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GUIDELINES FOR IMPLEMENTATION OF ENHANCED RECOVERY PROTOCOLS

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FOREWORD

Issues in Professional Practice is an occasional series of booklets published by the Association of Surgeons of Great Britain and Ireland to offer guidance on a wide range of areas which impact on the daily professional lives of surgeons. Some topics will focus on clinical issues, some will cover management and service delivery, whilst others will feature broader aspects of surgical working life such as education, leadership and the law.

Peri-operative surgical care is undergoing a paradigm shift. Traditional practices such as prolonged pre-operative fasting (“nil by mouth from midnight”), bowel cleansing and the use of nasogastric decompression are being shunned. These, and other similar changes, have been formulated into protocols called Enhanced Recovery after Surgery (ERAS) pathways, and this booklet offers Guidelines for Implementation of Enhanced Recovery Protocols.

The Association hopes that this publication, and the others in the series to follow, will provide concise advice and guidance on major current issues, and grow into a helpful and accessible resource to support your professional practice.

Suggestions for any potential topics for future booklets in the Issues in Professional Practice series would be gratefully received.

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SUMMARY OF RECOMMENDATIONS

Peri-operative surgical care is undergoing a paradigm shift. Traditional practices such as prolonged pre-operative fasting ("nil by mouth from midnight"), bowel cleansing and the use of nasogastric decompression are being shunned. These, and other similar changes, have been formulated into protocols called Enhanced Recovery after Surgery (ERAS) pathways. The Association of Surgeons of Great Britain and Ireland’s current recommendations on ERAS are summarised below and will be presented in more detail in this document:

Pre-operative recommendations

1) Pre-operative counselling and training.
2) A curtailed fast (6 hours to solids and 2 hours to clear liquids) and pre-operative carbohydrate loading.
3) Avoidance of mechanical bowel preparation.
5) A single dose of prophylactic antibiotics covering both aerobic and anaerobic pathogens.

Peri-operative recommendations

1) High (80%) inspired oxygen concentration in the peri-operative period.
2) Prevention of hypothermia.
3) Goal directed intra-operative fluid therapy.
4) Preferable use of short and transverse incisions for open surgery.
5) Avoidance of post-operative drains and nasogastric tubes.
6) Short duration of epidural analgesia and local blocks.

Post-operative recommendations

1) Avoidance of opiates and the use of Paracetamol and non steroidal anti-inflammatory drugs (NSAIDS).
2) Early commencement of post-operative diet.
3) Early and structured post-operative mobilisation.
4) Administration of restricted amounts of intravenous fluid.
5) Regular audit.
INTRODUCTION

Enhanced recovery after surgery (ERAS) protocols, also known as ‘fast-track surgery’ or ‘multimodal optimisation’, are a combination of evidence based peri-operative strategies which work synergistically to expedite recovery after surgery [1-2]. These strategies include, for example, a curtailed pre-operative fast, pre-operative carbohydrate loading, pre-emptive analgesia and early post-operative mobilisation together with expedited re-introduction of diet and fluids. Although each of these individual strategies is beneficial, to some extent, on its own, to achieve maximum benefit they have to be used together in the form of a package. Using ERAS protocols, post-operative stays following colorectal resection can be safely reduced to around two to four days. This expedited discharge is not achieved by lowering the prerequisites for release from hospital, but rather by fulfilling standard discharge criteria earlier due to an accelerated post-operative phase. The advantages of ERAS have been repeatedly borne out in a number of randomised clinical trials and meta-analyses. The underlying mechanism of ERAS protocols is thought to be an attenuation of the peri-operative stress response [3-5], although there is increasing evidence to suggest that benefits of ERAS are actually mediated by return of organ, particularly gut function [6].

The purpose of this document is threefold: To present the various components of enhanced recovery along with the rationale behind their inclusion; to suggest strategies to facilitate their implementation and compliance in day-to-day clinical practice, and; to propose directions for future research. Specific emphasis shall be given to ERAS in colorectal surgery as a reflection of the majority of research having been performed in this field. Many of the strategies are, however, transferrable to other branches of surgery. It is also noteworthy that different ERAS protocols have been trialled and validated in the literature. They have all been shown to produce similar results, suggesting that protocols can be tailored to take into account local requirements and available resources. Nonetheless, it must be emphasised that the principles of ERAS presented in this document are guidelines only and may not be applicable, particularly in the care of patients undergoing complex procedures.
COMPONENTS OF ERAS PROTOCOLS AND CURRENT RECOMMENDATIONS

Components of ERAS protocols can be broadly categorised into pre-operative, peri-operative and post-operative interventions. These shall be considered in turn, together with a brief review of the evidence and current recommendations.

