Enhanced Recovery After Emergency Colorectal Surgery

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13.1 Background

ERAS programmemes were first described for elective colorectal surgery [1] and have been validated in the elective setting, with benefits of reduced length of hospital stay, perioperative morbidity and mortality, healthcare costs [2] and improved patient satisfaction [3]. These benefits have been described in both open and laparoscopic colorectal surgery [4]. These programmes have also been shown to be feasible and effective in elderly patients undergoing colorectal surgery [5].

At the outset, these programmes aimed to reduce the variability of perioperative management, which was traditionally ad hoc, day by day decisions by the patients' surgical team, often based on the individual surgeons' experience. ERAS protocols were based on established practice guidelines and evidence-based literature. Varied interventions are usually provided in a "bundle", commencing in the weeks before elective surgery and continuing intraoperatively and in the postoperative period (see Table 13.1) [7].

As most programmes implement these varied interventions simultaneously, it is difficult to determine which components are the most beneficial. A retrospective review based on 8 years of experience with ERAS found that the strongest predictors of reduced hospital stay were early mobilisation, early oral nutrition, early removal of urinary catheter, early removal of epidural, lack of nasogastric tube and non-opioid analgesia [8]. ERAS interventions involve a multidisciplinary team including physicians, surgeons, nurses, physiotherapists and anaesthetists.

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Table 13.1 Potential ERAS interventions for colon and rectal surgery[a]

Pre-op	Intra-op	Post-op
• Preadmission education and counselling (including milestones, discharge criteria) • Preoperative stoma education and marking • Preadmission optimisation • Preoperative nutrition: clear fluids <2 h pre-op, carbohydrate loading • Preoperative antibiotics • Consider mechanical bowel preparation	• Prevention of surgical site infection • Minimally invasive surgery where possible • Consider addition of regional anaesthesia, e.g. epidural/spinal for open surgery • Avoiding nasogastric tubes • Avoidance of intra-abdominal drain • Fluid management (avoiding volume excess)	• Early mobilisation • Immediate post-op diet • Ileus prevention • Consider gum chewing • Early discontinuation of IV fluids • Early removal of urinary catheter • Standardised venous thromboembolism prophylaxis • Multimodal, opioid-sparing pain control • Prevention of perioperative nausea and vomiting

[a]Based on the 2017 ASCRS guidelines [6]

13.2 Reducing Surgical Trauma

Surgical trauma refers to both the effects of the systemic stress response and local tissue damage that occurs in response to surgery. The magnitude of this response is proportional to the severity of the surgical trauma and differs between open and laparoscopic surgery [9]. Longer operating times induce a larger peritoneal inflammatory response [10, 11]. ERAS interventions aim to minimise the stress response and improve the metabolic response to surgery.

13.2.1 Markers of Surgical Trauma

CRP is an acute phase reactant protein that increases during periods of inflammation and tissue damage. It is synthesised by hepatocytes upon stimulation with interlekin-6 (IL-6) [12]. The use of ERAS protocols is associated with decreased levels of CRP and IL-6 postoperatively [13]. A recent meta-analysis concluded the most likely intervention to account for this observation is the use of minimally invasive surgery, as there is convincing evidence that laparoscopic surgery is associated with decreased postoperative CRP [14]. A persistently elevated CRP beyond Day 5 and rising CRP on Day 3 may be predictive of infective complications and prolonged hospital stay after colorectal resection [15], including anastomotic leak [16]. Following on, CRP level may be a useful negatively predictive tool to facilitate early discharge following colorectal surgery [17].

13.2.2 General Measures to Reduce the Surgical Stress Response

A clear liquid diet up to 2 h before surgery is associated with a smaller gastric volume and higher gastric pH at the time of surgery and an improved sense of patient

wellbeing [18, 19]. Excessive provision or restriction of fluids can impair organ function and increase morbidity [20, 21], so close attention to appropriate fluid replacement is vital. Furthermore intravenous fluids should be ceased as soon as possible postoperatively to avoid fluid overload and resulting tissue oedema. Fluid type is also important, with the use of balanced chloride-restricted crystalloid solutions being preferred to normal saline to decrease the risk of hyperchloraemic metabolic acidosis [22]. Nasogastric tubes should be avoided where possible, as their routine use has been associated with delayed resumption of oral intake, without benefit in terms of prevention of nausea or vomiting or return of bowel function [23, 24]. Early removal of urinary catheters is preferable to reduce the risks of postoperative urinary tract infection and improve patient mobility [25]. While it can be assumed these measures would reduce surgical stress, there are few studies examining the effect of these individual ERAS components on the surgical stress response in colorectal surgery [14].

