use the same perioperative protocol. This idea would then enable a solid basis for clinical trials to further improve the concept and to allow studies of yet unanswered questions to be addressed in a multinational, multicenter setting.

The Groups spent about 1 year to scrutinize the literature and to update the previous protocols used by Kehlet's group. This protocol was later published.[6] When assembling the perioperative protocols in use in the various units, it became clear that different practices were being used and that each unit was using about 30% to 40% of what had been found to be best practice in the literature.[10] This finding inspired the group to perform a survey of practices in use in the countries involved and again different and mostly outdated treatments of the traditional kind were in use throughout Northern Europe.[11,12] Given the vast gap between the best practice according to the evidence available and what was in use, and the fact that the different units often had different traditions, it was decided to study the period of change into

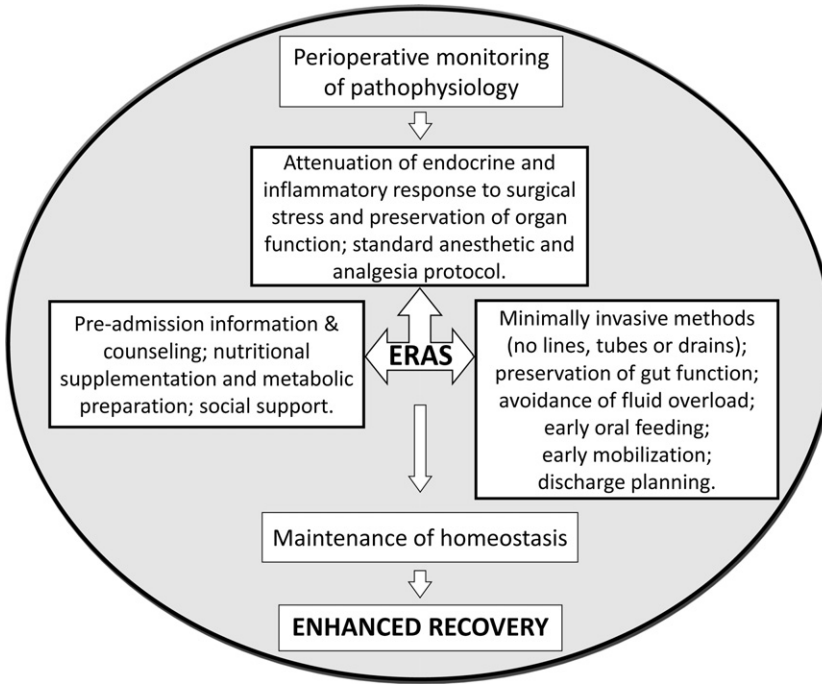

Fig. 2. Philosophy of ERAS.

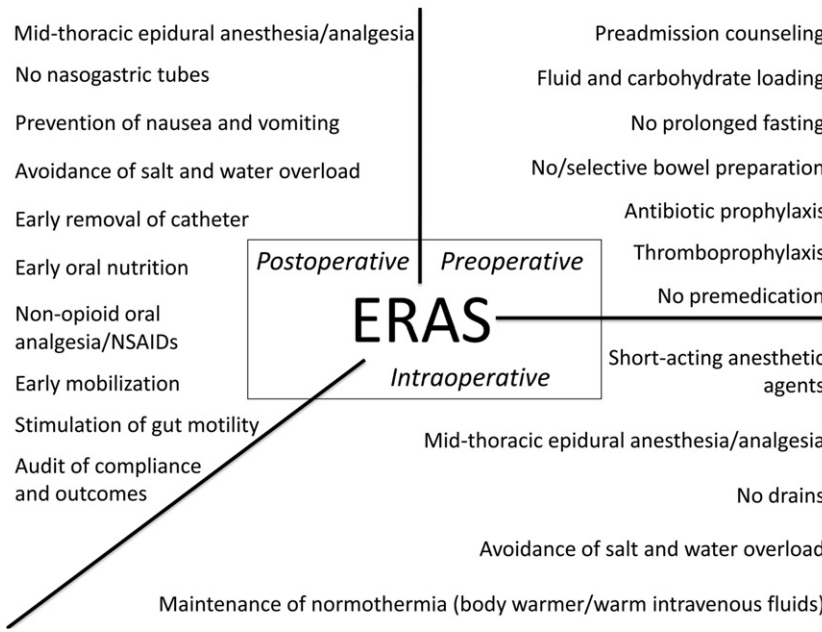

Fig. 3. Components of ERAS.