Pre-operative components

1) Pre-operative counselling and training:

**Recommendation:** All patients undergoing elective surgery should be counselled. Patients should be provided with both verbal as well as written information.

All patients undergoing elective surgery should be counselled adequately. This process involves not only members of the surgical team who will be directly involved with the proposed procedure, but should also include other health professionals, such as physiotherapists, dieticians, stoma and nutrition nurses, who will also be involved in the peri-operative care of the patient. Some units have a dedicated ERAS nurse. Counselling necessitates close collaboration between all members of the surgical team and the provision of both written and verbal information. Provision of this information to patients may occur in the out-patient clinic, the pre-assessment clinic or the patient’s home. Patient information leaflets on ERAS should be produced to facilitate patient education. Information discussed should include:

i.) What enhanced recovery involves, its core components and envisaged benefits.

ii.) What the patient should expect during the course of the hospital stay. This should include specifics of how ERAS is implemented locally and which modalities are employed.

iii.) Specific issues which may delay discharge (such as lack of social support).

iv.) Clear and specific instructions should be given about mobilisation, early introduction of diet and breathing exercises. Active participation of the patients themselves in their recovery should be sought, and daily targets for the patient to achieve should be set up.

v.) Patients who may require a stoma should be identified and appropriately trained such that they are proficient at stoma care, ideally prior to surgery [7].

Pre-operative information and education has been shown to improve patient satisfaction [8, 9], allay anxiety [10] and improve pain [11] and other outcomes [12].
2) Curtailed fasting and preoperative carbohydrate loading

**Recommendation:** Patients should be fasted for 6 hours to solids but they should be allowed small amounts of clear free fluids for up to 2 hours before induction of general anaesthesia. In addition, a clear carbohydrate rich drink (e.g. Polycal Liquid® [Nutricia Clinical Ltd, Trowbridge, Wiltshire, UK], Preload® [Vitaflo International Ltd. Liverpool, UK], Maxijul® [SHS- Nutrition, Liverpool, UK]) should be administered orally the night before surgery and 3 hours prior to induction of anaesthesia.

Fasting for a minimum of 8 hours before a general anaesthetic has been normal surgical practice for many years. It aims to reduce the volume and acidity of stomach contents, thereby reducing the risk of regurgitation or aspiration. Recent studies, however, have demonstrated that a short (3 hour) period of fasting after ingestion of clear fluids is safe and more acceptable to patients. This minimises patient thirst and improves post-operative well being. A short fast in combination with pre-operative carbohydrate loading has been shown to maintain nitrogen balance and reduce post-operative insulin resistance [13-15]. Carbohydrate loading involves the administration of appropriate carbohydrate drinks, such as Polycal Liquid® (200 ml), the night before surgery and 3 hours prior to surgery. Each carton of Polycal Liquid® liquid provides 494 Kcal, equivalent to approximately 120 grams of carbohydrates. Any commercially available preparation may be used. However, care should be taken that the formulation used is clear and residue free.

**Special circumstances:**
Non-insulin dependent diabetics: Pre-operative carbohydrate loading has been shown to be safe in non-insulin dependent diabetic patients, and their use is also recommended in this subgroup of patients. In diabetic patients, a pre-operative carbohydrate load has not been shown to result in adverse effects such as hyper-glycaemia or delayed gastric emptying. However, monitoring of blood glucose levels should be carried out at regular intervals [16].

3) Avoidance of mechanical bowel preparation:

**Recommendation:** Oral mechanical bowel preparation should not be used routinely in patients undergoing colonic resection. If clearance of the rectum is required for a left sided anastomosis, a single phosphate enema on the morning of the surgery may be used to evacuate the rectum.

