Enhanced Recovery: Pathways to better care

True of False:

1 An enhanced recovery pathway:
   • is procedure-specific
   • involves pre-admission elements of care
   • modulates the surgical stress response
   • reduces postoperative morbidity but has no effect on hospital length of stay
   • has a strong evidence base for all components of the pathway

2 The surgical stress response causes:
   • decreased myocardial oxygen consumption
   • decreased splanchnic and renal blood flow
   • decreased insulin resistance
   • decreased inflammation
   • sodium and water loss

3 Anaesthetic management of patients as part of an Enhanced Recovery protocol can include:
   • regional anaesthesia techniques
   • multimodal anti-emetic prophylaxis
   • long-acting sedative premedication
   • depth of anaesthesia monitoring
   • goal-directed fluid therapy

4 The following factors reduce perioperative insulin resistance:
   • prolonged preoperative fasting
   • preoperative carbohydrate loading
   • opiate analgesia
   • early postoperative enteral nutrition
   • early postoperative mobilisation

5 The following factors reduce the incidence of postoperative ileus:
   • opiate-sparing analgesia
   • early postoperative mobilisation
- routine postoperative use of nasogastric tubes
- delayed postoperative enteral feeding
- thoracic epidural analgesia

6 Recommended postoperative analgesic techniques include:

- multimodal analgesia
- thoracic epidural analgesia
- morphine PCA
- oral morphine
- intravenous lignocaine infusion

Key points:

- Enhanced recovery after surgery (ERAS) pathways incorporate multimodal packages of perioperative interventions that reduce postoperative complications and hospital length of stay.
- A reduction in the surgical stress response and maintenance of postoperative physiological function underlies the benefits of ERAS.
- ERAS pathways begins pre-admission with risk stratification and optimisation of patients.
- Anaesthetic factors, including monitoring anaesthetic depth and neuromuscular blockade, play an important role.
- Multimodal, opiate-sparing analgesia is a cornerstone of ERAS and facilitates other ERAS goals, such as early enteral nutrition and early mobilisation.
- The effect of anaesthesia and analgesia on cancer outcomes is becoming more relevant, leading to the concept of Enhanced Survival.

Introduction

Enhanced recovery has become a familiar term in recent years in the landscape of anaesthesia and perioperative medicine. The concept of “fast-track surgery” was first described by Henrik Kehlet in Denmark in the 1990s. Looking at the use of multimodal
packages in patients undergoing open colorectal surgery, he was able to demonstrate reductions in postoperative length of stay (LOS) and morbidity. From this, the concept of enhanced recovery after surgery (ERAS) was born.

ERAS comprises clinical pathways that are proposed to improve the quality of perioperative care, attenuate the loss of functional capacity and accelerate the recovery process for patients. Each pathway is procedure specific. Pathways were first introduced for patients undergoing colorectal surgery, but now pathways are available in many different specialities. The pathway involves multidisciplinary care at every stage, including anaesthetists, surgeons, GPs, nurses and allied health professionals. Each pathway includes several evidence-based components. There is a larger evidence base for some components, but it has been demonstrated that strict adherence to the entire pathway produces better aggregate outcomes than implementing individual components.

An important initial driving force behind the implementation of ERAS pathways were the benefits for hospital management. Reduced postoperative complications and shorter LOS lead to reduced costs and greater throughput of patients. Current challenges in healthcare – increasing patient autonomy, an aging patient population with multiple comorbidities, huge pressure on waiting lists and increasing transparency of hospital outcomes – create an even more favourable environment for implementation of ERAS pathways.

Advantages for patients are many – decreased incidence of perioperative complications leads to reduced LOS, faster return to normal function and greater patient satisfaction. For patients undergoing cancer surgery, there is the potential for earlier commencement of adjuvant therapies, such as chemo- and radiotherapy. There is some evidence that ERAS pathways may have also have an impact on long-term survival. The American National Surgical Quality Improvement Program (NSQIP) looked retrospectively at 105,000 patients and found that a complication within thirty days of surgery reduced median patient survival by 69%. This occurred independently of preoperative risk and was more important than either preoperative risk or intraoperative factors in determining survival.

The underlying principles for ERAS are reduction of the surgical stress response and maintenance of normal postoperative physiological functions. The surgical stress response causes activation of the sympathetic nervous system, release of pituitary hormones including ACTH, ADH, cortisol and GH. These result in metabolic changes including increased insulin resistance and protein and fat catabolism. There is also increased release of cytokines and other inflammatory mediators, resulting in a massive inflammatory response. These changes have myriad effects including increased
myocardial oxygen demand, splanchnic and renal vasoconstriction, sodium and water retention, hypercoagulability, loss of lean body mass and muscle strength, immunosuppression and impaired wound healing.\(^5\)

ERAS pathways have been widely used in the UK since the early 2000s. The various components can be divided into preoperative, intraoperative and postoperative interventions. The majority of the evidence comes from colorectal surgery, although there is an increasing evidence base in many other specialties. Many of the factors are relevant to all types of surgery.