Table 1
Summary of preoperative recommendations

Preoperative Elements	Rationale	Recommendations	Grade of Evidence
Preadmission information and counseling	Preadmission counseling ensures a clear understanding of the intended perioperative care to be received with emphasis on attaining specific preset targets and would help in alleviating the stress responses to surgery.[21–23,27,28]	Oral and written patient information regarding hospitalization, pain relief, and achieving postoperative targets, such as early nutrition, mobilization, and discharge	C
No bowel preparation	Bowel preparation leads to dehydration and changes in fluid and electrolyte balance.[17] No change[25] or rather an increased risk for complications, such as prolonged postoperative, and increased risk for anastomotic leakage from mechanical bowel preparation.[26,30,31,33]	Patients undergoing elective colonic resection above peritoneal reflection should not receive routine oral bowel preparation. May be considered in low rectal resection where a diverting stoma is planned.[77]	A
Preoperative nutritional support	Approximately 27%–45% of hospitalized patients are malnourished.[29,32,81] Increases risk for tissue wasting, impaired immune function, impaired healing, and organ dysfunction resulting in increased morbidity, length of stay, readmission rates, delayed recovery, hospital costs, and mortality.[20,24,73] Preoperative carbohydrate loading reduces the incidence of complications[34,48] and facilitates accelerated recovery through early return of gut function and shorter hospital stay leading to an improved perioperative well being.[51,52,54]	Patients at risk for malnutrition using NRS 2002 or SGA, or similar screening methods, should be given preoperative nutritional support, given orally if possible.[83,85] Patients should receive carbohydrate-enriched drinks preoperatively.[7]	A

Preoperative fasting	Preoperative fasting and surgery predisposes to metabolic stress and insulin resistance.[72] Overnight fasting does not reduce the risk for aspiration. Intake of clear fluids until 2 hours before anesthesia is as safe.[74]	The consensus guidelines from a Cochrane review[74] and guidelines from anesthetic societies recommend clear fluids until 2 hours before induction of anesthesia and a 6-hour fast for solid food.[7]	A
No long-acting sedatives/premedication	Long-acting sedatives, hypnotics, and opioids (preemptive analgesia) were thought to reduce anxiety and stress related to surgery, but these effects are far outweighed by the risk for prolonged recovery caused by inability to drink or mobilize postoperatively. No effect on postoperative pain relief by starting analgesic treatment before the operation.[50] Short-acting anxiolytics have not shown prolonged recovery or length of stay.[53]	Medications causing long-term sedation should be avoided. Short-acting medications given to facilitate insertion of epidural catheter are acceptable.	A
Antimicrobial Prophylaxis	Prophylactic antibiotics minimize infectious complications in colorectal surgery.[78]	A single dose, 1 hour before skin incision and further doses for procedures lasting more than 3 hours.[78]	A
Thromboembolic prophylaxis	Increased risk for thromboembolic complications in certain high-risk patients undergoing major abdominal surgery is associated with prolonged hospitalization and recovery	Subcutaneous low-dose unfractionated heparin or subcutaneous low-molecular-weight heparin.[76,80]	C

Abbreviations: NRS, nutritional risk screening; SGA, subjective global assessment.

