

Enhanced recovery for non-colorectal surgery

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Abstract

In recent years the advent of programs for enhanced recovery after major surgery (ERAS) has led to modifications of long-standing and well-established perioperative treatments. These programs are used to target factors that have been shown to delay postoperative recovery (pain, gut dysfunction, immobility) and combine a series of interventions to reduce perioperative stress and organ dysfunction. With due differences, the programs of enhanced recovery are generally based on the preoperative amelioration of the patient's clinical conditions with whom they present for the operation, on the intraoperative and postoperative avoidance of medications that could slow the resumption of physiological activities, and on the promotion of positive habits in the early postoperative period. Most of the studies were conducted on elective patients undergoing colorectal procedures (either laparotomic or laparoscopic surgery). Results showed that ERAS protocols significantly improved the lung function and reduced the time to resumption of oral diet, mobilization and passage of stool, hospital stay and return to normal activities. ERAS' acceptance is spreading quickly among major centers, as well as district hospitals. With this in mind, is there also a role for ERAS in non-colorectal operations?

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INTRODUCTION

In recent years the advent of programs for enhanced recovery after major surgery (ERAS) has led to modifications of long-standing and well-established perioperative treatments. These programs are used to target factors that have been shown to delay postoperative recovery (pain, gut dysfunction, immobility) and combine a series of interventions to reduce the perioperative stress and organ dysfunction^[1]. With due differences, the programs of enhanced recovery are generally based on the preoperative amelioration of the patient's clinical conditions with whom they presents for the operation, on the intraoperative and postoperative avoidance of medications that could slow the resumption of physiological activities, and on the promotion of positive habits in the early postoperative period (Table 1)^[2]. Common factors are postoperative pain control through continuous mid-thoracic epidural anaesthesia and avoidance of regular opioids drugs, stimulation of gut motility, no mechanical bowel preparation, early physical reactivation, and limited use of catheters, tubes and drains^[1].

Most of the studies were conducted on elective patients undergoing colorectal procedures (either laparotomic or laparoscopic surgery) and a growing number of articles and reviews have analysed the data produced (Figure 1). Results showed that ERAS protocols significantly

improved the lung function and reduced the time to resumption of oral diet, mobilization and passage of stool, hospital stay and return to normal activities^[5]. Any delay in hospital discharge or early readmission was due to the development of major complications^[4,5]. Higher American Society of Anesthesiologists (ASA) score, advanced age, and rectal surgery were associated with delayed mobilization, morbidity and prolonged stay^[6]. ERAS' acceptance is spreading quickly among major centers as well as district hospitals. With this in mind, is there also a role for ERAS in non-colorectal operations?

NON-COLORECTAL SURGERY

Compared to colorectal surgery, fewer studies have investigated ERAS in other operations (Table 1)^[3-24].

Radical cystectomy

Radical cystectomy is one of the urological procedures which has the highest rate of complications and longest hospital stay^[25]. Overall complication rate is 21%-34%, early reoperation rate 6%-7%, mortality rate 0.4%-2.7%, and the hospital stay is 17.4 ± 4.7 d. The most frequent complications are pelvic lymphoceles (8.1%), wound dehiscence (6%-9%), deep venous thrombosis (4.7%), ileus (3.9%), and pulmonary embolism (2%-4%)^[26-28]. Over the years, improvements in the surgical technique, anaesthesia and perioperative care have already resulted in reduced morbidity and shorter hospital stays^[28]. Age is not a contraindication, and the operation can be administered even to elderly patients with similar complications rates to younger patients^[26,29,30]. More important for the prediction of postoperative complications are the preoperative cardiac history, ASA score and the number of intraoperative blood transfusions. For preoperative mortality, the ASA score, blood transfusions and preoperative nutritional deficiency are important^[28,31,32].

