

## Enhanced recovery after surgery - current trends in perioperative care

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### Summary

Enhanced recovery after surgery involves implementation of change to many components of surgical care pathways. The proven benefits are reduction in morbidity and mortality as well as reduced hospital stay. The evidence behind these strategies is discussed in this article.

### INTRODUCTION

The concept of enhanced recovery after surgery (ERAS) or fast track surgery (FTS) was introduced over a decade ago and results in shorter hospital stay following operative procedures in a number of surgical specialties. These benefits have been documented for ambulatory procedures such as laparoscopic cholecystectomy and mastectomy, and also for major procedures such as abdominal aortic aneurysm repair.

This approach involves implementation of evidence-based pathways of care, incorporating slight modifications in many different aspects of clinical care. The combined effect of these multimodal strategies is to markedly decrease postoperative morbidity (such as hospital acquired infections and venous thromboembolism), length of hospital stay and time to resumption of normal activities of daily living. Some of these changes in perioperative practice are notable departures from traditional methods. Many of these techniques can be adapted to optimise perioperative care in a wide variety of healthcare settings.

### ENHANCED RECOVERY AFTER SURGERY - BACKGROUND

The Enhanced Recovery programme is a multi-disciplinary, evidence-based approach to perioperative care that was originally pioneered in Denmark by Professor Henrik Kehlet, a gastrointestinal surgeon from Copenhagen.<sup>1</sup>

It was originally utilised in colorectal surgery but has expanded to include gynaecological, urological and orthopaedic surgery. It aims to ensure patients are optimally prepared for their surgery, both physiologically and psychologically, and to provide perioperative care that reduces the stress of surgery and improves and accelerates recovery. It uses a series of individual interventions that are more effective when implemented together than alone – ‘the sum is greater than the parts’.

The perceived benefits are multiple. Patients are more empowered and should be fitter sooner after their operations, improving their level of satisfaction by

reducing their length of hospital stay and allowing them to resume normal activity and get back to work sooner. The cost of ongoing care and interventions may be reduced and for the providing hospital, the reduced lengths of stay may increase capacity and reduce waiting times.<sup>2,3</sup> This article summarises the strategies that are directly relevant to anaesthetic practice.

### PREOPERATIVE PREPARATION

The pre-operative preparation process is detailed and many organisational changes are required to facilitate enhanced recovery. Many hospitals have developed preoperative assessment clinics, which form a starting point for the development of an enhanced recovery service. Preparation for surgery should be conducted by staff trained specifically in this area of practice. The overall philosophy is to present the patient at their fittest to give them the best chance of dealing with the stress of surgery.

### Patient expectations and consent

Patient satisfaction is linked to their expectations. Enhanced recovery pathways aim to ensure that treatment options are actively discussed and the likely course of events for recovery is clear in the patient's mind. A ‘contract of care’ is agreed that empowers patients, increasing their involvement and control in their subsequent care and rehabilitation. Patient diaries that describe, for example, when oral intake is likely to start and what level of mobility is expected at what stage, are integral to this process. Discharge and rehabilitation planning should occur early so that social issues do not slow discharge when the patient is medically fit.<sup>3</sup>

### Medical assessment and optimisation - ‘Prehabilitation’

Physiological preparation for surgery is important; for patients undergoing abdominal surgery improved quality of life, reduction in postoperative pain, complication rates and overall mortality have all been reported.<sup>4</sup> When surgery becomes likely, a patient's general practitioner may be in an ideal position to optimise conditions such as diabetes, anaemia and hypertension. This reduces the chance that surgery

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will be cancelled at a late stage and gives additional time for these conditions to be improved (for example, iron supplementation for anaemia and changes to diabetic regimes). Evidence shows that treating even minor degrees of anaemia can reduce the risk of blood transfusion that in turn reduces morbidity, mortality and cost.<sup>5</sup>

### Alcohol and smoking

Alcohol abusers can reduce their increased risks of bleeding, wound and cardiopulmonary complications by abstaining preoperatively. Abstaining for a period of one month improves organ function sufficiently to reduce postoperative morbidity.<sup>6</sup> Smoking cessation for a month preoperatively can reduce the increased risk of wound and respiratory complications.<sup>7</sup>

### Preoperative assessment

A good preoperative assessment service ensures that necessary preoperative investigations are performed in plenty of time, helps reduce patient anxiety, allows time for planning and alerts teams to potential problems. Ideally all patients should be admitted on the day of surgery.<sup>8</sup>

### Nutrition

Patients who are well nourished have appropriate stores to cope with the peri- and postoperative catabolic state that is triggered by major surgery (the 'stress response'). Malnourished patients, a high proportion of whom have cancer, have smaller nutritional stores and have been shown to benefit from preoperative enteral supplementation. Preoperative nutritional supplementation is associated with a reduction in infectious complications and anastomotic leaks.<sup>9</sup> In severely malnourished patients (weight loss of more than 15%), enteral supplementation for 10 to 14 days preoperatively is suggested. These patients may also have vitamin and mineral deficiencies and these must be replaced.