13.2.3 Operative Interventions to Reduce Surgical Trauma

"The cleaner and gentler the act of operation, the less the patient suffers, the smoother and quicker his convalescence (and) the more exquisite his healed wound."
Lord Moynihan

The importance of minimising surgical trauma has been long recognised, and there are many time-honoured techniques that are described. In open and laparoscopic surgery, these include:

- Reducing unnecessary handling of tissues
- Minimising contamination
- Avoiding introduction of foreign material into the peritoneal cavity
- Avoiding tissue exposure to a dry environment
- Judicious use of heat-emitting devices to avoid thermal injury
- Avoiding tumour spillage
- Mobilisation of colon along bloodless planes

Laparoscopic colorectal resection has been shown to be beneficial in terms of quicker return of bowel function, less blood loss, reduced narcotic use, less postoperative pain, reduced length of hospital stay, reduced overall morbidity and improved short-term quality of life [26–31]. The laparoscopic approach has been associated with a shorter hospital stay and reduced postoperative mortality in emergency colorectal cancer resections [32].

Surgical techniques that can reduce surgical trauma in minimally invasive surgery include:

1. Insertion and removal of instruments under vision
2. Avoiding peritoneal injury during lavage
3. Using lower intra-abdominal pressure settings for pneumoperitoneum
4. Avoid gas leaks where possible
5. The use of wound protectors and non-traumatic retraction systems [33]

13.2.4 Surgical Trauma and Tumour Biology

Complex relationships exist between surgical trauma, inflammation and tumour biology in colorectal cancer progression, metastasis and survival. Growth factors and cytokines play an important role in normal tissue healing but also have an essential role in tumour recurrence and formation of metastases. The most potent factor for angiogenesis is vascular endothelial growth factor (VEGF), which has several subtypes [34]. VEGF-D promotes cancer spread via the lymphatic system, a crucial step in metastasis [35]. Serum VEGF is elevated after open and laparoscopic surgery and remains so for as long as 4 weeks postoperatively [36, 37].

These complex relationships remain unclear and require further investigation. However as the metastatic process can be enhanced by the surgical procedure itself, potential oncological advantage exists in using surgical techniques that minimise surgical trauma and its resultant immunological impact. This is especially important in colorectal cancer patients, who are prone to be immunosuppressed for a variety of reasons including age, nutritional status, recent neoadjuvant chemoradiotherapy and the direct immunosuppressive effect of the tumour itself, which increases with stage of disease and is reversible after tumour resection [38–40].

13.3 ERAS Protocols in Emergency Colorectal Surgery

Data from the American College of Surgeons (ACS) National Surgical Quality Improvement Project (NSQIP) reported patients undergoing emergency colorectal resection had the worst outcomes of all emergency general surgical patients, with an overall 30-day morbidity of 46.74% [41]. The application of ERAS interventions to this patient group may improve outcomes. Furthermore, patients undergoing emergency abdominal surgery may benefit from additional evidence-based measures to improve outcomes. Expediting resuscitation, early identification of sepsis, early administration of antibiotics and admission to an intensive care environment postoperatively have been shown to reduce mortality in patients undergoing emergency laparotomy [42].

Published studies exploring the use of ERAS in emergency surgery have adjusted common ERAS protocols, as not all interventions are possible or appropriate in more time critical situations. Depending on the urgency of surgery, preoperative education/counselling or medical optimisation may not be possible. Emergency surgical patients may experience a delay in diagnosis and/or resuscitation and may require large volume fluid resuscitation due to SIRS/sepsis-related hypotension. Many emergency surgical patients will have co-existing bowel obstruction or ileus, requiring prolonged preoperative fasting and/or nasogastric tube insertion. In this context early feeding is also not appropriate. Intraoperative findings of purulent or faeculent peritonitis may prompt the use of intra-abdominal drains or even laparostomy with re-laparotomy. Patients having emergency colorectal surgery are more likely to have formation of a stoma, which is associated with higher rates of readmission [43]. Emergency surgery patients are more likely to be cared for in an

intensive care unit postoperatively, where many ERAS interventions may not be possible. Emergency surgery is more likely to occur after hours, when less staff are available to implement interventions.

13.3.1 Outcomes of ERAS Protocols in Emergency Colorectal Surgery

The evidence for the use of ERAS protocols in emergency colorectal surgery is limited to cohort studies with low patient numbers. Table 13.2 provides a summary of reporting outcomes in emergency colorectal surgery.