Oral mechanical bowel clearing has traditionally been thought to reduce the severity of sepsis in the event of an anastomotic leak. However, a number of meta-analyses have suggested that, in patients undergoing colorectal procedures, the avoidance of mechanical bowel preparation is safe and does not result in increased sepsis in the event of an anastomotic leak [17-20].
Additionally, the use of mechanical bowel preparation can result in serious adverse events, such as fluid imbalance, in certain patient subgroups, including the elderly. We recognise that the evidence for omitting bowel preparation in patients undergoing rectal surgery alone is equivocal.

4) Deep vein thrombosis prophylaxis

**Recommendation:** All patients undergoing surgery should be started on a once daily low molecular weight heparin (Enoxaparin 20 mg) the night before surgery and continued for the entire length of the patient’s hospital stay. In addition, graduated compression thromboembolic deterrent stockings (TEDs) should be used. During the procedure, pneumatic mechanical compression stockings should be used. Prophylaxis should be considered for up to one month after discharge, especially in those at a higher risk of thromboembolic complications, such as those with residual malignancy or previous episodes of thrombosis.

A single daily dose of low molecular weight heparin is recommended for deep vein thrombosis prophylaxis because of its ease of administration and lower risk of bleeding complications [21]. The use of low molecular weight heparin in conjunction with graduated compression stockings was found to be the most effective anti-thromboprophylactic prophylaxis in a recent Cochrane review [22, 23]. There is an increased risk of thrombotic complications up to one month after surgery, due to a hypercoaguable state, and prolonged (up to 1 month after discharge) antithrombotic prophylaxis with low molecular weight heparin confers significant benefit in terms of reduction of thrombotic complications [24, 25].

5) Antibiotic prophylaxis

**Recommendation:** A single dose of antibiotics, covering both aerobic and anaerobic organisms, should be administered just prior to incising the skin. In prolonged procedures (more than 4 hours) or if there is major blood loss (greater than 1500 mls.) a second dose may be administered.

Antibiotic prophylaxis is used to reduce the rates of wound infection after surgery. Multiple doses have not been found to confer any additional advantages and result in increased costs and risk of infections such as *Clostridium difficile*. For this reason, a single dose of antibiotics covering both aerobic and anaerobic organisms should be administered just prior to incising the skin in all clean procedures which do not involve the insertion of prosthetic materials. When deciding the type of antibiotic used, local resistance patterns should be considered. Increased risk of acquiring a *Clostridium difficile* infection after using a third
A generation cephalosporin should also be considered. In those who are known to be carriers of MRSA (Methicillin resistant *Staphylococcus aureus*), prophylaxis with a glycopeptide antibiotic (Vancomycin, Teicoplanin) should be considered.

**Peri-operative components**

1) **High inspired oxygen concentrations**

*Recommendation:* Eighty percent (80%) oxygen should be administered during anaesthesia and then continued for at least 6 hours postoperatively. A face mask may be required to deliver this high concentration of oxygen.

Molecular oxygen is required by polymorphonuclear cells to produce free radicals which form an important line of defence against pathogens [26-28]. In addition, it plays an important role in the synthesis of collagen for wound healing and angiogenesis. Higher tissue oxygenation levels in the immediate post-operative period as a result of 80% inspired oxygen have been shown to improve perfusion at the anastomotic site and reduce the risk of surgical site infections [29]. In addition, there is some evidence that it may also reduce postoperative nausea and vomiting (PONV) although this is contentious [30, 31].

2) **Prevention of hypothermia**

*Recommendation:* Hypothermia (core temperature less than 36°C) should be actively prevented using warm-air blankets. Warming should be continued for as long as the patient is in recovery. If the procedure is expected to last for more than an hour, then warmed intravenous fluids should be used. An oesophageal probe should be used during the procedure for measurement of core body temperature.

General anaesthesia can disrupt the normal thermoregulatory processes and result in hypothermia. In addition, exposure of the patient to the cold theatre environment also contributes. Hypothermia (core temperature less than 36°C) can, in turn, lead to an increase in the incidence of surgical site infections, thought to be due to peripheral vasoconstriction induced hypoxia [32, 33] and an altered immune response. Other undesirable effects of hypothermia include coagulopathy [34], increased cardiac morbidity [35] and increased levels of circulating catecholamines with a resultant exaggerated catabolic response [36]. Active prevention of hypothermia during the peri-operative period has been shown to reduce blood loss and prevent infective [33, 37] and cardiac complications [38].
For these reasons, hypothermia should be actively prevented using warm-air blankets. Warming should be continued for as long as the patient is in recovery. If the procedure is expected to last for more than an hour, then warmed intravenous fluids should be used. An oesophageal probe should be used during the procedure for measurement of core body temperature.