**Preoperative Factors**

Preoperative care begins prior to admission to hospital. Pre-admission assessment and risk stratification is the combined responsibility of the GP, anaesthetist and surgeon. Up to 80% of postoperative mortality comes from a relatively small high-risk group of patients\(^6\); therefore risk stratification to identify those who are high risk for any major complication is important. Several validated risk stratification tools are available\(^7\). Recognition of high-risk patients allows the opportunity for optimisation of comorbidities, assistance with cessation of smoking and reducing alcohol intake. Smoking cessation has been shown to reduce postoperative morbidity, particularly wound complications.\(^8\)

Preoperative anaemia is an independent predictor of mortality and postoperative complications.\(^9\) Efforts should be made to correct haemoglobin levels preoperatively as a perioperative drop in haemoglobin is common secondary to blood loss and dilution with intravenous fluids. Perioperative blood transfusion results in a rapid rise in haemoglobin but is associated with a well-documented increase in morbidity and mortality. There is a lack of evidence, however, showing that normalising preoperative haemoglobin level reduces perioperative morbidity and mortality.

Anxiety is a common predictor for postoperative pain and correlates positively with pain intensity.\(^10\) Preoperative education and counselling has been shown to increase patient motivation and alleviate anxiety.

Following admission, preoperative components of an ERAS pathway include adherence to preoperative fasting guidelines and carbohydrate loading. Fasting guidelines recommend allowing clear fluids up to two hours and solid food up to six hours before induction of anaesthesia.\(^11\) There is no evidence to support prolonged fasting to ensure the safety of an empty stomach. On the contrary, prolonged fasting has been shown to increase patient discomfort, increase insulin resistance and decrease intravascular volume potentially resulting in a preoperative fluid deficit. Administration of oral
complex carbohydrates preoperatively, in the form of carbohydrate drinks taken the night before and 2-3 hours pre-induction of anaesthesia, reduces the catabolic state induced by prolonged fasting and the surgical stress response. There is an associated reduction in insulin resistance postoperatively and decreased protein catabolism.\textsuperscript{12,13}

As mentioned above, anxiety is a predictor of increased postoperative pain. For those patients requiring anxiolysis, short-acting anxiolytics are recommended.\textsuperscript{7} Long-acting anxiolytics should be avoided as they delay recovery, preventing early mobilisation and active participation, resulting in increased LOS. Short-acting benzodiazepines should also be avoided in elderly patients.

\textbf{Intraoperative Anaesthetic Factors}

ERAS pathways encompass several anaesthetic factors which may influence patient outcomes. These include anaesthetic depth, neuromuscular blockade, inspired oxygen concentration, postoperative nausea and vomiting (PONV) prevention, temperature control, glycaemic control and intraoperative haemodynamic management.

The ideal anaesthetic depth should prevent awareness but also minimise anaesthetic side effects and facilitate rapid awakening and recovery, thereby reducing the stress response. Anaesthetic depth should be monitored and targeted to a MAC of 0.7-1.3 or a BIS of 40-60.\textsuperscript{14,15} Very deep anaesthesia (BIS < 45) should be avoided as there is a potential association with increased long-term mortality.\textsuperscript{16}

Depth of neuromuscular blockade during abdominal surgery remains controversial. Deep neuromuscular blockade may improve surgical conditions leading to a shorter surgical time, hence reducing surgical stress.\textsuperscript{17} However, residual neuromuscular blockade at the end of surgery and the associated respiratory complications has a detrimental effect on patient recovery. Depth of neuromuscular blockade should be monitored to ensure adequate depth during operating time and optimal recovery of neuromuscular function at the end of surgery.\textsuperscript{7} Ensure spontaneous recovery of a TOF ratio of 0.9 is achieved to prevent residual blockade and associated complications.

Oxygen is used ubiquitously in anaesthesia. It has been suggested that use of high inspired oxygen concentration (FiO2) may decrease surgical site infection (SSI). The evidence supporting this is conflicting, however.\textsuperscript{18,19} Conversely, high oxygen concentrations have been associated with harmful outcomes, including increased long-term mortality in cancer patients\textsuperscript{20} and poorer neurological outcomes in post-cardiac arrest patients.\textsuperscript{21} It is therefore recommended to titrate FiO2 to normal arterial oxygen saturations and to avoid prolonged periods of high FiO2 which may result in hyperoxia.
Short-term use of high FiO2 to pre-oxygenate or to overcome desaturation can be used safely. In an ERAS protocol, all patients should be risk stratified for PONV and an aggressive PONV prevention and treatment protocol should be used. There is a large evidence base to support use of multimodal PONV prevention in high-risk patients.

Intraoperative hypothermia (a core temperature < 36°C) causes increased rates of wound infections, bleeding and transfusion requirements, cardiac complications, prolonged PACU stay and reduced overall survival. Active warming techniques should be used for any procedure of greater than thirty minutes duration.