Arumainayagam *et al.*^[25] developed the only ERAS protocol available for radical cystectomies. The protocol consisted of stopping the use of mechanical bowel preparation before the cystectomy, implementation of early enteral feeding (with nutritional supplements) and mobilization as tolerated. Patients with ileal conduits after radical cystectomy were encouraged self management of the stoma and catheter care on postoperative day 2. The application of the ERAS protocol produced a significant reduction in the length of stay (13 d *vs* 17 d) but had no effect on the time to first defecation (6 d), morbidity, mortality and readmission rates^[25]. Obviously the ERAS protocol does not affect these rates, as it has no influence on risk factors for morbidity, mortality and readmission rates. It would be interesting to evaluate if preoperative nutritional improvement, and not only for early enteral feeding, might decrease the postoperative complications rates in order to better prepare the body for surgical stress.

Liver resections

Liver resections have morbidity rates of 25%-48% and

mortality of 1%-7%^[33-35]. The length of stay with a traditional perioperative pathway ranges from between 8 and 14 d. The length of stays and intensive therapy unit stays are shorter if resections are conducted with laparoscopic surgery^[36,37]. Factors associated with postoperative morbidity are neoadjuvant chemotherapy, vascular clamping, intraoperative blood loss with transfusion^[35,38], comorbid conditions, pre-existent liver disease and small remnant liver volume^[39]. Factors associated with postoperative mortality are the presence of blood transfusions and extended resections^[40]. Age is not associated with an increase of morbidity or mortality^[41].

The application of an ERAS protocol to liver surgery was evaluated by van Dam *et al.*^[11]. Their protocol was similar to those of colorectal surgery, including: nutritional supplements up to two hours before surgery, thoracic epidural analgesia, short acting anesthetics, avoidance of excessive IV fluids, warm fluids, and one night in the recovery ward before being admitted to the normal surgical ward. Among the criteria for discharge was the normalization or decreasing of serum bilirubin. Results achieved confirmed hospital stays shorter than 2 d and with no significant differences in the rates of morbidity, mortality and readmissions. In fact, as for radical cystectomies, the ERAS protocol did not alter any of the risk factors for these outcomes. A different study performed on liver resections undergoing ERAS evaluated the addition of laxatives to the protocol^[42]. Although routing postoperative laxatives resulted in an earlier first passage of stool, the overall rate of recovery remained unaltered^[42].

Upper gastrointestinal surgery

Gastric and oesophageal resections are operations associated with long hospital stays and postoperative morbidities. The average length of hospital stay after oesophagectomy ranges from 11 to 26 d following open surgery, and 7 to 13 d following laparoscopic surgery^[43]. Postoperative pulmonary complications have been reported in 15%-30% of cases and are the most common cause of major morbidity and mortality^[44]. Risk factors include impairment in lung function, cardiac reserve, preoperative physical activity and body composition^[44]. Furthermore, a history of pulmonary disease, age, and preoperative physical activity also significantly predicts postoperative death^[45]. For gastric resections, old age does not seem to affect morbidity rates (25%-29%)^[46,47] but still influences mortality, which is higher amongst elderly patients (3% *vs* 10%)^[29]. Advanced age, low albumin, ASA score, palliative resections and resection of two or more additional organs were independent risk factors for mortality^[47].

ERAS protocols have been applied on both trans-thoracic oesophagectomies (Ivor-Lewis procedure) and laparoscopic gastric resections^[43,48]. The ERAS protocol for oesophagectomies involved extubation in the operating theatre or immediately on arrival in the intensive care unit, early mobilization, negative fluid balance, intense respiratory physiotherapy and epidural analgesia. Patients remained in intensive care for three days, most drains