3) Goal directed intra-operative fluid therapy

**Recommendation:** An oesophageal Doppler probe (or other minimally invasive methods of stroke volume measurement such as LiDCO plus™ and LiDCO rapid™) should be used to continuously measure the cardiac output, and fluid administration should be titrated according to variations in the cardiac output.

A degree of intra-operative splanchnic hypoperfusion may go undetected with conventional monitoring, and this plays an important role in post-operative delay of return of gut function. In addition, occult hypoperfusion can lead to bacterial translocation across the gut wall which can result in sepsis syndrome. On the other hand, the administration of excessive amounts of fluid during surgery can also result in delayed return of gut function and cardiac morbidity. An oesophageal Doppler probe is a minimally invasive method of determining the hemodynamic status in the peri-operative period and allows guided fluid management targeted against indicators of cardiac output. The intra-operative use of an oesophageal Doppler probe has been shown to accelerate the return of gut function and expedite discharge after surgery. The haemodynamic status of the patient should first be optimised using an oesophageal Doppler probe such that the cardiac output is maximum. Further boluses of colloids (on a background of maintenance fluids) should then be administered against variations in stroke volume (SV) and velocity of blood flow in the descending aorta (FTc). If resources do not permit the universal use of oesophageal Doppler, then its use may be restricted to high risk (ASA 3 and above) and elderly patients. A schema for administering Doppler guided fluid is shown in Figure 1.

Other minimally invasive methods of optimising the fluid balance include LiDCO plus™ and LiDCO rapid™ and may be used instead of the oesophageal Doppler. These systems depend on a Lithium dilution technique to measure changes in haemodynamic parameters, such as cardiac output and stroke volume, and provide continuous real-time measurements.
4) Surgical approach and incisions

**Recommendation:** Both a laparoscopic or an open approach may be used, depending on local expertise and available resources. For open surgery, a lower transverse incision should be used whenever possible. If a transverse incision is not possible, then a selectively lower or upper midline incision is recommended. The length of the incision should be kept as short as possible.

Laparoscopic colorectal techniques have been shown to improve outcomes over similar open surgery techniques. These improvements include an earlier return of organ function, reduced post-operative analgesic requirement and an earlier discharge from hospital [42]. However, the major trials which have compared laparoscopic to open colorectal surgery have not taken ERAS into account and have, instead, compared laparoscopic surgery to conventional open surgery. Only three, single-centred and small-sized, randomised trials have compared the outcomes of laparoscopic and open colorectal surgery within the setting of ERAS, and these have produced conflicting results. At least two large multi-centre randomised trials, investigating the role of laparoscopic surgery within ERAS pathways, are currently ongoing and their results should, hopefully, clarify this issue to some extent [43, 44]. It is currently not possible to recommend whether or not the use of the laparoscopic approach within an ERAS pathway would result in indisputable advantages to the patient, over and above to those offered by open surgery in conjunction with ERAS. However, laparoscopic colorectal resection may be undertaken if local resources and expertise allow.
When undertaking open procedures, a number of considerations need to be borne in mind. Short transverse incisions are thought to be less painful, impair lung function to a lesser extent, and reduce subsequent post-operative analgesic requirement when compared to vertical wounds. In addition, there is some evidence that the incidence of wound dehiscence may be reduced in transverse incisions. These were the conclusions of a Cochrane review in 2005 [45]. However, the results of a recent large randomized trial did not find that transverse incisions were less painful than longitudinal ones [46].

5) Avoidance of post-operative drains and nasogastric tubes

**Recommendation:** Routine abdominal drains and nasogastric tubes should be avoided. If gastric decompression is required during surgery, a nasogastric tube may be inserted temporarily and removed at the end of the procedure.

Nasogastric tubes may be painful and cause considerable discomfort. This can render post-operative mobilisation difficult. There is good evidence that routine use of nasogastric decompression delays the return of gut function, leads to an increase in pulmonary complication and fever and prolongs hospital stay. These findings are supported by at least two meta-analyses [47-49].

