

CHAPTER 17

Application of enhanced recovery after surgery (ERAS) for colon cancer

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Why does the surgeon need to audit his results?

In medicine and in all health teams, there is an implicit need to offer patients the best care, relying on the knowledge and tools available at the time in which our activity is carried out. Over time, and specifically in the last 30 years, the anesthetic-surgical community has attempted to improve perioperative care by defining different parameters that together allow achieving the gold standard.

In the mid-1990s, Professor Henry Kehlet began to talk about what he called Fast Track or Accelerated Recovery protocols in colorectal surgery. In his first publication in 1997, he referred to the fact that the morbidity of surgery is fundamentally linked to the organic response to surgical stress, mediated by metabolic/endocrine changes that lead to the activation of the inflammatory cascade. Therefore, by understanding these changes, it is possible to try to modulate this response and minimize complications.¹

In 2002, Kehlet and Wilmore² defined the three factors that contribute to delayed postoperative recovery: inadequate pain management, bowel dysfunction, and immobilization. They concluded that understanding perioperative pathophysiology and implementing care regimens that seek to reduce surgical stress accelerate patient rehabilitation, which is associated with shorter hospital stay and greater satisfaction and safety after discharge. The greatest challenge for healthcare teams is to develop and improve multimodal rehabilitation protocols to achieve a “pain-free and risk-free” perioperative period.

More than 230 million major surgical procedures are performed worldwide each year, so surgical care impacts the lives of millions of people. At least 7 million patients a year may suffer postoperative complications, and about 1 million die in the perioperative period. Surgery-related complications cause disability or increase hospital stay in 3–25% of patients, depending on a variety of factors, primarily surgical complexity and hospital setting.³

According to the World Health Organization, the vast majority of surgeries performed annually around the world are not recorded, making it very difficult to truly assess the problem. The *Safe Practices Save Lives* initiative is a collaboration between more than 200 ministries of health, national and international medical societies and health professional organizations and aims to reduce deaths and complications related to surgical care.

Improving access to surgical care and the safe delivery of related services is crucial to ensuring its effectiveness. No less than half of complications and deaths associated with surgery could be avoided by following a series of basic standards of care.

In this regard, and concerned about the morbidity and mortality of anesthetic-surgical procedures, the ERAS (Enhanced Recovery After Surgery) collaborative group was created in 2001, led by surgeons and anesthesiologists from five countries (Denmark, Sweden, Norway, Scotland and the Netherlands). In those early years, they discovered that there was a variety of traditions in use in different centers, but also large discrepancies between actual practices and what was already known to be best practice, according to the literature. This led the group to examine and lead the process of changing tradition to best clinical practice.

In 2005, they published the first consensus protocol for patients undergoing colon surgery. Two years later, the same group in a new publication stated that the implementation of a multimodal action protocol is

not sufficient to allow hospital discharge upon recovery of functionality, but that good organization and experience are required.⁴

Finally, the ERAS Society was founded in Amsterdam in 2010. This is a non-profit multidisciplinary, multi-professional, academic-medical society that spans all continents and involves a wide range of health disciplines. Its mission is to develop perioperative care and improve postoperative recovery by promoting research, education, the implementation of practices based on the best scientific evidence and the auditing of results.^{5,6}

The ERAS implementation program introduces the use of the ERAS Interactive Audit System (EIAS) created and developed by the company. This audit system provides real-time quality control and is a very powerful research tool. Data is updated hourly and available online, helping teams to continuously monitor their results and processes, as well as benchmark against other hospitals to standardize practice and improve outcomes.

In short, ERAS refers not only to the use of action protocols (ERAS guidelines), but also to the implementation of a standardized program to homogenize the actions of all teams and also to the interactive audit system (EIAS), all of which implies a new way of understanding and executing perioperative care.

Nowadays, the concept of “value in health” is gaining great importance in healthcare, involving the quality of care, healthcare costs, objective results and patient satisfaction. Value in health relates the quality of care to costs (Value = Quality/Costs). Quality of care is defined by two parameters: clinical results and the patient’s perception of the care received and the results that can be objectified. On the other hand, health costs involve those derived directly from healthcare and those indirectly resulting from that care. Therefore, we can affirm that value in health is an indicator of quality of care towards which all providers must tend to improve their administrative management and clinical results. This new way of working proposed by the ERAS Society is in line with the improvement of quality indicators of care and management, since it promotes quality improvement with patient-centered protocols, based on the best clinical evidence and seeks to reduce direct and indirect costs.