Table 1 Types of Enhanced Recovery protocols adopted

	Preoperative	Intraoperative	Postop (first 24 h)	Day 1	Day 2	Day 3	Day 4	Additional comments
Kahokehr <i>et al</i> ^[7,8]	Routine nutritional assessment; nutrition supplementation; NBM 2 h preinduction; carbohydrate loading; no bowel preparation; functional assessment and goal setting	Thoracic epidural; short acting anesthetics; intraoperative fluids: 1000 mL of crystalloid and 500 mL of colloid; prophylactic antiemetics at induction (dexamethasone); no drains or NG tubes	All IV fluid stopped before patient discharged to ward; prophylactic antiemetics; early oral feeding; nutritional supplementation; no opioids	Removal of urinary catheter	Removal of epidural			Early mobilization and physiotherapy
King <i>et al</i> ^[9-11] , Blazeby <i>et al</i> ^[12] , Faiz <i>et al</i> ^[13]	Optimized pre-morbid health status; functional assessment and goal setting; Meeting with stoma nurse. Nutrition supplementation; bowel preparation (for left colonic, sigmoid and rectal tumours)	Thoracic epidural; intraoperative fluids: 2000 mL of crystalloid; minimal-access surgery; local anaesthetic infiltration to the largest wound; no drains or NG tubes	Free fluid; 1 high-protein/high-calorie drink; patient sat out in chair	All IV fluid stopped; regular paracetamol; 3 high-protein/high-calorie drink; patient sat out in chair; start walking; removal of urinary catheter for colonic resections; laxatives	Removal of epidural; regular NSAIDs; Morphine for breakthrough	Removal of urinary catheter for rectal resections		Aim for discharge on day 3 for colonic or day 5 for rectal resection; Provision of hospital contact numbers, review on ward if problems within 2 wk; review in outpatient clinic on day 12
Jottard <i>et al</i> ^[14]	Functional assessment and goal setting; nutrition supplementation; no bowel preparation	Thoracic epidural; anti-thrombotic and infection prophylaxis; standard anesthetic protocol; prevention of intraoperative hypothermia; no drains or NG tubes	Free fluid	All IV fluid stopped; normal diet offered				Use of anti-emetics; early mobilization; postoperative nutritional care
Maessen <i>et al</i> ^[4,5] , Nygren <i>et al</i> ^[3] , Hendry <i>et al</i> ^[6]	Functional assessment and goal setting; nutrition supplementation; no bowel preparation	Thoracic epidural; prevention of intraoperative hypothermia; Transverse/curved incision	Oral analgesia; Patient sat out in chair; nutritional supplements; free fluid > 800 mL	All IV fluid stopped; nutritional supplements > 400 mL; normal diet offered; patient sat out in chair > 6 h	Removal of epidural; removal of urinary catheter			
Soop <i>et al</i> ^[15]	Nutrition supplementation	Thoracic epidural	Prophylactic antiemetics	Regular paracetamol and NSAIDs; patient sat out in chair for 2 h	Patient sat out in chair for 4 h	Patient sat out in chair for 3 h	Epidural removed (at least)	
Raymond <i>et al</i> ^[16]	Functional assessment and goal setting; nutrition supplementation	Thoracic epidural; Intra-operative targeted fluid management; No NG tube						Early mobilization/resumption of diet
Turunen <i>et al</i> ^[17]	Functional assessment and goal setting; preoperative feeding; bowel preparation	Thoracic epidural; high-oxygen P; prevention of hypothermia; no drains or NG tubes		Removal of urinary catheter				Early mobilization/resumption of diet; no routine opioids, regular paracetamol and NSAIDs; fluid restriction
Senagore <i>et al</i> ^[18]		No NG tube	PCA; free fluids	Removal of urinary catheter; normal diet offered; regular NSAIDs, gabapentin, hydroxycodone if needed; no drains				
Wennstrom <i>et al</i> ^[19]	Functional assessment and goal setting; no bowel preparation; preoperative oral hydration	Thoracic epidural; short acting anaesthetics; no opioids	Free fluid; patient sat out in chair		Epidural removed; urinary catheter removal			

