The concept of ‘enhanced recovery’ following elective surgery is becoming increasingly prominent in the world of perioperative practice. Enhanced recovery pathways (ERP) are being implemented in more and more trusts throughout the UK, and in multiple different surgical specialties. But what does enhanced recovery actually mean and how does it impact upon both patients and healthcare professionals? Our unit has been using an ERP in colorectal surgery since 2007 and we are currently in the process of implementing a pathway for both our orthopaedic and gynaecological patients. This article comprises some background information on the evolution of enhanced recovery, a summary of its key elements and a review of the evidence, including a look at our unit’s experience.

Background

The enhanced recovery technique (also termed ‘fast-track surgery’ or ‘a multi-modal surgical approach’) was pioneered in the 1990s by Professor Henrik Kehlet, a gastrointestinal surgeon from Denmark. He noted that, despite advances in surgical and anaesthetic techniques, patients undergoing major surgical procedures still suffered significant morbidity causing prolonged post-operative recovery times (Kehlet 1997). He postulated that, whilst good anaesthetic and surgical technique were obviously important, the fact that complications were still occurring independent of these meant that other factors were involved.

One thing common to all surgical patients, to a varying degree, is the presence of the ‘surgical stress response’ (Bessey 1995). The term ‘stress response’ describes the phenomenon of widespread changes in organ function that is seen in patients following surgery and is mediated by the body’s immunological, endocrine and metabolic reactions to the surgical trauma. Kehlet (1997) proposed using a multi-modal approach towards perioperative care. His model comprised better patient information preoperatively, minimally invasive surgical techniques, increased use of regional anaesthetic techniques, effective pain relief, enteral nutrition and early mobilisation as a way of modifying the stress response and minimising the impact of surgery on the patient. The hope was that by producing ‘stress free anaesthesia and surgery’ (Kehlet 1991) one could speed up patients’ post-operative recovery times and reduce their morbidity and mortality. Over the intervening years there has been a lot of research looking at the multi-modal surgical approach. Then, in 2008, the National Health Service (NHS) Institute for Innovation and Improvement launched its Enhanced Recovery Programme which is based on the principles outlined by Kehlet in 1997. The NHS Institute of Innovation and Improvement has collaborated with a number of other national organisations including the Department of Health (DH 2010), the National Cancer Action Team, and the National Cancer Action Team, and NHS Improvement to create the Enhanced Recovery Partnership Programme (ERPP). The aim of the ERPP is to improve the quality of the patient experience and outcomes and reduce the length of elective care pathways across the NHS by sharing the good practice principles of enhanced recovery models of care (NHS London 2010). As such, ERPs are being implemented across the NHS to enhance patient care.

Key elements of an enhanced recovery programme

Enhanced recovery programmes have been successfully implemented for a number of different surgical specialties across the UK including colorectal, gynaecological and orthopaedic surgery. Examples of these programmes for various specialties can be found via the NHS London website (NHS London 2010). Enhanced recovery was originally developed for use in open colorectal surgery and the following section of this article is focused on that area. However, although different specialties present different surgical and anaesthetic challenges, the principles behind the key elements of enhanced recovery still apply.

Preoperative preparation

Preoperative preparation should begin in the primary care setting with optimisation of any chronic co-morbidities, for example diabetes/anaemia.

Pre-admission information and counselling

It has been shown that greater preoperative patient information can improve recovery and pain relief.
postoperatively (Kiecót-Ólasnler et al 1998). Patients should receive oral and written information, prior to admission describing what to expect through the perioperative course and what their role is in their recovery. In colorectal surgery, for example, this may include information on how soon following surgery they should expect to be eating and how long it will be before they are able to mobilise (Fearon et al 2005). Good preoperative counselling will help the patient have a clear understanding of the expected perioperative course, leading to reduced anxiety, improved patient experience and alleviating the stress response to surgery (Varadhan et al 2010a).

Avoidance of routine bowel preparation
Bowel preparation causes significant dehydration and may produce electrolyte disturbances (Holte et al 2004). It should not be used routinely, but may still be necessary in selected patients, for example those requiring intraoperative colonoscopy.