The role of the surgeon in an accelerated perioperative recovery protocol

One of the major problems in gastrointestinal surgery has always been the management of postoperative pain and the reduction of postoperative ileus, nausea and vomiting, which ultimately cause a delay in patient recovery and hospital discharge.

For more than 2 decades, surgeons have tried to acquire technical skills and develop minimally invasive procedures as the only way to improve postoperative results. In recent years, two changes have occurred that have revolutionized the results of elective colorectal surgery. On the one hand, the introduction of minimally invasive surgery on a routine basis, and on the other, the development of protocols for optimized recovery after surgery (ERAS), which represented a paradigm shift in surgical practice. The surgeon ceased to be the central axis in patient care and became one more link in a correctly structured chain. The patient is the center of attention and each member of the team contributes from their place to try to achieve care efficiency. In this way, the surgeon must learn to work as a

team and understand that, although his role is important, the final result depends not only on an adequate surgical technique, but also on the set of perioperative measures.⁷

One of the strengths of this new way of working is the possibility of auditing the results and knowing the advantages, failures and possible improvements. This is known in the program as the ERAS Interactive Audit System® (EIAS) and allows efforts and changes in the way of acting to be directed, in order to improve the results through permanent auditing and evaluation.⁶

Below are some of the actions proposed in the ERAS guidelines for colon surgery related to the surgeon's performance:

Mechanical bowel preparation (MBP)

In terms of surgical practice, among the preoperative measures, one of the most resisted and controversial is the MBP. Classically, colon surgery was not permitted without MBP and this remains the case even today. MBP is stressful for the patient, leads to adverse effects such as dehydration and is associated with an increase in postoperative ileus.^{7,8}

The dogma of MBP prior to elective colon surgery has been strongly challenged. In the 2011 Cochrane review for colon surgery, which included 18 prospective randomized trials and 5805 patients, no significant differences were found between patients with and without MBP, or with MBP vs. rectal enema alone, in terms of anastomotic leak, mortality, reoperation, and operative wound infection.⁹ Furthermore, it was shown that laparoscopic colectomy can be safely performed without MBP.¹⁰

Patron Uriburu conducted a study on MBP in 60 patients with 2 branches of 30, not randomized. Malignant pathology was 70%. Laparoscopic surgery and anastomosis were similar. There was morbidity in a quarter of patients, somewhat less in those who were not prepared. He concludes that surgery without MBP is safe and similar in infectious complications and hospitalization time.¹¹

Leiro and Bianchi¹¹ published a prospective, randomized study of 129 elective patients with benign and malignant colonic pathology divided into two groups: one with MBP and antibiotics and the other with antibiotic prophylaxis. In the MBP group, there was a 21.9% rate of surgical site infection and 5.7% rate of anastomotic dehiscence. In the group without MBP, there was a 21.5% rate of surgical site infection and 15.2% rate of anastomotic dehiscence, with no significant difference, although in this group there were more extraperitoneal anastomoses. According to this study, MBP did not influence infectious complications or anastomotic dehiscences, while extraperitoneal anastomoses in middle and lower rectal cancer had a better outcome with preparation. The authors recommend the possibility of performing colon anastomoses in patients without MBP.

On the other hand, the justification is to avoid dehydration and hydroelectrolytic alterations that MBP entails, in addition to the discomfort for the patient. In any case, MPP is recommended in the case of small lesions that cannot be palpated and require intraoperative colonoscopy, although it is preferred to mark the lesion preoperatively with India ink. According to the 2013 ERAS guidelines, the recommendation is not to routinely perform MBP in colon surgery, with a high level of evidence and a strong degree of recommendation.⁷

