Journal of Surgical Sciences (2014) Vol. 18 (1) : 28-35

JOURNAL OF SURGICAL SCIENCES

Review Article

ENHANCED RECOVERY PROGRAMME (ERP) AFTER ABDOMINAL SURGERY: TIME TO CHANGE PRACTICE

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Introduction

Over the last 20 years, a new concept of perioperative patient care after different types of abdominal surgical procedures has been developed and evaluated[1,2]. This construct of evidence-based interventions, referred to as Enhanced Recovery Programme (ERP) 'fast-track surgery', 'enhanced recovery after surgery' (ERAS) or 'multimodal rehabilitation', is mainly focused on the minimization of the impact of surgery on patients' homeostasis[3]. The reduction of postoperative physiological stress by attenuation of the neurohormonal response to the surgical intervention not only provides the basis for a faster recovery but also seems to diminish the risk of organ dysfunction and complications[1,2]. Therefore, the main goal of ERAS programs is to achieve a shorter hospital stay without increasing postoperative complications and readmission rates.

ERAS programs consist of well-organized 'pathways' of consecutive clinical interventions that begin from outpatient preoperative information, counseling and physical optimization, proceed through pre-, intra- and postoperative protocolled intrahospital actions and end with patient discharge following pre-established criteria. The 3 main pillars of this organized structure are optimal postoperative pain management, early enteral feeding and aggressive rehabilitation/early mobilization after surgery[5],the heterogeneity of which usually requires a multidisciplinary collaboration involving anesthesiologists, surgeons, surgical nurses and physiotherapists[1].

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Received 09 September 2012 **Accepted** 12 October 2012

What is ERAS?

Initiated by Professor Henrik Kehlet in the 1990s,[7] ERAS, enhanced recovery programs (ERPs) or "fast-track" programs have become an important focus of perioperative management after colorectal surgery,[8] vascular surgery,[9] thoracic surgery[10] and more recently radical cystectomy.[6,11] These programs attempt to modify the physiological and psychological responses to major surgery[12], and have been shown to lead to a reduction in complications and hospital stay, improvements in cardiopulmonary function, earlier return of bowel function and earlier resumption of normal activities[13]. The key principles of the ERAS protocol include pre-operative counselling, preoperative nutrition, avoidance of perioperative fasting and carbohydrate loading up to 2 hours preoperatively, standardized anesthetic and analgesic regimens (epidural and non-opiod analgesia) and early mobilization[14]. The introduction of ERAS in a centre in the United Kingdom lead to a significant reduction in hospital stay and equivalent morbidity in radical cystectomy patients, compared to traditional approaches[11]. The protocol focused on reduced bowel preparation, standardized feeding schedule and standardized analgesic regimens. Similar findings have been replicated in a small number of other urological publications.[15]

Preoperative nutrition

It is well-known that poor nutrition is detrimental to outcomes postoperatively[16]. It frequently occurs with

comorbidities and with underlying disease processes, such as cancer. Inadequate nutrition, particularly for cancer patients undergoing surgery, is an independent risk factor for complications, increased hospital stay and costs[17]. The importance of nutritional status in patients undergoing abdominal surgery has long been noted,[18] with reported complications rates as high as 80% in patients with poor nutrition.[19] More recently, data from Vanderbilt University demonstrate that nutritional deficiency preoperatively is a strong predictor of 90-day mortality and poor overall survival.[20] It is therefore unsurprising that assessment and treatment of poor nutrition is an essential component of ERAS protocols. In terms of defining the problem, the European Society of Parenteral and Enteral Nutrition (ESPEN) defines "severe" nutritional risk as one or more of the following: weight loss >10% to 15% in 6 months, body mass index <18.5 kg/m2 or a serum albumin of <30 g/L[14]. The British Association of Parenteral and Enteral uses similar parameters as part of the Malnutrition Universal Screening Tool (MUST) to risk stratify patients according to their nutritional level. Correction of preoperative nutritional deficiencies may sometimes require prolonged parenteral, or a combination of parenteral and enteral nutrition depending on the severity of the problem and the patient's gastrointestinal function. However, in most cases patients can be managed with appropriate input from a dietician or nutritionist, and the use of a standard whole protein liquid nutritional supplement.

Carbohydrate loading and early enteral feeding

The stress response is initiated by a variety of physical insults, such as tissue injury, infection, hypovolemia or hypoxia. The ERAS program is aimed at attenuating the body's response to surgery which is characterized by its catabolic effect[21]. Autonomic afferent impulses from the area of injury or trauma stimulate the hypothalamus-pituitary-adrenal axis and mediate the body's subsequent endocrine response[22]. Adrenocorticotropic hormone and cortisol production leads to protein catabolism, weight loss, muscle (skeletal and visceral) wasting and nitrogenous loss[21]. There is also a relative lack of insulin and peripheral insulin resistance occurs due to alpha-2-adrenergic inhibition of pancreatic B cells (facilitated by catecholamines) and defects in the insulin receptor/ intracellular signalling pathway. Hyperglycaemia is therefore a significant finding after major surgery,[23] and the observed insulin resistance is a major variable influencing length of stay,[24] poor wound healing and increased risk of infective complications. Methods which reduce the insulin resistance include adequate pain relief[25], avoiding a prolonged period when oral intake is interrupted, and the use of carbohydrate loading.