Table 2
Summary of intraoperative recommendations

Intraoperative Elements	Rationale	Recommendations	Grade of Evidence
Standard anesthetic protocol/mid-thoracic epidural with local anesthetic/opioid	Rational use of short-acting agents to facilitate proactive recovery postoperatively. Preoperative commencement of mid-thoracic epidural blocks stress hormone release and attenuates postoperative insulin resistance.[7] Helps in achieving analgesia and sympathetic blockade and in preventing gut paralysis.[49]	Avoid long-acting opioids. Mid-thoracic epidural commenced preoperatively, containing local anesthetic in combination with a low-dose opioid. Consider short-acting inhalational anesthesia as an alternative to total intravenous anesthesia.	A
Laparoscopic/minimally invasive surgery	Decreased inflammatory response, insulin resistance, improved pulmonary function, early return of bowel function, mobilization, less pain, reduced incidence of complications, readmissions, and length of stay.[38,45,46]	Laparoscopic-assisted colorectal surgery is recommended in dedicated specialist centers, with outcomes comparable to open surgery.	A
Maintenance of normothermia	Reduced wound infections, cardiac complications, bleeding, and transfusion requirements.[35,37,41,43,44]	Routine use of upper-body, forced-air heating cover; prevention of hypothermia by warm intravenous fluids	A
Perioperative fluid management	Sodium and fluid overload delays return of gastrointestinal function, prolongs hospital stay, increases side-effects and complications.[39,40,42]	Fluid restriction, avoiding hypovolemia, sodium, and fluid overload Goal-directed fluid therapy in high-risk cases	A
Selective use of drains	Routine use of drains does not reduce the incidence or severity of anastomotic leak.[36,69]	No drains after routine colonic resections above peritoneal reflections Short-term (<24 hours) drainage after low anterior resections	A
Urinary drainage	Increased risk for urinary tract infections following prolonged use.[70] Reduced incidence of complications[58]	Suprapubic catheter for rectal surgery Early removal of catheters following colonic surgery	C

modern and evidence-based care in more detail. A database was initiated where the demographics of the patients were to be recorded and detailed information about the surgery and the perioperative care were also noted. A vast amount of work was put into defining complications and having them recorded. The same was true for many other details, in particular the definitions of a given surgical procedure that could be different in different units. The physiological and operative severity score for the enumeration of mortality and morbidity (POSSUM) scoring system was also included along with the American Society of Anesthesiologists (ASA) classification to give an opportunity to compare different units with different patient populations. One of the criticisms of Kehlet's first report was that there had been patient selection. When comparing the units using the POSSUM scoring, the patient material was remarkably similar in Copenhagen, Tromsö, Stockholm, Maastricht, and Edinburgh.

Each unit went ahead and started the implementation of the new routines. The ERAS study group met on a regular basis and reviewed the data and shared experiences. It became obvious that all units had difficulties getting the new program in place, but the problems were not always the same. Although one unit may have problems overcoming resistance for a change in practice, the fact that another unit was using that treatment successfully often helped effect the change. Already during the first periods of running the program it became evident that the Copenhagen group was much ahead of the rest and that it would take some time to catch up with them. They, therefore, left the collaboration after the initial phase. It was also clear that the patient material was much the same in all units and thus it should be possible to have patients recover in about 3 days to be ready for discharge in all units. The Copenhagen group, having sent patients home on day 2 as the target, had a high readmission rate of 25%, whereas the rest had a readmission rate of around 10% after a hospital stay of 3 to 4 days. This result led to the Copenhagen group to change the targeted stay to 3 days. It was, however, obvious that the most important factor for the success of the protocol was the time itself that the program had been in place.[13]

A typical example for the Group was the work done at Ersta hospital in Stockholm. A prospective collection of data was done before the commencement of the program and the data from these patients were later compared with the first 100 patients entering the program. From these data, it was obvious that even if it takes time to put the entire program in place, it is still possible to achieve significant improvements in outcomes and recovery from the start.[14] However, without the use of the database it would have been difficult to detect where the initial problems were and in which units the program did or did not work. But already at the first complete follow-up it became clear that there were two main problems: patients were given too much fluids during and after surgery and the protocol was not working well from time to time at the postoperative high-dependency unit. These issues were addressed and another round of training was performed. Again it was shown that with improved compliance with the protocol, further improvements in outcomes could be achieved. This time complication rates reduced as did several of the key problems that delayed discharge.[15]

The database rapidly grew to one of the largest of its kind and opened possibilities to study the roles of various factors for outcomes. For instance, one report showed that when running an ERAS protocol in daily practice, factors, such as a low body mass index, no longer affected outcomes.[16] Clearly, even vulnerable patients who are at risk also benefit from this standardized protocol and a recent study has shown that patients classified as ASA 3 and 4 can also recover rapidly when managed according to the ERAS protocol.[16] A mixture of patients undergoing colorectal procedures was fit for discharge at a median of 4 days. More