Preoperative carbohydrate
Hausel et al (2001) concluded that carbohydrate loading in the form of a carbohydrate-rich clear liquid beverage, given to the patient the night before and again 2-3 hours before the start of surgery, reduced preoperative anxiety, thirst and hunger. Fasting times should be kept to a minimum. Current consensus is two hours fasting pre-operatively for liquids and six hours for solids (AAGBI 2010).

Intraoperative management
Anaesthetic protocol
Although different operations will require different anaesthetic techniques, the same general principles apply to enhancing postoperative recovery, namely: avoidance of sedative pre-medication; use of modern, shorter-acting agents (e.g. remifentanil); use of regional techniques where appropriate (e.g. thoracic epidural in colorectal surgery); and the avoidance of long-acting opioids (Fearon et al 2005).

Surgical technique
General principles which can be used to enhance recovery are, where possible, to adopt a laparoscopic/minimally invasive approach (Vlug et al 2009); in open procedures use minimum length incisions (Fearon et al 2005); selective use of surgical drains (Varadhan et al 2010a); avoid routine use of nasogastric tubes (Cheatham et al 1995).

Maintenance of normothermia
Intraoperative hypothermia increases the risk of post-operative complications (Scott & Buckland 2006). In 2008 the National Institute for Health and Clinical Excellence published guidelines for avoiding inadvertent perioperative hypothermia via use of forced-air warming devices and warmed IV fluids (NICE 2008).

Perioperative fluids
It is important to achieve the correct balance with regards to perioperative fluid administration. Whilst most patients undergoing major surgery will require some fluid, excessive administration of intravenous fluids can lead to sodium and fluid overload which increases complications and delays the return of gut function, prolonging hospital stay (Nisanevich et al 2005). There are now a number of different devices available for monitoring cardiac output intraoperatively which can help to guide fluid administration. The oesophageal Doppler monitor (ODM) has been validated as a method to guide the administration of fluids during surgery (Gan et al 2002, Wakeling et al 2005). ODM can lead to a reduction in post-operative complications and admissions to critical care. Tailoring fluid therapy to the individual patient needs is a key aspect of enhanced recovery.

Postoperatively
Postoperative nausea and vomiting
Postoperative nausea and vomiting (PONV) hinders the resumption of oral nutrition and is stressful for the patient. This in turn may delay the return of bowel function, increasing the risk of complications and prolonging the patient’s recovery time (Bisgaard & Kehlet 2002). There should be a defined strategy for managing postoperative nausea and vomiting (PONV). Risk factors for PONV are: female gender, non-smoker, history of motion sickness/PONV, and administration of emetogenic agents (e.g. opioids). Individuals with more than two risk factors should receive prophylactic treatment (e.g. dexamethasone, ondansetron) (Carlisle & Stevenson 2006).

Postoperative analgesia
Inadequate analgesia, oral or IV opiates, delay mobilisation, decrease appetite and contribute to prolonged gastrointestinal recovery (Bisgaard & Kehlet 2002). Effective analgesia that allows for early mobilisation may be achieved through using a combination of techniques and agents, so-called ‘balanced analgesia’ (Kehlet et al 1999). In enhanced recovery the main principle of analgesia is opioid-sparing, thereby minimising the potential side effects of opioids (Kehlet & Holte 2001). In small operations the use of simple local anaesthetic infiltration should be encouraged (Möniche et al 1998). For larger procedures such as open intra-abdominal or pelvic surgery, then continuous mid-thoracic epidural low-dose anaesthetic and opioid combinations should be used in combination with baseline paracetamol (4g/day) with breakthrough pain being managed via epidural boluses and NSAIDs (Fearon et al 2005, Varadhan et al 2010a).

Urinary catheters
Urinary catheters can represent an impediment to early mobilisation. They are recommended whilst epidural analgesia is in progress, but they do not have to stay for the full duration and removal may be considered if the epidural is stopped (Fearon et al 2005).