The practice of fasting patients from midnight is used to avoid pulmonary aspiration after elective surgery; however, there is no evidence to support this.[26] Preoperative fasting actually increases the metabolic stress, hyperglycemia and insulin resistance, which the body is already prone to during the surgical process[24]. Changing the metabolic state of patients by shortening preoperative fasting not only decreases insulin resistance, but reduces protein loss and improves muscle function[27]. A review of 22 RCTs comparing different perioperative fasting regimens and perioperative complications revealed that there is no evidence to suggest a shortened fluid fast results in an increased risk of aspiration, regurgitation or related morbidity compared to the standard fasting from midnight policy[28]. Furthermore, if patients are allowed to take solids up to 6 hours preoperatively and clear fluids up to 2 hours, there is no increase in complications,[28,29] which forms the basis of preoperative guidelines adopted by the Royal College of Anaesthetists[30] and the American Society of Anesthesiologists[31].

As mentioned previously, the use of carbohydrate loading attenuates postoperative insulin resistance, reduces nitrogen and protein losses[32], preserves skeletal muscle mass and reduces preoperative thirst, hunger and anxiety[33]. It involves the use of clear carbohydrate drinks the day prior to surgery and up to 2 hours before. In addition to the metabolic effects, it facilitates accelerated recovery through early return of bowel function and shorter hospital stay, ultimately leading to an improved perioperative well-being[34]. As a result, it is an important element of the nutritional aspects of ERAS and should replace the practice of overnight fasting.

Role of mechanical bowel preparation

The routine use of preoperative mechanical bowel preparation (MBP) has long been a tradition in colorectal surgery. The aim of MBP is to rid the large bowel of solid fecal contents and to lower the bacterial load, thereby reducing the incidence of postoperative complications. However, MBP liquefies solid faeces, which may increase the risk of intra-operative spillage

of contaminant, and it is almost impossible to reduce the bacterial load in the bowel due to the vast number of micro-organisms present in the digestive tract[35].

The routine practice of MBP has been challenged for over 30 years. In 1972, Hughes originally questioned MBP and concluded that vigorous mechanical bowel preparation is unnecessary[36]. Not only does MBP cause metabolic and electrolyte imbalance, dehydration, abdominal pain/bloating and fatique[37], but it may actually have detrimental effects on surgical outcome[38]. Multiple RCTs and meta-analyses have been published over the last decade suggesting that it is safe to abandon MBP[38]. One of the largest RCTs from Denmark was published in 2007[60]. The authors examined 1431 patients at 13 colorectal centres and found no difference in anastamotic leakage, septic complications, fascial dehiscence or mortality between the groups. In addition to an absence of benefit, MBP is also likely associated with an increased risk of complications, particularly anastamostic leakage[39]. A meta-analysis of 10 trials and nearly 2000 patients published in 2007, not only found an increased incidence of anastamotic leaks and wound infections, but also a trend toward increased incidence of intra-abdominal abscesses and extradigestive complications.[38] With this in mind, Slim and colleagues published an updated meta-analysis and review of the literature which included 14 RCTs and nearly 5000 patients[40]. Although it did not confirm the harmful effect of MBP as previously suggested, it demonstrated that any kind of MBP can safely be omitted before colonic surgery.

Postoperative nutrition

In addition to preoperative carbohydrate loading, early postoperative nutrition can ameliorate the metabolic response leading to less insulin resistance, lower nitrogen losses and reduce the loss of muscle strength[41]. An assessment of gastrointestinal function and patient tolerability is essential when commencing postoperative oral intake. Multiple studies exist on the timing of post-operative nutrition. One of the early meta-analyses, although relatively small, found that there is no advantage in keeping patients nil by mouth after elective gastrointestinal resection and early feeding may actually be beneficial by reducing infectious complications and length of hospital stay[41]. Lewis and colleagues [41]demonstrated no detrimental effect with early feeding, but a trend towards a lower incidence of anastomotic dehiscence, wound infection, pneumonia, intra-abdominal abscess or mortality in patients who received early enteral feeding. A Cochrane review in 2006 found a direction of effect towards a reduction in complications and mortality rate,[42] and in an update to their original metanalysis, Lewis and colleagues confirmed no benefit to keeping patients nothing by mouth (NBM) postoperatively, a reduction in complications and a reduced mortality rate; although, the mechanism for reduced mortality remains unclear[43]. Andersen and colleagues[42] conducted a systematic 2006 review of 13 randomized trials totaling 1173 patients undergoing gastrointestinal surgery. There were no significant differences between restricted and ad lib postoperative diets, but the findings also suggested that there was no advantage to dietary restriction. Also, although not reaching statistical significance, the direction of effect in the analysis also indicated that earlier feeding may reduce the risk of postoperative complications.