Blood glucose concentrations increase perioperatively secondary to increased insulin resistance associated with the surgical stress response. Hyperglycaemia is associated with adverse outcomes. There is, however, insufficient evidence to show that strict glycaemic control positively affects outcomes. It remains a balance between the benefits of treating hyperglycaemia and the risks of hypoglycaemia. There is wide variation in treatment guidelines for glucose management perioperatively. Generally, it is recommended to treat blood glucose concentrations greater than 10mmol/l, without causing hypoglycaemia. Adherence to other components of an ERAS pathway will reduce insulin resistance and perioperative hyperglycaemia. These include avoidance of prolonged fasting, carbohydrate loading, opiate-sparing analgesia, early enteral nutrition and early mobilisation.

The avoidance of prolonged fasting and use of carbohydrate loading substantially reduces preoperative fluid deficit and intraoperative fluid requirements. There can still be a large variation in hydration status though, particularly in emergency surgery. Use of goal-directed fluid therapy (GDFT) to guide intraoperative fluid administration has been the subject of much research in recent years. Multiple meta-analyses demonstrate a reduction in postoperative morbidity and mortality with use of perioperative GDFT. The benefits of GDFT seem to be more relevant in high-risk patients, however, with two recent trials showing no difference in outcomes in low-risk patients.

**Intraoperative Surgical Factors**

Minimally invasive surgical techniques are recommended where the surgical expertise is available. The short-term benefits of laparoscopic versus open colorectal surgery have been well demonstrated, although there does not appear to be any long-term difference in outcomes in cancer patients. Within the context of an ERAS protocol, use of laparoscopic surgery did show improvement in other outcomes however, including
LOS and postoperative morbidity. A systematic review looking at transverse versus midline incisions for laparotomy showed a decrease in postoperative requirement for opiate analgesia but no difference in postoperative outcomes between groups. There is insufficient evidence to support other minimally invasive surgical techniques.

There is a large evidence base showing that routine nasogastric decompression after gastrointestinal surgery should be avoided. It delays return of bowel function and is associated with increased incidence of pulmonary complications and fever. There is an increased incidence of vomiting in patients without nasogastric tubes, but the benefits still outweigh the risks. Recognition of prolonged ileus which may lead to vomiting and aspiration is important, however. These patients may benefit from selective insertion of a nasogastric tube.

**Postoperative Factors**

The aim of postoperative analgesia is to achieve patient comfort and to facilitate other ERAS goals such as early mobilisation and early enteral feeding. To achieve this, postoperative analgesia should be multimodal and opiate-sparing. Opiate side effects are associated with prolonged ileus, delayed enteral feeding, reduced participation in mobilisation and prolonged recovery. Looking at colorectal ERAS pathways, thoracic epidural analgesia is the gold standard for postoperative analgesia. Despite clear evidence that TEA provides better analgesia, there is not yet definitive evidence that it results in better postoperative outcomes. The largest single RCT did not show any difference in postoperative mortality or overall morbidity, but did show a reduction in respiratory complications. More recently, a meta-analysis of RCTs comparing epidural analgesia with systemic analgesia in all types of surgery found a 40% reduction in mortality and a significant reduction in postoperative morbidity. Commencement of epidural analgesia at the start of surgery reduces the need for systemic opioids, anaesthetic depth and neuromuscular blockade intraoperatively. The same outcome benefit has not been shown for laparoscopic surgery. It may be useful, however, in cases with a high risk of respiratory complications or a high risk of conversion to open surgery. Other opiate-sparing analgesic techniques include intrathecal analgesia, continuous wound infusions, TAP/rectus sheath blocks and intravenous lignocaine infusions.

Delirium can occur in the postoperative period, particularly in elderly patients with pre-existing risk factors, and is under-recognised. Untreated delirium increases morbidity and mortality. Avoidance of delirium-inducing factors such as use of sedatives, deep anaesthesia and prolonged fasting can reduce the incidence of postoperative delirium. Postoperative routine screening increases detection of delirium. Various
validated screening tools are available. Early detection of delirium allows prompt
treatment which is associated with a reduction in mortality.46

Postoperative ileus following gastrointestinal surgery is associated with delayed
recovery, increased LOS and higher risk of complications. A multimodal strategy to
minimise postoperative ileus should be utilised as part of ERAS protocols and includes
opiate-sparing analgesia, early mobilisation, early enteral feeding and avoidance of
routine nasogastric tubes.

Early postoperative mobilisation helps to maintain muscle strength and reduces
complications of prolonged immobility, while also promoting patient involvement in their
recovery. Early mobilisation is an integral component of any ERAS protocol.7,48 There is
little guidance on the best way to mobilise patients but it requires a multidisciplinary
team and should actively encourage the patient to participate.

The Future of Enhanced Recovery

The widespread introduction of ERAS protocols has changed the multidisciplinary
approach to patients undergoing major surgery and has been shown to decrease
postoperative LOS and morbidity.49 Ongoing research is rapidly increasing the evidence
base for ERAS protocols in different types of surgery and for both short- and long-term
complications. There is also a lot of current interest in how anaesthesia and analgesia
may affect not only surgical outcomes, but also long-term cancer outcomes50,51 through
immunomodulation of the stress response. As further evidence becomes available, the
focus may soon move from Enhanced Recovery to Enhanced Survival.

Answers to MCQs:

1  FFTF
2  FTFF
3  FFFT
4  FTFF
5  FTFF
References