Abdominal drains have been traditionally placed to evacuate post-operative collections at the site of surgery and drain any possible anastomotic leak. However, similar to nasogastric tubes, they cause considerable discomfort and can hinder mobilisation. Moreover, at least three meta-analyses have revealed that routine prophylactic drainage of the abdominal cavity does not confer any advantages [50-52].

6) Short duration of epidural analgesia and local blocks

**Recommendation:** All patients undergoing open colorectal surgery should receive epidural analgesia. It should be initiated at the beginning of the procedure and continued for a maximum of 48 hours. Weaning from epidural analgesia should start 12 hours post-operatively. Care should be taken that the equipment does not interfere with mobilisation. Patients undergoing laparoscopic resection may or may not be administered epidural analgesia depending upon the preference of the operating surgeon and anaesthetist.

A fine bore catheter placed into the epidural space at the level of T9 and T10 can be used to deliver a mixture of a short acting opiate (Fentanyl 2mcg/ml) and a local anaesthetic solution (Bupivacaine 0.15%). This results in a blockade of the spinal
nerves. Epidurals analgesia directly attenuates the post-operative stress response and promotes the return of gut function by blocking the sympathetic activity \cite{53, 54}. However, this sympathetic blockade can result in hypotension due to vasodilatation which can prove difficult to manage as it may not respond to intravenous fluids. In these situations, an early decision to transfer the patient to a high dependency unit must be taken and inotropic or vasopressor support initiated. Another disadvantage is that the equipment can interfere with postoperative mobilisation. Whenever epidurals are utilised, these should be initiated at the beginning of the procedure and continued for a maximum of 48 hours. Weaning from epidural analgesia should start 12 hours post-operatively. Alternatives to epidural analgesia include transversus abdominis plane (TAP) blocks and other infiltrations with local anaesthetic aimed at reducing post-operative opiate usage.

The role of epidural analgesia in relation to laparoscopic colorectal surgery is not clear. A small number of studies have questioned the use of epidural analgesia in the setting of laparoscopic surgery. They argue that analgesic requirements after laparoscopic surgery are lower and, as such, epidurals may not have an added advantage and, on the other hand, only increase the risk of epidural related complications \cite{55-57}. However, a small number of trials have produced contradictory results and have shown that additional advantages may be obtained when epidurals and laparoscopic surgery are used together \cite{58, 59}. The current evidence level is weak and insufficient to advocate the universal use of epidural analgesia in laparoscopic colorectal resection. However, this should not preclude the surgeon or the anaesthetist to use epidural analgesia for laparoscopic surgery if they deem it to be safe and useful in their local setting.

**Post-operative Components**

1) **Avoidance of opiates and the use of Paracetamol and non steroidal anti-inflammatory drugs (NSAIDS)**

**Recommendation:** Post-operatively, patients should be prescribed regular Paracetamol and NSAIDS such as Ibuprofen or Diclofenac if there are no contraindications to their use. Opiates, including Codeine preparations and Tramadol, should only be reserved for breakthrough pain. Whenever opiates are used, attention should be paid to prevent nausea and vomiting and regular antiemetics prescribed.

Early return of gut function and prevention of its various adverse sequels is thought to be one of the underlying mechanisms by which ERAS protocols work. Opiates are known to delay the return of gut function and should be avoided whenever possible. In addition, they can cause considerable post-operative nausea and
vomiting (PONV). Opiate minimisation should include the avoidance of Codeine and Tramadol preparations as well as opiate containing patient controlled analgesia (PCA) infusions. In their stead, patients should be prescribed paracetamol and NSAIDS, if there are no contraindications to their use. Opiates should be used only for purposes of rescue analgesia. Liberal use of antiemetics should be employed, but the limitation of these medications in expediting the recovery of post-operative gut function should be recognised [60].

2) Early postoperative diet

**Recommendation:** Patients should be allowed oral fluids as tolerated on the day of the surgery and built up to an oral diet over the next 24 hours. Patients who are not meeting their nutritional requirements by 72 hours after surgery should be assessed by a dietician.

Traditionally, oral diet and fluid has been reintroduced cautiously and gradually after bowel surgery, often rendering the patients nil by mouth or on oral sips only for many days in the post-operative period. This, it was thought, was necessary for adequate healing of bowel anastomoses. However, recently, early introduction of diet and fluids (within 24 hours post-operatively) has been shown to be safe [61, 62]. In addition, there is some evidence that early feeding may be beneficial in reducing the risks of anastomotic dehiscence, infections and reducing the length of stay [63]. In our view, tolerance to early feeding provides a more objective evaluation of gut function than assessment on the basis of bowel sounds of passage of flatus.