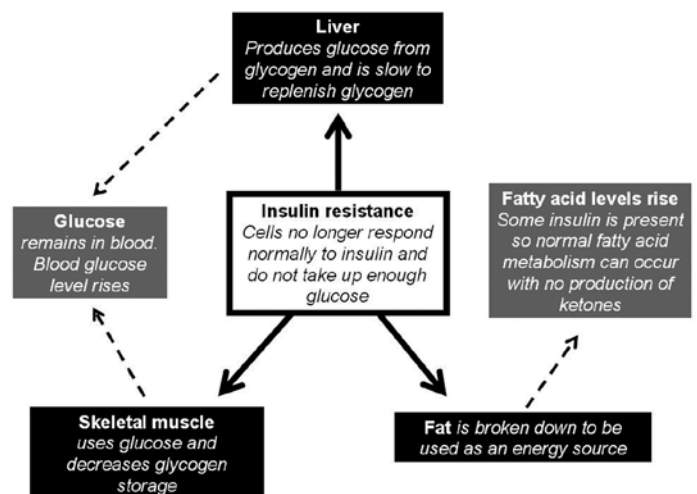
### Preoperative starvation

Preoperative guidelines generally state that patients should be nil by mouth for food for six hours prior to induction and two hours for clear fluids. However we know that patients are starved for far longer than this, leading to dehydration and increased perioperative fluid requirements.<sup>10</sup> This period of starvation should be kept as close to that recommended as possible, encouraging patients to eat and drink normally as late as possible, particularly encouraging consumption of clear fluids (water, squash or black tea and coffee) for up to two hours prior to surgery.

Use of preoperative iso-osmolar carbohydrate drinks up to two hours preoperatively, reduces anxiety, prevents dehydration, minimizes the stress response to surgery, reduces insulin resistance and obtunds the development of a catabolic state. By giving a carbohydrate 'load', the patient is in the 'fed' state at the beginning of surgery. This leads to reduced postoperative resistance to insulin (Figure 1), earlier return of bowel function and shortened hospital length of stay. There is no change in gastric emptying time with the ingestion of up to 400ml of a carbohydrate solution up to 2 hours before surgery and so there is unlikely to be any increased risk of aspiration.<sup>11</sup>

### Bowel preparation

Traditional 'bowel preparation' uses enemas to clean the bowel of



**Figure 1.** The consequences of insulin resistance

solid stool prior to surgery. When introduced in the 1960's there was a dramatic decrease in morbidity in colorectal surgery – the bowel was easier to handle and there was less contamination of the peritoneal cavity. The disadvantages are patient discomfort, dehydration and electrolyte disturbances. With the improvement in surgical techniques (such as transanal stapling devices) and use of perioperative antibiotics, routine bowel preparation is now being questioned. Avoiding bowel preparation can help patients to maintain a normal diet within the permitted time scales and can help reduce dehydration.<sup>12</sup>

### Premedication

Sedative premedication use is falling, although some patients will benefit from anxiety reduction. In general patients should continue normal medications such as cardiac medications and proton pump inhibitors. Exceptions include anticoagulants and some antiplatelet drugs. For these patients a plan should be made that balances the risks of continuing therapy against the risks of stopping it. Staff should be guided by local and national guidelines, which may be tailored to suite the particular needs of each patient (see page 5).

Other drugs may be considered and these may contribute to improving surgical outcome:

- *Clonidine* is an  $\alpha_2$ -agonist which has been associated with reduced postoperative opioid use, nausea and vomiting (PONV) and reduced intraoperative blood loss. Clonidine's inhibitory effects on the stress response facilitate glycaemic control in type-2 diabetic patients and reduce myocardial ischaemia after surgery.
- $\beta$ -blockers (e.g. metoprolol, atenolol) also have effects on the stress response to surgery, have analgesic and anaesthetic sparing qualities and are anti-catabolic.

### Nursing care

This aspect of ERAS is hugely important as the program relies on nursing staff to implement and support daily milestones, mobilization and discharge. This may be best implemented in the form of structured care pathways. The role may be expanded to involve preoperative assessment and post-discharge contact in the community.