In 2007, Charoenkwan and colleagues[44] performed another systematic review of postoperative diets in patients undergoing abdominal gynecologic surgery. They also found that early feeding was safe, but, similar to other reports, associated with increased nausea. There appeared to be no significant shortening of time to first passage of flatus or time to first bowel movement. They concluded that the decision to initiate early oral feeding should be made on an individual basis, taking into consideration cost-effectiveness, patient satisfaction, and other physiologic changes[44].

In a 2006 study of "fast-track" rehabilitation programs in colonic surgery, the authors used a postoperative diet consisting of tea and soup, which gave the patients optimistic signals that they were in good health and would leave the hospital shortly. The authors concluded that early feeding, then, also may have positive psychological effects that can aid recovery. In any case, the authors cited studies showing that protein-enriched, high-caloric nutritional supplements (1.5 kcal and 0.05 g protein/mL) significantly decrease postoperative complications and they recommended that they be administered immediately after surgery and continued until the patient starts eating and drinking normally.[45,46]

In summary, the study under discussion here adds to information available from several prior studies indicating that early oral feeding is safe and does not increase morbidity or mortality. Because if time to resumption of a normal diet is significantly shorter

hospital stay may be shortened.

Perhaps the best policy might be an "in between" approach. Patients could be told: "After your operation you can eat and drink whatever appeals to you, but we don't advise resuming a normal diet or eating a lot of solid foods for the first 24-36 hours." Such a policy might avoid the increased nausea and reduce the need for reinsertion of a nasogastric tube.

Prevention of prolonged postoperative ileus

The etiology of postoperative ileus is multifactoral, with bowel function relying on a combination of the enteric and central nervous systems, hormonal influences, neurotransmitters and local inflammatory pathways[47]. Surgical stress, bowel handling, opioids and intraoperative fluid resuscitation can disrupt these normal arrangements within the gastrointestinal tract and lead to postoperative ileus and impaired gastrointestinal absorptive function[48]. Factors that help reduce this include epidural anesthesia, minimally invasive surgery, gentle tissue handling, avoiding of fluid overload[49] and early feeding.[50] Furthermore, the use of routine nasogastric decompression should be avoided after surgery as the incidence of fever, atelectasis and pneumoniae are increased in patients with nasogastric tube drainage, and any nasogastric tubes placed during surgery should be removed prior to extubation[13].

Chewing gum has previously been used in an attempt to improve the postoperative recovery of bowel function in patients. Chewing gum in the postoperative period has been described as a form of sham feeding,[51] whereby a food substance is chewed but does not enter the stomach. Gum is postulated to increase cephalo-vagal stimulation, leading to increased gastric motility and reduced inhibitory inputs from the sympathetic nervous system. Gastrointestinal hormones, such as gastrin, neurotensin, cholecystokinin and pancreatic polypeptide, are also increased and result in vagal stimulation of smooth muscle fibres.[52] Chewing gum also increases secretion of saliva and pancreatic juices, and a recent study proposed that sorbitol and hexitol found in sugar-free gum may also play a role in the reduction of postoperative ileus. A number of studies exist which demonstrate the benefits in patients undergoing colorectal surgery[52,53]. A meta-analysis of several RCTs evaluating the effect of chewing gum on postoperative ileus has subsequently been published. Although there are relatively low patient numbers and a significant heterogeneity of studies, chewing gum offers significant benefits by reducing the time to pass flatus and the time until first bowel movement[54].

Health economic benefits

The implementation of ERAS protocols represents a significant change in practice and a potential increase in the use of resources. Certain aspects, such as chewing gum, represent a simple and cheap intervention, which could potentially lead to significant cost savings. Schuster and colleagues estimated that the use of chewing gum following colectomy could save $118 828 000 per year in the United States[55]. King and colleagues examined information regarding in-patient days, out-patient and general practitioner visits and the use of community services and estimated costs from national published figures. Direct medical and indirect non-medical costs were significantly lower in the ERAS group. Similarly, Sammour and colleagues have recently published a cost-analysis of ERAS in colorectal surgery[56]. There was a significant reduction in total hospital stay, intravenous fluid use, complications and duration of epidural use in the ERAS group, with an overall cost-saving of roughly $6900 per patient.

Conclusions

Enhanced recovery after surgery protocols were initially described in open colorectal surgery, but have since been studied in a variety of surgical specialties, including urology. Although growing evidence from several RCTs, systematic reviews and meta-analyses suggest significant benefits from ERAS pathways, there are still major difficulties when introducing these evidence-based guidelines into routine practice[57]. Many surgeons state that they have "never heard of ERAS," while others cite inadequate multidisciplinary and community support as an impediment to implementation[58].

In terms of barriers to introducing ERAS, even the simple measures discussed in this review still represent fundamental changes in practice, and can therefore be difficult to achieve. Kahokher and colleagues outlined the key aspects required for the implementation of an ERAS protocol[59]. One of the most important aspects is the ERAS team, which includes pre-admission staff, dieticians, nurses, physiotherapists, social workers, occupational therapists and doctors. All team members must be

familiar ERAS principles and be motivated to carry out the program; they must be able to overcome traditional concepts, teaching and attitudes towards perioperative care. In light of such compelling evidence, the evidence-based environment in which we practice demands that we review the perioperative management of abdominal surgery patients and alter it accordingly.

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