Table 3
Summary of postoperative recommendations

Postoperative Elements	Rationale	Recommendations	Grade of Evidence
No routine use of nasogastric tube	Facilitates earlier return of bowel function Not associated with increased risk for complications or length of stay.[66,71]	Nasogastric tubes should not be used routinely in the postoperative period. Used in selected cases of postoperative ileus, or unless severe PONV	A
Aggressive treatment of PONV	Facilitates early oral feeding Symptoms related to postoperative ileus and opioids can be more stressful than postoperative pain. Female gender, nonsmoking status, history of motion sickness or PONV, and postoperative opioids confer high risk.	Individuals at moderate risk (>2 factors) should receive, prophylactically, dexamethasone sodium phosphate at induction or serotonin receptor antagonist at the end of surgery.[75,79]	A
Prevention of postoperative ileus	Surgical stress, opioids, bowel handling, and fluid overload predispose to ileus and impair GI function leading to delayed discharge. Oral magnesium oxide promotes postoperative bowel function.[56,57]	Mid-thoracic epidural analgesia, avoidance of fluid overload, and laparoscopic approach, where possible, is recommended. A low-dose postoperative laxative, such as magnesium oxide, may also be considered.	A
Postoperative analgesia/Mid-thoracic epidural analgesia	TEDA results in better pain relief and earlier return-of-bowel function compared with patient-controlled analgesia.[60,65,67,68] Ineffective pain control, analgesia with oral or intravenous opiates, lack of mobility, and loss of appetite contributes to the delayed GI recovery.[59] TEDA also results in attenuated stress response, insulin resistance, reduced incidence of respiratory and cardiovascular complications.[61]	Continuous epidural mid-thoracic low-dose local anesthetic and opioid combinations for approximately 48 hours, following elective colonic surgery and approximately 72–96 hours after pelvic surgery Acetaminophen (paracetamol) for baseline analgesia (4g/d) postoperatively Boluses for breakthrough pain NSAIDS started following removal of epidural (multimodal analgesia). Urinary catheter does not have to stay for full duration of epidural and should be removed at earliest	A

Early oral nutrition	Less gut permeability, early return of bowel function, reduced length of stay and complications.[59,62–64]	Oral diet, day of surgery with nutritional supplements (200 mL, energy dense, 2–3 times daily) until normal food intake is achieved. Continued for several weeks in nutritionally depleted patients.	A
Early mobilization	Decreases insulin resistance, risk of thromboembolism and pulmonary dysfunction. Increases muscle strength and facilitates early discharge.	Encourage independence and mobilization for at least 2 hours on the day of surgery (eg, turning, sitting in bed) and 6 hours thereafter (eg, walking).	C
Discharge criteria	Addressing patients' special needs and anticipating problems delaying discharge facilitates early recovery and does not increase readmission rates.[55]	Criteria for discharge: mobilized to preoperative level, pain control on oral analgesic, return of gut function, and no complications in need of hospital care.	C
Systematic audit	Documenting defined outcomes after implementation of ERAS programs ensures standard of care and identifies areas for improvement.	A systematic audit should be performed to allow direct comparison across institutions.	C

Abbreviations: GI, gastrointestinal; NSAIDs, nonsteroidal antiinflammatory drugs; PONV, postoperative nausea and vomiting; TEDA, thoracic epidural analgesia.

work is needed in this particular field, but given that the protocol itself relies completely on best practice it would seem odd if the most vulnerable patients should have any benefit from not being treated in an optimal way. Another novel advantage of the database is that it has helped provide information about compliance with the various elements of the ERAS pathway and relate this to outcome.[14] Reporting how well various elements of a perioperative protocol have been employed has major impact on outcomes, but this information is something that is almost always missing.