Mohn <i>et al</i> ^[20]	Functional assessment and goal setting; nutrition supplementation; bowel preparation.	Thoracic epidural; total intravenous anesthesia; intra-operative targeted fluid management; restricted postoperative intravenous fluids; routing antiemetics postoperatively; short midline incisions; No drains or NG tubes	Patient sat out in chair	Removal of urinary catheter; patient sat out in chair; normal diet offered; regular paracetamol and nsais, opioids for breakthrough	Epidural removed	Regular laxatives twice daily; anti-thrombotic prophylaxis
Teeuwen <i>et al</i> ^[21]	Nutritional supplements; bowel preparation in left-sided resections; thrombotic prophylaxis	Thoracic epidural; transverse incisions except in Crohn's disease and rectal surgery; intra-operative targeted fluid management (hypotension treated with vasopressors); no drains except in rectal surgery; no NG tubes; prophylactic antiemetics	Free fluids; nutritional supplements; patient sat out in chair	Normal diet offered; intravenous fluid administration; start walking	Epidural removed; urinary catheter removal; regular paracetamol; NSAIDs opioids for breakthrough	
Ahmed <i>et al</i> ^[22,23]	Functional assessment and goal setting; nutritional supplements; no bowel preparation	High inspired oxygen; concentration; transverse incisions; no drains or NG tubes	Free fluids; soft diet offered; patient sat out in chair	Start walking		Regular paracetamol NSAIDs, opioids for breakthrough
Kirdak <i>et al</i> ^[24]	Thrombotic prophylaxis; bowel preparation; nutritional supplements	Thoracic epidural; pelvic drains with rectal dissections; urinary, central venous, and nasogastric catheters were routinely used	Start walking	NG tubes and urinary catheters removed (except pelvic dissection); soft diet offered; start walking; patient sat out in chair	Removal of urinary catheter (low pelvic operations) and drains	Epidural removed; regular paracetamol; central venous catheters removed; normal diet

NBM: Neuronal basal medium; NG: Nasogastric; NSAIDs: Nonsteroidal antiinflammatory drugs; PCA: Pyrrolidone carboxylic acid.

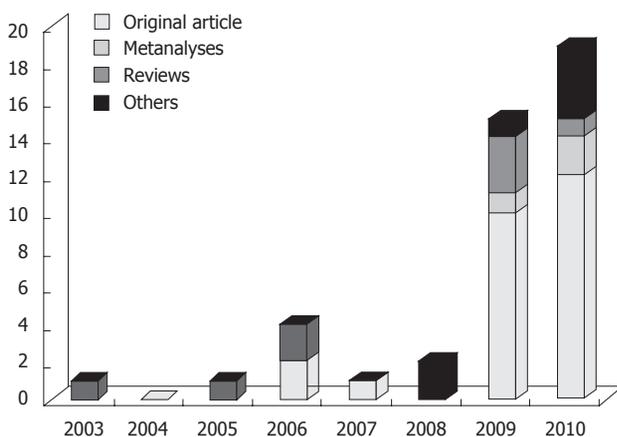


Figure 1 Number and types of articles published on Enhanced Recovery.

and tubes were removed on day 4, oesophageal radiology studies were performed on day 5 and the nasogastric tube consequently removed. Particular attention was dedicated to early signs of potential complications (pulmonary infections or anastomotic leaks). With this protocol the authors achieved a significant reduction of pulmonary complications (31% *vs* 38%), mortality (1% *vs* 5%) and hospital stay (9 d *vs* 13 d)^[43]. Even in this case, as well as for radical cystectomy, no evaluation aimed for an improvement of the preoperative nutritional status, which might decrease the postoperative complications rates in

order to better prepare the body for surgical stress.