## INTRAOPERATIVE MANAGEMENT

### Operative techniques

#### *Incision*

The current incision choice is based on surgical preference – transverse or vertical. It is usually based on suitable access, duration, and postoperative complications including wound dehiscence, infection and incisional hernia. However, transverse incisions are known to be less painful and provide a better cosmetic result, as well as speeding recovery.<sup>2</sup>

#### *Laparoscopic surgery*

In the UK, the National Institute for Clinical Excellence (NICE) guidance has recommended laparoscopic approaches to surgery if a patient's condition is amenable to it and the surgical expertise is available. The guidance originally referred to colorectal resections but laparoscopic techniques are increasingly used in gynaecological and urological resections.<sup>13</sup> Laparoscopic surgery offers the advantages of reduced tissue trauma, less bowel handling and possibly a reduced stress response.

### Anaesthetic technique

Propofol is the induction agent of choice and, where available, the less soluble volatiles (sevoflurane and desflurane) may facilitate more rapid emergence from anaesthesia. Nitrous oxide has anaesthetic and analgesic-sparing qualities, however infusion of remifentanyl, an ultra short-acting opioid agent, is an increasingly popular technique, allowing lower levels of volatile agent to be used (e.g. 0.5 MAC).

A laryngeal mask airway is preferred when appropriate and if endotracheal intubation is necessary, short or medium acting muscle relaxants should be used. Reversal should be routine, in order to avoid prolonged muscle paralysis and development of postoperative respiratory complications.

### Analgesia

This is one of the most important anaesthetic factors and there is a good deal of evidence to suggest that acute pain is poorly managed in hospitals. Good pain management is essential for rapid recovery from surgery.<sup>14</sup> Postoperative analgesia focuses on multi-modal pain relief, aiming to minimise side effects of the different classes of drugs, particularly opioids.<sup>15</sup>

### Regional and neuraxial analgesia

Regional analgesia has long been thought of as a tool to speed recovery. When administered appropriately this form of pain relief is often better than systemic analgesia. Thoracic epidural analgesia is a good example and is routinely practised for open colorectal surgery in many centres. There are many proposed benefits including a reduction in venous thromboembolism, decreased respiratory complications and decreased duration of ileus, attributed to reduced systemic opioid intake and decreased sympathetic outflow to the bowel.<sup>16</sup>

Not all of the studies investigating the effects of the quality of postoperative analgesia, particularly neuraxial techniques, have shown clear benefits.<sup>17,18</sup> This may be due to the use of surrogate markers such as pain scores and opioid-sparing effects as end-points, that do not reflect clinically meaningful outcome measures such as

return to oral intake or mobility. In addition, clinically significant adverse outcomes, such as cardio-respiratory events are rare and multifactorial; it has been difficult to clarify the specific role of neuraxial analgesia in their prevention.<sup>19</sup> Neuraxial analgesia also has its specific problems that are well known and well documented. When epidurals work, they work well but they have a significant failure rate, commonly accepted to be in excess of 10% and possibly as high as 50%.<sup>20</sup> Epidurals also cause hypotension due to vasodilatation and care is needed to balance the motor and sensory components of the block to avoid problems with mobilisation.

Epidural related hypotension is common and causes concern for splanchnic as well as coronary, renal and cerebrovascular perfusion. In the UK, patients with thoracic epidural analgesia are often managed in a busy ward setting which may limit the treatment options for hypotension to fluid administration. This may result in large quantities of fluid being administered and this in turn may contribute to anastomotic oedema and a possible increase in anastomotic breakdown.<sup>21</sup> Many agree that the hypotension caused by vasodilatation with epidurals should be treated with vasopressors rather than intravenous fluids and there is some published literature to support this.<sup>22</sup>

### Rectus sheath local anaesthesia (see articles on pages 9 & 12)

There is increasing interest in alternative methods of regional analgesia which cause less motor and sympathetic blockade. Rectus sheath catheters are commonly used in our hospital for open colorectal, urological and gynaecological surgery. Rectus sheath local anaesthesia can provide effective analgesia for laparotomy wounds and the catheters may be placed perioperatively, either by the anaesthetist using a percutaneous ultrasound technique or by the surgeon under direct vision. The technique can give good analgesia with limited additional PCA opioid.<sup>23,24</sup>

### Analgesia for laparoscopic surgery

There is less data available to identify the optimal analgesic regimes for laparoscopic surgery but it is known that recovery is faster if adequate pain relief can be achieved with oral analgesics after the first postoperative day.