The ERAS study group has recently been expanded with the inclusion of members from Nottingham and St Mark's Hospital in the United Kingdom and from Charité Hospitals in Berlin. The Group has also decided to further expand the network within and outside of Europe. The interest internationally is growing fast and more clinicians are realizing that there are clear advantages to using experiences from other units and from training sessions when trying to implement and spread the use of optimal perioperative care. This mission is one that the Group has now decided to undertake and the ERAS group is now organizing itself to run major training sessions in multiple countries. At the same time the plan is to introduce the database to as many units as possible and to set standards for audit and clinical research. The spreading of best practice will also serve to help form clinical research networks that can further improve the care of this large group of patients.

Most hospitals are organized in smaller units within larger departments and the communication between the different departments is often far from optimal. In particular, it is unusual that staff from one unit are aware of what is actually going on in the unit to which most of their patients are referred. Integration of all the treatments using a multimodal approach at various stages of the patients' journey leads to better outcome.

Fluid administration represents a good example of how things can go wrong in many places leading to problems further down the chain. The surgeon may still be a believer in bowel cleansing and preoperative fasting (although both are shown to be outdated as a routine). Bowel cleansing dehydrates patients[17] and so does overnight fasting, to some extent. Once anesthesia is induced, regardless of whether it is regional or general, the blood pressure will drop. If patients are dehydrated, the pressure will fall even more. This leads to the anesthetist or the nurse giving intravenous fluids to restore the effective circulatory volume. Often patients receive around 3 to 4 L of fluid in excess during a colonic resection lasting 2 to 3 hours. The excess fluid is often followed postoperatively by even more intravenous fluids. Most of this fluid will end up in interstitial space overload in most tissues and organ systems, including the gastrointestinal tract.[18] This practice is one of the main reasons for postoperative ileus that leave patients with abdominal distension, raised intra-abdominal pressure, stretching of the wound, stress on the anastomosis, pain that is often difficult to relieve without large doses of morphine, additional nausea and vomiting, further ileus as a result of that medication, and the vicious cycle is perpetrated.[18,19] It all began with the surgeon ordering the wrong treatments, causing problems for the anesthetist who in turn also orders the wrong treatment. This practice could easily set patients back to stay in the hospital up to 1 week longer, often without the capacity to eat, and hence, losing muscle and strength, which results in a substantially longer convalescence to return to normal function.

The ERAS protocol would have had patients go through the same operation with a completely different protocol and outcome: no bowel cleansing, dinner and drinks on the evening before the operation, carbohydrate drinks 2 hours before anesthesia, and epidural activated in patients who are normovolemic. If there is any fall of blood

pressure, the procedure is to limit fluids using colloids and balanced salt solutions according to protocol (typically 1500 mL total) or under guidance of an esophageal Doppler, and if needed, use vasopressors to control blood pressure during surgery. Immediately after surgery patients are encouraged to drink and eat again. The target for the fluid regimen is to have the patients' weight stable through day 1 and to take down the drip the morning after surgery. Several other factors also come into play to secure gut mobility as fast as possible after surgery, but those previously mentioned give the general idea behind the concept.

COMPONENTS OF ENHANCED RECOVERY AFTER SURGERY

Fig. 3 depicts the various elements of the ERAS pathway, which are grouped according to the timing of intervention of these elements throughout the perioperative period. Although most of these elements are derived from high-quality evidence from published literature, some of the less studied elements of the ERAS pathway are based on common consensus review or derived from traditional-care settings.

The rationale[7,17,20–73] for incorporating these elements in the ERAS pathway and the summary of recommendations for individual elements[74–83] with the grades of evidence according to the Center for Evidence Based Medicine, Oxford, England,[84] are illustrated in **Tables 1–3**. **Table 1** shows ERAS elements that are instituted in the preoperative period, whereas **Tables 2** and **3** illustrate the elements that form the ERAS pathway in the intra- and postoperative periods, respectively.