Prevention of ileus
Factors that contribute to postoperative ileus include intraoperative bowel handling, opioids and fluid overload. Where possible measures should be taken to minimise the impact of these, including regional analgesic techniques, avoidance of fluid overload, and a laparoscopic/minimally invasive approach (Fearon et al 2005). Oral magnesium oxide has been shown to promote postoperative bowel function and may also be considered (Basse et al 2001).

Nasogastric tubes and surgical drains
Nasogastric (NG) tubes should not be used routinely (Cheatham et al 1995). It may be necessary to insert a naso/oro-gastric tube

Optimising perioperative patient care: ‘Enhanced recovery’ following colorectal surgery
Continued
To facilitate discharge from hospital it is important to have defined discharge criteria

intraoperatively to evacuate air from the stomach (for example in laparoscopic surgery). When they are used, they should be removed before the patient wakes up from anaesthesia to facilitate return of bowel function and mobilisation (Fearon et al 2005). Surgical drains also represent an impediment to early postoperative mobilisation. Routine use of drains does not reduce the incidence of anastomotic leak (de Jesus et al 2004) and is not recommended.

**Early oral nutrition**

Oral nutrition promotes the early return of gut function and reduces complications such as ileus (Bisgaard & Kehlet 2002, Varadhan et al 2010a). Oral food intake should be encouraged on the day of surgery along with oral nutritional supplements 2-3 times a day, until the normal level of food intake is achieved (Fearon et al 2005, Varadhan et al 2010a).

**Early mobilisation**

Prolonged bed rest decreases muscle strength, promotes pulmonary dysfunction, impairs tissue oxygenation and increases insulin resistance (Kehlet & Wilmore 2002). Measures should be taken to facilitate mobilisation and patients should be nursed in an environment that encourages independence. Patients should expect to mobilise for two hours on the day of surgery (e.g. sitting up in bed/chair) and six hours a day thereafter (e.g. walking)( Fearon et al 2005, Varadhan et al 2010a).

**Discharge from hospital**

To facilitate discharge from hospital it is important to have defined discharge criteria. Discharge planning should begin at the pre-admission stage, allowing any potential problems that might delay discharge (e.g. transport, social care) to be identified and addressed (Fearon et al 2005). An example of suitable clinical discharge criteria may be: pain controlled with oral analgesia, tolerating oral diet, independently mobile/mobilising pre-admission levels, willing to go home.

**Follow-up and audit**

Surgical units that use enhanced recovery programmes must be able to provide adequate follow-up and continuity of care to its patients. This includes keeping GPs and community care services informed of a patient’s participation in an enhanced recovery programme and alerting them to their increased needs in the community (Fearon et al 2005). Patients should be made aware of how to access advice and services following discharge and there should be a clear pathway established for their prompt and safe readmission if required.

Audit is a cornerstone of good clinical practice and should be performed on defined outcomes following implementation of an enhanced recovery programme. This will ensure standards of care and identify areas for improvement (Varadhan et al 2010a).

**Does enhanced recovery work?**

Early evidence to support the multimodal approach took the form of small-scale non-randomised single-centre case series. However over the last ten years there have been an increasing number of randomised controlled trials (RCTs) published, principally in the field of colorectal surgery. One such trial (Anderson et al 2003) compared 25 patients undergoing elective right or left hemicolectomy (open); subjects were randomised to receive either conventional care or a fast-track programme. Patients in the fast-track programme had significantly lower pain and fatigue scores, mobilised earlier and were tolerating a full oral diet sooner than those who received conventional care (Anderson et al 2003). In addition the fast-track patients had a decreased length of stay (3 vs. 7 days; P=0.002). Whilst Anderson et al’s (2003) study was small, a larger RCT in 2005 showed similar results (Gatt et al 2005). A recent meta-analysis of RCTs (Varadhan et al 2010b) reported that subjects undergoing major colorectal surgery and managed with a perioperative enhanced recovery programme had a hospital stay of 2.5 days less than those managed using conventional care. In addition they had fewer postoperative complications and reduced readmission or mortality rates. This suggests that enhanced recovery programmes can be beneficial to patient care.