Retrospective cohort studies have assessed the use of ERAS in emergency surgery patients undergoing major abdominal surgery (colorectal resections, adhesiolysis, small bowel resection, Hartmann's procedure and appendicectomies [44, 46]), reporting equivalent outcomes compared to the pre-ERAS period and to elective patients.

The only study that exclusively examined emergency colon resection reported a reduced median length of hospital stay (ERAS (5.5 days, range 3–16) vs. the non-ERAS group (7.5 days, range 5–25)), a shorter time to first flatus (1.6 days vs. 2.8 days) and earlier resumption of normal diet (3.5 days vs. 5.5 days) [45]. Patients in this group were operated for the indication of colorectal cancer, and authors reported the interval from operation to initiation of adjuvant chemotherapy was significantly shorter in the ERAS group (37 days vs. 49 days) [45].

The risk calculator CR-POSSUM score has been used to predict the failure of ERAS in patients undergoing elective colorectal surgery [47]. It is likely patients undergoing emergency colorectal surgery have higher CR-POSSUM scores, which may be useful for assessing suitability for inclusion in ERAS programmes.

Ideally an evidence-based ERAS protocol tailored to the needs of patients having emergency colorectal surgery should be developed. In particular, evidence for diet strategy in emergency surgery requires adequately powered randomised controlled trails [48].

Table 13.2 Literature review: ERAS in emergency colorectal surgery

Author	Year	Country	Description	Outcome
Wisely [44]	2016	Australia	Retrospective cohort: 370 emergency abdominal surgeries (159 colorectal resections)	No change in outcomes including major and minor complications, unplanned readmission, length of stay or inpatient mortality
Lohsiriwat [45]	2014	Thailand	Case matched cohort: 20 ERAS compared with 40 conventional postoperative cares after emergency colorectal surgery	Reduced hospital stay and faster return of bowel function
Roulin [46]	2014	Switzerland	Prospective cohort: 28 urgent colectomies vs. 63 elective colectomies, all ERAS	Similar outcomes in emergency vs. elective setting

13.4 Implementing ERAS Protocols

Implementing ERAS programmes poses many challenges due to their complex, multicomponent structure. Barriers to implementation include patient-, staff- and organisation-related factors, in addition to limitations of resources (including financial, staffing, space restrictions and education). Quality evaluation and monitoring is a vital aspect of ERAS programmes, particularly at implementation.

As these programmes were implemented worldwide, early experience was assessed using qualitative process evaluations [49–51]. This has helped to identify enablers and also potential barriers to implementation (see Table 13.3). Knowledge of enablers and barriers at the planning stage can assist practitioners to develop strategies that address potential issues and so more effectively enable successful programme implementation.

Different strategies can be used to increase the effectiveness of introducing new interventions. These include audit and feedback, reminders, education workshops and meetings, opinion leaders and written educational material [52]. Of these, appointing opinion leaders or "local champions" is the most effective intervention [53]. Ideally identifying an opinion leader for each discipline (e.g. nursing, physiotherapy, anaesthesia and surgery) should be selected to lead implementation. Having a dedicated implementation team who are able to meet regularly is ideal, as is a dedicated ERAS nurse. Specialist nurses are vital to providing education (including presentations, in-services), perioperative care and postoperative evaluation [54]. Furthermore, engaging nursing staff is essential to enabling the successful and continued use of the pathways. In the era of electronic medical records, the use of patient care templates for orders ("order sets") has assisted teams to establish ERAS protocols. An example is having the postoperative order set linked to the operation note, with specific orders for each ERAS intervention.

Audit and feedback is a vital component of implementation. Results of audit should be fed back to the team, along with any data regarding an individual hospital performance against benchmark data. To support efficient and successful implementation, measures need to be taken on a national or regional level to support caregivers to create necessary changes to improve healthcare provision.

Table 13.3 Enablers and barriers to ERAS implementation

Enablers	Barriers
• Good teamwork and communication • Consistency across the team • Stakeholder engagement • Normalisation of ERAS into everyday practice • Effective integration with existing systems • Audit and feedback	• Lack of communication and/or collaboration between departments • Need to change attitudes and behaviour • Limited resources • Limited access to stoma care nurses • Lack of patient support on discharge • Special needs of highly co-morbid patients

13.5 Conclusion

Reducing the morbidity and mortality of emergency surgery remains a key priority in general surgical practice. Early studies suggest ERAS is safe and feasible in the emergency colorectal surgery setting, with potential benefits when compared to conventional care. Further studies are required to better define these benefits and to determine the precise interventions that should be used in the emergency setting.

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