ROLE OF LAPAROSCOPY

Laparoscopic colorectal surgery has struggled to get wider acceptance in ERAS protocols because of its steep learning curve, concerns with oncological outcomes, and initial reports on port-site recurrence after curative resection. Several studies show that these reasons are unjustified and have reported individual advantages of minimally invasive surgery, such as reduced inflammatory response, insulin resistance, improved pulmonary function, early return of bowel function, mobilization, less pain, reduced incidence of complications, and readmissions, leading to shorter hospital stays and early recovery, despite varied postoperative management.[38,45,46] This finding is supported by two meta-analyses and a Cochrane review comparing outcomes of laparoscopic colorectal resections that have reported early return of bowel function; less analgesic requirements; and more importantly, similar oncological clearance, no significant difference in local recurrence, distant metastasis, or port or wound-site recurrence.[86–88] Laparoscopic surgery is associated with earlier return to full activity (approximately 2 weeks, compared with 8 weeks for open surgery) within the ERAS program.[89,90] A study looking at health-related quality-of-life data showed shorter hospital stays and about 88% of subjects who had laparoscopic surgery recovered completely within 12 months as compared with 58% who had open surgery.[91] However, evidence for laparoscopic resections for rectal cancers is less clear.[92–94] Studies looking at the feasibility of laparoscopic surgery for rectal cancers have reported that laparoscopic resection and a fast-track program complement each other leading to better outcomes, and they can be safely implemented in a general surgical unit.[95,96]

Evidence of Enhanced Recovery After Surgery from Randomized Controlled Trials

A recent meta-analysis[97] of RCTs[98–103] has reported that subjects undergoing major open colorectal surgery and managed with a perioperative ERAS pathway had a primary hospital stay of 2.5 days less than those managed with a traditional-care

pathway, and had significantly fewer postoperative complications. There were no statistically significant differences in readmission and mortality rates (**Table 4**).

EVIDENCE FROM OTHER SPECIALTIES

ERAS pathways have also shown positive outcomes, such as decreased length of stay and complications, in patients undergoing surgical procedures other than colorectal surgery, such as thoracic,[104] vascular,[105,106] orthopedics, urology,[107–110] esophageal,[111,112] pancreatic,[113–115] and liver[116,117] surgery. However, the evidence is limited and needs further evaluation in future prospective studies.

COSTS AND SAVINGS

Evidence presented for individual elements of the ERAS pathway in the perioperative period result in favorable outcomes without increasing readmission or mortality rates. Although factors, such as patients' fear or anxiety, preoperative organ dysfunction, surgical stress response, perioperative hypothermia, hypoxemia, nausea, vomiting, ileus, sleep disturbance, semi-starvation, nasogastric tubes, and drains and catheters, can delay recovery, ERAS addresses these factors by preoperative information/psychological preparation, optimizing associated physiologic dysfunction, correcting nutritional defects, modifying alcohol abuse and smoking, epidural blockade, minimally invasive operations, maintenance of normothermia and oxygen delivery, nausea and ileus prevention, early feeding, disturbance-free sleep time, opioid sparing analgesia, and evidence-based postoperative care. Although avoiding routine bowel preparation and prolonged preoperative fasting; using intravenous fluids, drains, and nasogastric tubes; and reducing nursing time and hospital stay all decrease the overall costs, factors, such as preoperative counseling, patient and staff education, early mobilization, and perioperative nutrition, can potentially increase the health care costs in the short term. However, some studies have reported successful implementation of ERAS elements with economic benefits at no increased costs without increasing the complication or readmission rates.[2,118] The economic benefit of laparoscopic colorectal surgery, however, still remains unclear.[119] There are inconsistencies in reporting cost effectiveness,[92] though some studies have reported short-term and long-term clinical benefits, including fewer complications,[120–122] similar survival, and cure rates up to 3 years.[123] Changes in nursing tasks with reduction in postoperative nursing care per day and per stay have been reported with no increased demands on nursing time.[124,125] Although the exact savings may vary between units and health care systems, undoubtedly shortening length of stay by 2 to 3 days saves resources and decreasing complication rates by up to 50% reduces cost and suffering.