However, it is not just colorectal surgery where enhanced recovery programmes have shown favourable outcomes like reduced complications and length of stay. There is growing evidence from other surgical specialties including orthopaedics (Husted & Holm 2007), urology (Arumainayagam et al 2008) and vascular surgery (Muehling et al 2009), although currently this is limited and further prospective work is required.

**Enhanced recovery after surgery - The Guildford experience**

As explored above, the concept of enhanced recovery following colorectal surgery originated at the end of the 1990s and has been since modified by various steering groups (Fearon et al 2005, Lassen et al 2009). The various elements of the Enhanced Recovery After Surgery (ERAS) pathway were originally designed for use in open colorectal surgery, where they have been shown to reduce the potential length of post-operative stay (Varadhan et al 2010b). Laparoscopic colorectal surgery has also been shown to reduce the length of post-operative stay in comparison to open colorectal surgery (Abraham et al 2004).

The application of the ERAS pathway to laparoscopic colorectal surgery has the potential to produce a further reduction in length of stay (King et al 2006, Faiz et al 2009, Al Chalabi et al 2010). However it is important to consider whether the main elements of the programme can be directly translated from open to laparoscopic colorectal surgery.

In our unit we have focused our research on looking at two main areas of ERAS when applied to laparoscopic colorectal surgery. These are: the type of postoperative analgesia, and the administration of intraoperative fluids. If the correct postoperative analgesia is applied, along with carefully guided intraoperative fluid administration, patients can achieve rapid...
mobility and recovery after surgery leading towards an early discharge.

An integral part of ERAS in open colorectal surgery is the insertion of a thoracic epidural starting before surgery and running for 48 hours following the operation.

Through research (RCT due to be published this year) we have conducted at the Minimal Access Therapy Training Unit (MATTU) in Guildford we have shown that patients undergoing laparoscopic colorectal resection can have a significantly reduced length of stay if a spinal or PCA (patient controlled analgesia) is used in place of an epidural. The epidural group had a median length of stay of 3.7 days compared to 2.7 days in the spinal group and 2.8 days in the PCA group.

The other key element in laparoscopic colorectal surgery is goal-directed intraoperative fluid administration. As previously mentioned the oesophageal Doppler monitor (ODM) has been validated as a method to guide the administration of fluids during surgery (Gan et al 2002, Wakeling et al 2005) and can lead to a reduction in post-operative complications and admissions to critical care. Prior to research undertaken at the MATTU patients received a mean of 1700ml of colloid during surgery in our unit. Fluid administration in this group was guided by haemodynamic monitoring. With the use of ODM the mean amount of colloid administered was reduced to 1000ml to maintain fluid balance.

Following our research the standard of care for patients undergoing laparoscopic colorectal surgery within our unit is to receive either a spinal or PCA for postoperative analgesia and to use ODM for goal-directed fluid administration. With the use of laparoscopic colorectal resection, goal-directed fluid administration and spinal analgesia it is possible to discharge patients only 23 hours after surgery in selected patient groups (Levy et al 2009).

We are currently undertaking research to clarify how the stress response to surgery is affected by spinal or PCA and to elucidate which is the most appropriate method of analgesia. We are also examining the effect that this may have on long term patient survival following colorectal surgery and whether the choice of crystalloidal or colloidal influences ODM in assisting with fluid balance.

Conclusion

The evidence shows that, when successfully implemented, enhanced recovery programmes produce improvements in patient care and outcomes. Shorter lengths of stay and fewer complications, without an increase in readmission rates, are beneficial to both the patients having surgery and the NHS as a whole, thanks to the financial savings and increased availability of services for other users.

Local research has indicated that ERPs, which were originally developed for use following open colorectal surgery, may also be utilised following laparoscopic colorectal surgery. In addition we are now in the process of implementing ERPs for both our orthopaedic and gynaecological patients. As awareness of enhanced recovery increases, driven by initiatives such as the Enhanced Recovery Partnership Programme, more NHS trusts will be implementing enhanced recovery programmes across a range of specialties. This will present those of us who work in perioperative care with new challenges in the very near future.

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