3) Early postoperative mobilisation

**Recommendation:** A structured mobilisation plan should be in place. Patients should be helped to sit out in a chair on the evening of surgery and definitely by the first post-operative day. This should be followed by gentle assisted mobilisation either the same day or the next day. Patients should be seen by a named physiotherapist pre-operatively with the aim of explaining the mobilisation plan. This physiotherapist should then help enforce this plan throughout the post-operative period.

Even short periods of immobilisation can lead to deleterious consequences such as thromboembolism, loss of muscle strength, pulmonary atelectasis and worsening of pulmonary function. Continuous patient education regarding the benefits of mobilisation is recommended. It was shown in a randomised trial that avoidance of bed-side entertainment systems is one pragmatic approach to encourage mobilisation [64].
4) Restricted amounts of intravenous fluid

**Recommendation:** It is not possible to recommend a single point in time by which all intravenous fluid administration should be stopped. However, in the majority of patients, this should be possible by the second post-operative day, by which time adequate oral fluids should be tolerated and indwelling epidural catheters removed.

During the post-operative phase, intravenous fluids may be required as long as adequate oral fluid intake has not been achieved and/or epidural catheters are still in situ. However, excessive amounts of intravenous fluid should be avoided. A daily regime of 1.5 to 2.5 L should suffice for most patients. The ability of individuals to get rid of accumulated sodium is greatly curtailed in the post-operative period. For this and other reasons, balanced intravenous solutions such as Hartmann’s™ should be prescribed in preference to Normal Saline (0.9% NaCl) in an attempt to avoid sodium overload, hyperchloremic acidosis and a delayed return of gut function [65].

5) Audit

**Recommendation:** Clinical outcomes, including readmission rates and compliance to the various ERAS strategies, should be regularly audited. Readmission rates after ERAS implementation should not exceed 10%. Audit findings should be discussed in regular audit meetings attended by medical, nursing and other ancillary staff. Results should also be disseminated using the local IT systems such as the intranet and e-mail.

A perceived disadvantage of many ERAS protocols is that, by discharging patients home sooner, one is simply transferring their responsibility on to primary care providers whilst also predisposing patients to higher readmission rates, despite the risks associated with such practices. This has not been borne out in trials, where the emphasis was to enhance patients’ recovery in preference to “fast tracking” patients through their hospital stay [66].

Continued audit should permit such problems to be detected early, and necessary modifications made to discharge criteria, so as to ensure that patients receive the best possible care. Readmission rates after ERAS implementation should not exceed 10%. Additionally, a continuous audit cycle should ensure detection of any institutional problems associated with ERAS implementation as well ascertaining a continuously up-to-date and evidenced based ERAS practice.
SPECIAL CIRCUMSTANCES

1) Elderly patients and those with high co-morbidity

Such patients have been shown to benefit from enhanced recovery and should be included in these programmes. There is no evidence for concern in including ASA 3 and 4 patients into ERAS programmes, although the literature in this area is limited [67]. Elderly patients may not be able to cope at home after discharge if there is no one to assist them. This may delay patient discharge, cognisant of the fact that the overarching aim of ERAS is to enhance post-operative recovery, not to discharge patients home earlier. The elderly may require a degree of input after discharge and this may be in the form of regular telephone calls, a home-visit by a healthcare professional or even by a relative. Therefore, discharge planning should be initiated at a very early stage for these patients.

Certain components of ERAS protocols may be even more relevant in this cohort of patients. For example, Doppler guided fluid therapy may be particularly useful in the elderly and high risk patients in whom accurate fluid administration is possibly more important due to the increased risk of fluid overload.

2) Emergency surgery

Although ERAS pathways have been primarily studied in the elective setting, they should still be applied to the emergency situation. Although in emergencies implementation of the pre-operative components may not be possible, every effort should be made to implement as many components as possible [68].
SETTING UP AN ERAS PATHWAY AND IMPROVING COMPLIANCE

Enhanced recovery programmes require a multi-disciplinary approach and co-ordination. This can render their initiation and implementation difficult. Compliance to these packages has often been reported to be low, especially in the post-operative period and outwith the remits of clinical trials. Factors which can facilitate introduction and implementation of enhanced recovery pathways and improve protocol compliance include:

1) Selected anaesthetic input

Patients should be managed by a selected group of anaesthetists who are committed to the concept of enhanced recovery.