Another point in which both surgeons and anesthesiologists must modify their behavior is related to preoperative fasting and carbohydrate loading. The classic 8-hour fast is sometimes a difficult measure to modify. The patient must arrive at the operating room in a state as close to euolemia as possible, with electrolyte disturbances corrected and euglycemic or slightly hyperglycemic. The most physiological way to achieve this objective is through oral replacement, since prolonged fasting and intravenous replacement cause excess fluid to leave the intravascular space towards the interstitium, producing visceral edema. Prolonged fasting causes the patient to arrive at surgery

hypovolemic and hypoglycemic and has not been shown to reduce the risk of aspiration during anesthetic induction. Several prospective and randomized studies have shown that clear liquids can be administered up to 2 hours before surgery and a light meal up to 6 hours before.^{12,13}

Preoperative administration of complex carbohydrates, such as 12.5% maltodextrin, 285 mOsm/k (approximately 100 g maltodextrin in 800 ml water) on the night before surgery and 50 g maltodextrin in 400 ml water 2–3 hours before anesthetic induction, reduces the catabolic response generated by prolonged fasting. It also improves patient well-being and reduces peripheral insulin resistance.¹⁴

Current ERAS guidelines recognise the advantages of minimally invasive approaches to colon cancer, including faster recovery, fewer overall complications, lower wall morbidity and fewer adhesions, without compromising oncological outcomes, which in some cases may even improve. The level of evidence for the superiority of minimally invasive surgery over conventional surgery is high and the grade of recommendation is strong.

Early restart of feeding

Historically, preoperative instructions for gastrointestinal surgery involved “*nothing by mouth from the night before until bowel function is restored*” which may occur several days after surgery. In addition, routine prophylactic use of a nasogastric tube was also indicated. Currently, there is evidence that early refeeding is safe and well tolerated in 80-90% of patients, improves postoperative comfort, and promotes early discharge.¹⁵⁻¹⁷

The resumption of intestinal transit is also favoured by the administration of prokinetics, as well as by rapid and active mobilisation. The postoperative hospitalization time is related to the resumption of intestinal transit, oral tolerance and postoperative analgesia. An anastomotic dehiscence usually appears between the 5th and 7th postoperative day, so even if the patient is discharged he or she should be strictly monitored during this period. The warning signs are the appearance of hyperthermia, abdominal distension, lack of progression of intestinal transit, abdominal pain and vomiting.

Fluid administration

Perioperative fluid administration has been a topic of debate in recent decades, and multiple prospective randomized studies have attempted to compare a volume-free vs. a restrictive regimen. Currently, the trend is not to overhydrate patients parenterally and to actively restart oral diet, particularly with carbohydrate solutions initially, then to resume soft diet and progressively general diet.

Surgeons and anesthesiologists have for decades been inclined to use a free regimen to prevent hypotension and hypoperfusion of tissues, particularly the anastomosis.^{18,19} However, excess fluids, especially saline, lead to pulmonary edema, metabolic acidosis, renal failure, and splanchnic edema, events that can compromise the safety of the anastomosis. On the other hand, it is important to know that both volume overload and extreme restriction are harmful and have a negative impact on complications and hospital stay.

The goal of ERAS programs is appropriate volume management, with goal-guided therapy that achieves a balance close to zero and minimal body weight gain.

Surgical considerations

The incidence and duration of postoperative ileus appears to be related to the degree of surgical trauma, which is less in minimally invasive procedures.^{20,21}

With regard to wounds, it is important to monitor the site of extraction of the specimen due to the possibility of infection of the surgical site.⁸ After discharge, it is suggested to carry out a follow-up at 7, 15 and 30 days postoperatively to evaluate the clinical progression and

tolerance to the oral diet, which should be fractionated, progressive and restricted as appropriate.

Analgesia

Non-opioid analgesia, or a short-acting opioid, should be used both intraoperatively and postoperatively. This allows for early re-feeding and mobilization. It is essential that each team has its own pain management strategy, based on the lowest possible use of opioids.

Drains and tubes

It is advisable to restrict or not routinely use the nasogastric tube in the postoperative period and avoid the placement of drains, since both delay recovery and do not improve results.

Finally, we can conclude that with the new perioperative optimization protocols, several paradigms of classical surgery have been destroyed. The surgeon must adapt to the changes, but fundamentally must understand that it is one more link in a care process that not only requires an adequate surgical technique.

Importance of auditing in the implementation and development of the ERAS protocol

The word audit comes from the Latin *audire*, meaning to hear, and is generally used to refer to the examination of an entity's financial management.