When compared to the use of PCA morphine, thoracic epidural analgesia reduces pain scores on the first and second postoperative days after colorectal surgery and speeds the resumption of a full diet. However, this has not been shown to translate into a shorter hospital stay and does not reduce the incidence of nausea, urinary retention, hypotension and later pain scores.<sup>25,26</sup> The PROSPECT website (Procedure Specific Postoperative Pain Management - [www.postoppain.org](http://www.postoppain.org)) recommends that this form of analgesia is not recommended for laparoscopic colorectal surgery due to the poor risk:benefit ratio.

Spinal anaesthesia, in conjunction with general anaesthesia, has been used successfully for short stay laparoscopic colorectal surgery and whilst active fluid and monitoring strategies are needed to cope with the haemodynamic changes of a pneumoperitoneum and the Trendelenburg position, the technique is well tolerated.<sup>27</sup> In this study, the spinal anaesthesia group required less vasopressor and had a

reduced hospital stay compared to a group having epidural anaesthesia. Morphine consumption was significantly reduced, compared to a group managed solely with morphine patient controlled analgesia (PCA). In addition, postoperative pulmonary function was better in the spinal group than in the other two groups.

Transversus abdominus plane (TAP) blocks,<sup>28</sup> either using landmark techniques or ultrasound, have also been shown to have a place in laparoscopic surgery, significantly reducing opioid consumption.

### **Analgesia for orthopaedic surgery**

Orthopaedic surgery presents some different clinical problems. Peripheral surgery does not cause ileus and neuraxial techniques do not need to cover higher dermatomes thus reducing the chance of a sympathetic block. The focus on rapid mobilisation has tended to favour techniques which reduce motor block.

The use of peripheral nerve blocks, with or without catheters for postoperative infusion, has grown in popularity in recent years and provides effective analgesia without the need for urinary catheters or exposure to the risk of central nerve injury. A series of procedure specific and evidence-based recommendations have been available for some years at the PROSPECT website<sup>29</sup> and these generally recommend multimodal analgesia and regional anaesthetic techniques. In addition administration of local anaesthesia closer to the surgical site is well established, the idea being that this is a simple method with reduced risks of side effects and complications than more proximal regional anaesthesia.

### **Local infiltration analgesia**

A technique of 'local infiltration analgesia' has been described for knee or hip arthroplasty. A study of 325 patients demonstrated satisfactory pain scores (0-3 out of 10) in all patients with two-thirds of the group requiring no morphine at all.<sup>30</sup> These patients were mobilised early, in some cases within 5-6 hours, and 71% of the group were discharged home on the first postoperative day. The same technique has subsequently been reported on more occasions with varying results and a more detailed description of the actual infiltration process has been described by a group from Denmark.<sup>31</sup>

The regimen consists of premedication with acetaminophen (paracetamol), celecoxib (a COX-2 specific NSAID) and gabapentin, spinal anaesthesia (bupivacaine only) and local anaesthetic infiltration performed in stages during the operation, with an intra-articular catheter placed for post-operative analgesia. Up to 340 mg of ropivacaine with epinephrine was injected. Care was taken over the actual methods of infiltration with pressure bandaging and cooling applied post-operatively. Pain scores were acceptable and higher after the knee compared to hip surgery. Importantly postoperative analgesia permitted patients to be mobilised immediately after spinal anaesthesia had resolved, urinary catheters were not needed and no patients suffered hypotension, urinary retention or motor blockade. Whilst the level of analgesia achieved was inferior to that seen with epidural or peripheral nerve blocks, it was sufficient for patients to be actively mobilised and discharged back to their homes with minimal side effects and, arguably, maximum simplicity. Patient expectation must be proactively managed for this technique to be successful.

A subsequent randomised control trial comparing this technique

with injection of saline showed a significant improvement in pain scores in the first 24 hours.<sup>32</sup>

### **Intraoperative fluid management**

Major surgery is usually associated with significant fluid requirements attributable to preoperative starvation, intraoperative blood loss, pharmacological vasodilatation from neuraxial and systemic drugs, intraoperative evaporative losses and the vasodilatation that may accompany a systemic inflammatory response to surgery.

In high risk surgical patients, therapy aiming to optimise cardiac output and oxygen delivery, is associated with improved outcome.<sup>33,34</sup> Fluid administration is an essential component of this '*goal directed therapy*' and fluid restriction risks organ hypo-perfusion and inadequate oxygen delivery to tissues with a variety of possible adverse consequences.<sup>35</sup> However, administration of excess fluid, particularly crystalloids, is thought to contribute to oedema, to slow gut recovery and lead to many other complications. A study in 2003 demonstrated a reduction in postoperative complications in major surgery patients in whom a restrictive fluid regimen was used. This compared favourably to the control group who received large volumes of 0.9% saline and therefore a large sodium load.<sup>36</sup> At a time when the stress response to surgery leads to sodium and water retention, it may simply be that **avoidance of fluid overload** is the important message.