Patients receiving an ERAS protocol for laparoscopic gastric surgery had their anastomosis tested on the first postoperative day with a water soluble swallow study. If the anastomosis was intact, free fluids were started and an early diet on day 2 consisting of small, frequent low-sugar meals^[48]. The urinary catheter was removed on day 1. No epidural analgesia was used for pain relief, nor any abdominal drains or nasogastric tubes. Discharge was planned for day 3. Results showed a short length of stay (4 d, range 2-30) and reduced readmission rate (6.2%). Only two patients developed postoperative complications, namely a wound abscess and an urinary infection^[48].

Gynecological surgery

Hysterectomy is a common gynecological procedure that is performed through various routes. Overall morbidity is present in 16% of cases, but their frequency depends on the route adopted to remove the uterus; they are usually rare after open abdominal hysterectomies (hemorrhages: 2.4%, genitourinary disorders: 1.9%, infection: 1.6% and urinary tract infections: 1.6%), even lower with the vaginal route but higher for laparoscopic abdominal hysterectomy^[49]. The major causes of morbidity in patients who undergo abdominal hysterectomies are medical rather than surgical and the most important factor associated with them is the presence of comorbidities^[50,51]. Readmissions are confined to 5.4%-7.2% of cases.

One article focused on ERAS protocol in gynecological operations. The protocol consisted of intensified information on pre-hospitalization consultations and admission. Intravenous lines, urinary catheters and tampons were removed before the patient left the recovery unit. Mobilization and normal food intake, including per oral analgesics, started a few hours after the operation. Routine postoperative enemas were discontinued^[52]. A significant reduction of the length of stay was also confirmed in this study, but no mention was made about the rate of postoperative complications or readmission^[52].

Post-bariatric body contouring surgery

Patients undergoing post-bariatric body contouring surgery have a higher risk for postoperative complications (28%)^[53,54] and among these the most common are those involving the wound healing process (infections, seromas, hematomas and delayed healing)^[55-58]. The causes are multifactorial and include the percentage excess weight loss^[53], total tissue resection weight^[59], preoperative body mass index^[60] and the recently discovered “high-calorie malnutrition”^[61]. This syndrome involves the preoperative deficiency of vitamins and minerals that are important for the healing process. Differently from the other risk factors, high-calorie malnutrition syndrome is common to the overweight, obese and post-obese patients, and its perioperative corrective could improve the wound healing in all these subcategories. This is shown in the study by Agha-Mohammadi where the rate of complications in post-bariatric and obese patients was similar to normal-weight patients after perioperative nutritional supplementation of many primary ingredients necessary for wound healing and immune system competency^[61]. In this case the length of stay was not evaluated because most plastic surgery procedures can be conducted during short admissions or even day surgery.

CONCLUSION

The application of ERAS protocols to non-colorectal surgery is more complex due to the paucity of literature available and to the outcomes that might be different according to the peculiarities posed by each discipline and its specific problems. Generally, a principle of ERAS is that the reduction of hospital stay should be balanced against the possibility of increased readmission rates. To achieve this objective, the rate of postoperative complications should be reduced so that patients can be safely sent home earlier with no risk to their health and no need for readmission. These two principles, reduction of the length of stay and of the postoperative morbidity, should both be targeted in a comprehensive ERAS program. However, most of the studies analyzing ERAS protocols in non colorectal-surgery focused mainly on only one factor, the length of hospital stay, which is the most evident in terms of hospital costs and productivity. The analysis conducted on non-colorectal studies showed that most protocols tried to optimize the perioperative administration of drugs, fluids and tubes following the path traced

by colorectal studies. These factors obviously impacted on the overall length of stay but did not act on risk factors for postoperative morbidity, with an exception made for the post-bariatric study. Not surprisingly, the incidence of postoperative complications remained the same in most articles except for the post-bariatric study. To further improve the already positive results achieved by most ERAS programs it is advisable to focus more on the clinical conditions with which the patient arrives to the operation, redefining the situation by which the body faces the surgical stress and improving its ability to deal with it. This could not only reduce the length of stay, but also the complication and readmission rates.

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