In health, the term began to be applied to the retrospective evaluation of medical performance based on the analysis of generally poorly organized available records, essentially the medical history. Currently, it is understood that it is a process that begins with the analysis of carefully selected data and its comparison against well-defined standards. The audit is part of an efficient cycle of data use to implement changes that objectively improve the quality of care.²²

Structures, care processes, and results are the subject of audit. In our case, the structure is a surgical team made up of surgeons, anesthesiologists, nurses and nutritionists. The care processes are the guidelines we agree on to care for our patients. The results refer to objective variables such as the reacquisition of normal functions, complications, and hospital stay.

One of the pillars of the ERAS program is the exhaustive audit of all these elements, and one of its advantages is that it makes the methods and the tool available to the team through the EIAS.²³

When the program is officially introduced into daily clinical practice, the entire team is committed to the audit process, each person has a specific responsibility for one of the parts and has defined a time in their agenda to complete the task. In other words, the audit is incorporated as another aspect of the care because the entire group understands the positive impact of knowing the result of their actions.

To produce improvements, the audit process cannot stop at the analysis of the data collected, but extends through a repetitive cycle of planning, action, analysis and corrections.²⁴

There is controversy about the final impact of this process. Among the elements that predict significant improvement are the existence of a team leader, verbal and written communication, repetition over time (iterations), and the level of specification of the objectives and the action plan.²⁵

The EIAS audit program is organized in such a way that it contemplates all these elements and includes numerous guidelines that the evidence considers necessary for the process to produce continuous improvement. Some of them are:

- Have a very structured program (previously defined).
- Have a selection of criteria based on evidence.
- Audit the process and the results.

- Be applied by a multidisciplinary team that has a leader.
- Be executed repetitively once a week.

Why implement an ERAS program?

Protocols derived from evidence-based medicine are the standard of care in referral centers, whether or not they have an ERAS program. As noted above, the EIAS audit system is based on methods that have proven their usefulness, and impact studies show that it is effective in producing significant changes, profoundly and positively transforming health services with low adherence to good practices.²⁶ A benefit is also reported in the professional performance of team members and in their level of satisfaction, as evidenced by the fact that it motivates them to seek excellence, greater adherence, and better results.²³

The weekly team meeting includes a time slot to review the audit and plan problem resolution, and another time slot to review the status of each patient who entered the program. Problem resolution primarily consists of introducing a change to improve adherence to the protocol when noncompliance is detected.²⁷

As noted above, ERAS offers an online audit system that is built on evidence to produce improvements. There are numerous publications that denounce audit systems that do not produce improvements, due to the selection of incorrect indicators, erroneous readings of data and deficiencies in the training and functioning of teams. Other times, institutional realities such as the lack of dedication of professionals or support from administrators, conspire against the virtuous circle of audit-corrective action.²²

Among the emerging properties of an audit system of this nature are the unification of the language used to compare the results and the alerts that are generated as a product of the association of practices and results.

The first case is exemplified by the comparison of the percentage of complications that occur. The definition of complications, or their choice for drawing up a list, is practically unreproducible among current publications. In ERAS, the comparison between the complications of one centre and another is immediate and faithful because they are perfectly defined and weighted in the same way. For a hospital and its professionals, the mere fact of confirming that their complications do not exceed the standard is of great value. The fact that this information goes unnoticed is detrimental to the assisted population and an additional cost that can be several times higher than that of the implementation of the programme. In the second case, alerts are generated when practices associated with results that deviate from the average are identified. These indicate entry points for carrying out prospective studies and improving protocols.

REFERENCES

1. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. *Br J Anaesth*. 1997;78:606–17.
2. Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. *Am J Surg*. 2002;183:630–41.
3. Weiser TG, Regenbogen SE, Thompson KD, et al. An estimation of the global volume of surgery: a modelling strategy based on available data. *Lancet*. 2008;372:139–44.
4. Fearon KCH, Ljungqvist O, Von Meyenfeldt M, et al. Enhanced recovery after surgery: a consensus review of clinical care for patients undergoing colonic resection. *Clin Nutr*. 2005;24:466–77.
5. Maessen J, Dejong CHC, Hausel J, et al. A protocol is not enough to implement an enhanced recovery programme for colorectal resection. *Br J Surg*. 2007;94:224–31.
6. Ljungqvist O, Young-Fadok T, Demartines N. The history of enhanced recovery after surgery and the ERAS society. *J Laparoendosc Adv Surg Tech A*. 2017;27:860–62.
7. Gustafsson UO, Scott MJ, Schwenk W, et al. Guidelines for perioperative care in elective colonic surgery: Enhanced Recovery After Surgery (ERAS®) Society recommendations. *World J Surg*. 2013;37:259–84.
8. Holte K, Nielsen KG, Madsen JL, et al. Physiologic effects of bowel preparation. *Dis Colon Rectum*. 2004;47:1397–402.
9. Güenaga KF, Matos D, Wille-Jørgensen P. Mechanical bowel preparation for elective colorectal surgery. *Cochrane Database Syst Rev*. 2011;2011:CD001544.