Accurate fluid management and resuscitation requires regular reassessment of physiological parameters and, where available, invasive haemodynamic monitoring. Historically this has been provided by pulmonary artery catheters, but these are increasingly being replaced by targeted stroke volume optimisation with oesophageal Doppler probes. Given the relative simplicity and lack of complications, where available the latter is the recommended method of guiding fluid administration in the operating room.

Stroke volume optimisation has been described with the administration of colloid fluid challenges looking for a rise in stroke volume of 10%. Patients in whom this occurs are deemed to be on the rising part of their Starling curve and further boluses can be given until the stroke volume fails to rise after which fluid boluses are withheld until there is a fall in stroke volume. This approach may protect against relative hypovolaemia as well as fluid overload and has been shown to improve outcome.<sup>35,37-39</sup>

The NHS Technology Adoption Centre placed this technology into three NHS Trust hospitals and compared outcomes after major surgery with case-matched controls prior to implementation. There was a 67% reduction in mortality, a four-day reduction in length of stay, a 23% reduction in central venous catheter use, a 33% reduction in the readmission rate and a 25% reduction in re-operation rate. This evidence and the recommendations relating to perioperative management and enhanced recovery are presented online at the referenced websites.<sup>40</sup>

In addition, consensus guidelines with graded recommendations concerning perioperative fluid management can be viewed online.<sup>41</sup>

### **Temperature regulation**

Hypothermia is defined as a body core temperature below 36°C. Most

initial temperature loss occurs on induction of anaesthesia, however if surgery involves opening of visceral cavities, especially intra-abdominal, for longer than 2 hours, hypothermia occurs in 70%. Hypothermia causes sympathetic stimulation, vasoconstriction and shivering, leading to increased oxygen demand. Cardiac patients are particularly at risk with an increase in angina, myocardial ischaemia, and arrhythmias. Other complications include coagulation disorders, increased risk of infection, increased blood loss and longer hospital stay.

To combat heat loss, active convection warming blankets should be used – these have been shown to be superior to simple blankets or foil. Increasing the ambient temperature (of relevance to warmer countries) interestingly does not completely protect the patient from a drop in temperature. Also there should be routine use of fluid warmers for cases in which a significant amount of fluid is expected to be given.

### Glucose control

Impaired glucose homeostasis during surgery can result in hyperglycaemia, which is an independent risk factor for postoperative complications including death after cardiac surgery. Normoglycaemia should be maintained in diabetic patients and hyperglycaemia should be detected and treated in non-diabetics.

## POSTOPERATIVE MANAGEMENT

### Drains, nasogastric tubes and urinary catheters

Patients frequently emerge from surgery with various tubes attached to them or entering body cavities. Current thinking is that the use of surgical drains, urinary catheters and nasogastric tubes should be avoided if possible and appropriate. There will always be patients who will benefit from such tubes but perhaps their use should be specifically indicated rather than routinely adopted.

Some studies have shown no significant difference in the incidence of anastomotic complications, wound infections or re-interventions in colorectal surgery with or without abdominal drain placement.<sup>42</sup> In addition, avoidance or the early removal of urinary catheters facilitates mobilisation and reduces the risk of urinary tract infections.

Nasogastric tubes are often used routinely to decompress the stomach, reduce nausea, protect anastomoses and reduce pulmonary complications. However, in the absence of conditions such as bowel obstruction, it has been argued that their routine use can actually delay the return of bowel function and possibly increase nausea and hospital stay.<sup>43</sup> Patients are also encouraged to resume oral intake of diet and fluids as soon as is practicable, within the limits of their surgery - this may be on the day of surgery or on the first postoperative day. High energy drinks can help improve nutritional support in the early stages.<sup>43</sup>

## CONCLUSIONS

Enhanced recovery aims to provide better care with more patient involvement, improved patient satisfaction and a faster return to levels of pre-operative activity by reducing the stress of surgery physiologically and physically. This may in turn reduce the drain on resources in terms of bed days, length of stay and resultant hospital acquired complications.

Much of this involves a shift in thinking in terms of variation from traditional practice – the use of drains and urinary catheters, fluid management and types of analgesia techniques. There is an emphasis on getting the simple things right in an attempt to have a bigger effect on outcomes.

We may, therefore, see an increasing role for simpler analgesia techniques aimed at the site of surgery and the local tissue, avoiding the need for centrally or more proximally based techniques with increased side effects and risks.

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