IMPLEMENTATION: DIFFICULTIES AND SOLUTIONS

The implementation of ERAS pathways, despite demonstration of advantages with regards to clinical outcomes, such as length of stay, complications, readmissions, or mortality, have been slow or have not been applied optimally in many centers.[47,126,127] Even though individual elements of ERAS pathways are based on evidence-based principles that have been successfully implemented in dedicated centers and district general hospitals,[128–132] critics argue that reported advantages in outcomes, such as shorter lengths of stay, could relate to changes in organizational structure following implementation of fast-track programs and evidence regarding recovery and follow-up should be reported in more detail in ERAS programs.[133] A study reporting improved outcomes, such as early feeding, early mobilization, and

Table 4
Summary of outcomes: evidence from six RCTs comparing eras with traditional care in patients undergoing major elective open colorectal surgery

Outcome	Studies	Participants	Statistical Method	Effect Estimate	Heterogeneity (I^2) and *P* Value
Length of hospital stay	6	452	Mean difference (IV, random, 95% CI)	-2.51 (-3.54, -1.47)	I^2 = 55%, *P*<.00001
Complications	6	452	Risk ratio (M-H, random, 95% CI)	0.53 (0.41, 0.69)	I^2 = 0%; *P*<.00001
Readmissions	6	452	Risk ratio (M-H, random, 95% CI)	0.80 (0.32, 1.98)	I^2 = 9%; *P* = .62
Mortality	6	452	Risk ratio (M-H, random, 95% CI)	0.53 (0.09, 3.15)	I^2 = 0%; *P* = .49

Effect estimate for experimental group (ERAS) compared with control group (traditional care). The degree of heterogeneity is proportional to the I^2 value.

Abbreviations: CI, confidence interval; IV, inverse variance; M-H, Mantel-Haenszel.

Data from Varadhan KK, Neal KR, Dejong CHC, et al. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomised controlled trials. Clin Nutr 2010. [Epub ahead of print]. DOI:10.1016/j.clnu.2010.01.004.

early return of bowel function, before and immediately after implementing the enhanced recovery program also showed that despite resulting in increased readmission rates, the total hospital stay was still lower compared with traditional care, with decreased risk for complications in colonic surgery and no change in complication rates in rectal surgery. However, implementation of ERAS protocols in a shared-practice environment creates a complementary pattern of change, which favored better outcomes for all patients, regardless of treatment by ERAS or traditional methods[134] and without comprising the workload or working environment of nursing staff.[124] Another study reported, despite incomplete implementation, ERAS protocols showed good results when compared with traditional care.[135] Successful implementation of ERAS pathways have been reported following a brief preparatory period, emphasizing the need for staff and patient education in achieving the intended goals of ERAS pathways.[124,136,137] There is also evidence to support the fact that elderly patients fare better when treated within an ERAS pathway and that age and nutritional status are not independent determinants of morbidity or mortality[16] and improved patient satisfaction and quality of life with ERAS pathways.[21,138]

Although several studies and meta-analyses over the last few years have shown that patients benefit from ERAS programs, implementing ERAS pathways across multiple institutions has remained a challenge. Despite sometimes overwhelming evidence in its favor, the acceptance of principles of ERAS has been slow among different health care systems and clinicians in many countries. A way forward seems to be to focus on identifying the pitfalls that inhibit implementation of ERAS programs, so that further developments can be made within health care infrastructures for successful delivery of ERAS pathways.[139] Improved application of ERAS pathways through staff and patient education, a multidisciplinary approach to patient care, maintaining compliance to ERAS elements, improving rehabilitation processes, benchmarking standards

of care, and monitoring of performance against national and international standards are recommended to further improve resource use and health care delivery across all surgical specialties.

SUMMARY

In units where ERAS has been studied or implemented, the evidence shows marked improvements in patient care and outcome. ERAS results in substantially faster recovery of function and significantly fewer complications. Although there are no exact figures available, these improvements also represent economic benefits to the society. These improvements have been shown for patients undergoing elective colorectal surgery, and there are reports demonstrating similar improvements in many other types of surgery. Although the multimodal approach yields positive results, it is less clear which specific components are particularly important for these improvements. This matter remains to be studied. Despite the overwhelming improvements in the results, it is difficult to implement the principles of ERAS in day-to-day general surgical practice. Most units in the world cling to old and outdated traditional care principles. It is only in some select centers that implementation of ERAS has been successful. To successfully have the change of practice take place in a large number of hospitals, a structured program for the implementation of ERAS seems to be the most successful method employed so far. To secure the wide-spread use of modern care and to find ways of securing the implementation of improved-care pathways in daily surgical practice remains the main challenge for the surgical community. The evidence is already there, it is the inner will and strength to change that is missing.

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