10. Zmora O, Lebedyev A, Hoffman A, et al. Laparoscopic colectomy without mechanical bowel preparation. *Int J Colorectal Dis.* 2006;21:683-87.
11. Leiro F, Bianchi R. Técnicas quirúrgicas abdominales. En: Lumi CM, Bianchi R, Canelas A, Collía Ávila K, Farina PA, Laporte M, Mattacheo AE, Pastore RLO, eds. *Enfermedades del colon, recto y ano*. Buenos Aires: Sociedad Argentina de Coloproctología; 2023:755-72.
12. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: an updated report by the American Society of Anesthesiologists Task Force on preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration. *Anesthesiology.* 2017;126:376-93.
13. Brady M, Kinn S, Ness V, et al. Preoperative fasting for preventing perioperative complications in children. *Cochrane Database Syst Rev.* 2009;CD005285.
14. Nygren J. The metabolic effects of fasting and surgery. *Best Pract Res Clin Anaesthesiol.* 2006;20:429-38.
15. Bauer VP. The Evidence against Prophylactic nasogastric intubation and oral restriction. *Clin Colon Rectal Surg.* 2013;26:182-85.
16. Wolff BG, Pemberton JH, van Heerden JA, et al. Elective colon and rectal surgery without nasogastric decompression. A prospective, randomized trial. *Ann Surg.* 1989;209:670-73; discussion 673-75.
17. Lassen K, Kjæve J, Fetveit T, et al. Allowing normal food at will after major upper gastrointestinal surgery does not increase morbidity: a randomized multicenter trial. *Ann Surg.* 2008;247:721-29.
18. Lobo DN. Fluid, electrolytes and nutrition: physiological and clinical aspects. *Proc Nutr Soc.* 2004;63:453-66.
19. Marjanovic G, Villain C, Juettner E, et al. Impact of different crystalloid volume regimes on intestinal anastomotic stability. *Ann Surg.* 2009;249:181-85.
20. Varadhan KK, Lobo DN. A meta-analysis of randomized controlled trials of intravenous fluid therapy in major elective open abdominal surgery: getting the balance right. *Proc Nutr Soc.* 2010;69:488-98.
21. Shussman N, Brown MR, Johnson MC, et al. Does nasogastric tube decompression get used less often with laparoscopic and hand-assisted compared with open colectomy? *Surg Endosc.* 2013;27:4564-68.
22. Esposito P, Dal Canton A. Clinical audit, a valuable tool to improve quality of care: General methodology and applications in nephrology. *World J Nephrol.* 2014;3:249-55.
23. Currie A, Soop M, Demartines N, et al. Enhanced recovery after surgery interactive audit system: 10 years' experience with an international web-based clinical and research perioperative care database. *Clin Colon Rectal Surg.* 2019;32:75-81.
24. Benjamin A. Audit: how to do it in practice. *BMJ.* 2008;336:1241-45.
25. Thomson O'Brien MA, Oxman AD, Davis DA, et al. Audit and feedback: effects on professional practice and health care outcomes. *Cochrane Database Syst Rev.* 2000;CD000259.
26. Gramlich LM, Sheppard CE, Wasylak T, et al. Implementation of enhanced recovery after surgery: a strategy to transform surgical care across a health system. *Implement Sci.* 2017;12:67.
27. Joliat G-R, Ljungqvist O, Wasylak T, et al. Beyond surgery: clinical and economic impact of Enhanced Recovery After Surgery programs. *BMC Health Serv Res.* 2018;18:1008.