2) Patients should be managed on specific wards

The management of patients by a select group of medical and nursing staff trained in the principles of enhanced recovery may improve compliance. If resources permit, specialised units dedicated to implementing ERAS called ‘Enhanced Recovery Units’ should be set up. This may facilitate the organisational aspects of running ERAS protocols. Such units can also play a role in patient education, where patients are continuously reminded of the importance of their active participation in the success of enhanced recovery. This may be facilitated by direct staff contact as well as by using apposite posters and pamphlets.

3) Continuous staff education

The majority of strategies of ERAS pathways are simple measures which can be implemented by junior medical and nursing staff. Therefore, whenever junior medical staff rotate into a unit that practices enhanced recovery, targeted teaching sessions should be held to ensure that all staff are familiar with the practices of the unit.

4) A multidisciplinary team approach

An ERAS team should be in place and should comprise one or more surgeons, anaesthetists, nurses, dieticians and physiotherapists. These individuals should be ‘signed up’ to the concept of enhanced recovery. In the majority of hospitals, it should not be necessary to expand the work force to formulate such teams and a reconfiguration and collaboration of existing services should be sufficient. The ERAS team may replace and take over the role of other previously existing teams such as the Pain Management Team whose members can, in turn, be trained to be a part of the new ERAS team. This would ensure that aspects such as pain control are dealt with in accordance with the principles of ERAS. In addition to the clinical care, the ERAS team should take
up additional roles such as ensuring compliance, auditing outcomes and continuous staff and patient education to facilitate implementation of ERAS.

5) **A local champion**

Successful implementation of enhanced recovery packages necessitates a local ‘champion’. Such a person is essential to coordinate the various aspects of enhanced recovery packages from pre-assessment until discharge. This may be any senior member of the ERAS multi-disciplinary team outlined above.

6) **Audit and research**

Regular auditing and dissemination of results should be undertaken. Wherever possible, an active research programme on ERAS related issues is recommended. Regular audit and research can facilitate the development of local ERAS protocols tailored to the specific requirements of the institution.
The safety and applicability of ERAS, in terms of reducing the post-operative length of stay and morbidity, is well established from well designed randomised clinical trials and meta-analyses. However, certain issues related to ERAS require further research:

1) **Influence on quality of life (QoL) and patient satisfaction**

Although ERAS pathways have not been shown to adversely influence patient satisfaction or quality of life, the full impact of the various strategies employed, as well as earlier discharge from hospital after major surgery, requires further research for a better understanding.\(^6\)

2) **Role of laparoscopic surgery within an ERAS programme**

Both laparoscopic surgery and ERAS significantly shorten post-operative lengths of stay. However, whether or not the inclusion of laparoscopic surgery within a successful ERAS protocol offers any further advantage to that of ERAS alone is not clear. There is currently no adequately powered study in the literature to answer this question, but the results of on-going appropriately designed studies are awaited.\(^43, 44\) Current evidence seems to suggest that, in the presence of a well implemented ERAS pathway, similar results can be obtained with or without the laparoscope. Future research should also compare the costs and quality of life after inclusion of the laparoscopic approach within an ERAS pathway.

3) **Inclusion of gut specific nutrients in ERAS pathways**

ERAS pathways are thought to work by preserving organ function and particularly gut function. Glutamine is a conditionally essentially amino acid which is used as a preferential nutrient source by the gut enterocytes and cells of the immune system. Glutamine levels are known to be sub-normal in catabolic states such as after surgery, trauma or burns. Preliminary research has shown that pre-operative oral Glutamine supplementation reduces septic complications and length of stay after surgery. However, further research in the form of well designed and appropriately powered randomised trials is required.\(^70-73\)

4) **Cost-benefit analysis**

Whilst it is self-evident to some that ERAS should be cost effective, targeted studies investigating the cost-benefit interplay of ERAS protocols are conspicuous by their scarcity.\(^74-77\) A sound economic basis for implementing ERAS protocols in various surgical specialties would greatly enhance the argument in favour of ERAS. In many branches of surgery, such studies are eagerly awaited.
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