



**THE SURGICAL MANAGEMENT  
OF PATIENTS WITH ACUTE  
INTESTINAL FAILURE**

**September 2010**

Association of Surgeons of Great Britain and Ireland

***ISSUES IN PROFESSIONAL PRACTICE***

The Surgical Management of Patients with Acute Intestinal Failure





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## ISSUES IN PROFESSIONAL PRACTICE

# THE SURGICAL MANAGEMENT OF PATIENTS WITH ACUTE INTESTINAL FAILURE

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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 focus on clinical issues, some cover management and service delivery, whilst others feature broader aspects of surgical working life such as education, leadership and the law.

The aim of this booklet is to increase awareness of acute IF and to provide advice on its prevention and management. The facilities, training and expertise that we believe are required for successful and cost-effective management of patients with acute IF are highlighted, as well as criteria which define the group of patients for whom referral to a specialised centre should be considered.

The Association hopes that this publication, and the others in the series, 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.

A handwritten signature in blue ink that reads "Michael Horrocks". The signature is written in a cursive style and is underlined with a single blue stroke.

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## EXECUTIVE SUMMARY

- Intestinal failure (IF) is a distinct clinical entity, characterised by inadequate intake and absorption of nutrients through the gastrointestinal tract.
- IF is associated with poor outcomes.
- IF is common in surgical practice. All hospitals undertaking emergency abdominal surgery will have patients with IF.
- IF can be sub-classified into Types 1, 2 or 3, depending upon duration of nutritional support required and reversibility of original pathology.
- The management of patients with IF necessitates close collaboration between surgical teams, physicians and radiologists. Involvement of a multi-disciplinary nutrition support team (NST) is essential.
- Hospitals that do not have a NST or a surgeon with a committed interest to nutritional support should consider referral to centres where these facilities exist.

## INTRODUCTION

To many clinicians, the term intestinal failure (IF) is associated with the need for long-term nutritional support and possibly Home Parenteral Nutrition (HPN). Fortunately, such patients are very uncommon and most general or gastroenterological surgeons will encounter such patients rarely, if at all.

It is increasingly being recognised, however, that short-term, acute IF is a diagnostic entity that deserves greater recognition. These patients usually fall within the province of the general or gastroenterological surgeon and will be encountered, on a regular basis, in any hospital providing an emergency take.

Despite advances in critical care, antibiotic therapy and nutritional and metabolic support, acute IF is still associated with considerable morbidity and mortality.

The aim of this booklet is to increase awareness of acute IF and to provide advice on its prevention and management. The facilities, training and expertise that we believe are required for successful and cost-effective management of patients with acute IF are highlighted, as well as criteria which define the group of patients for whom referral to a specialised centre should be considered.

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## CHAPTER ONE: DEFINITION OF ACUTE INTESTINAL FAILURE

Intestinal failure (IF) may be said to occur when “*gastrointestinal function is inadequate to maintain the nutrition and hydration of the individual without supplements given orally or intravenously*” (Jeejeebhoy, 2005).

The diagnosis of IF is difficult because of an absence of agreed definitions. The presence of audible bowel sounds and the passage of flatus or faeces, are easily noted at the bedside, but are unreliable indicators of intestinal function. Most authorities now agree that intolerance of oral diet or enteral feeding is probably the most reliable indicator of intestinal failure in the clinical setting. Its reliability can be improved when performed in the context of a predefined feeding protocol (such as that associated with most current enhanced recovery care plans). Recent evidence suggests that a simple, practical, clinical definition of intestinal failure, applicable to the bedside, is “*inability to tolerate 80% of nutritional requirements delivered enterally for a minimum of 48 hours*” (Gatt, 2010).

IF can be arbitrarily sub-classified into three types depending upon duration and irreversibility (Lal et al, 2006). Thus:

**Type 1 IF** is usually considered to be of less than 28 days duration. It is typified by conditions such as postoperative ileus or small intestinal obstruction, usually requires short term parenteral nutrition and generally resolves within 28 days.

**Type 2 IF** is usually considered to be of greater than 28 days duration. Typical patients might include those with complex Crohn’s disease, intestinal fistulas or abdominal sepsis. These patients require much more prolonged nutritional and metabolic support pending spontaneous resolution or surgical treatment.

Patients with both Type 1 and Type 2 IF would be expected to return to full enteral autonomy in time.

**Type 3 IF** is generally irreversible and usually occurs as a consequence of massive small bowel resection, leading to short bowel syndrome, although there is increasing recognition that severe motility problems may account for a small proportion of cases (BAPEN, 2009). Patients with type 3 IF will require HPN and, in some cases, referral for intestinal transplantation may be appropriate.

## CHAPTER TWO: PREVENTING ACUTE INTESTINAL FAILURE

Ileus is not an inevitable consequence of intestinal surgery. Many interventions have been shown to encourage early return of gut function after abdominal surgery. These include the avoidance of opiates, minimally invasive surgery, ensuring appropriate fluid repletion without water or sodium overload and early instigation of diet.

While judicious and thoughtful management of some patients with type 1 IF may expedite resolution, the converse is also true. For example, undertaking (or even worse, allowing an inexperienced colleague to undertake) a difficult emergency relaparotomy for small intestinal obstruction 12 days postoperatively, exposes the patient to an unacceptably high risk of complications, which may result in type 2 IF.

In other cases, inappropriate patient or case selection, or poor surgical technique may lead to IF. Constructing intestinal anastomoses in severely undernourished or shocked patients, for example, may lead to anastomotic leakage and severe abdominal sepsis. Preoperative risk factors for abdominal sepsis in patients with Crohn's disease (hypoalbuminaemia, immunosuppression, intra-abdominal collections and fistulas) have been well-characterised (**Yamamoto et al**, 2000), as has the influence of inadvertent enterotomy on outcome after laparotomy (**Van Der Krabben et al**, 2000).

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## CHAPTER THREE: AETIOLOGY AND PATHOGENESIS OF ACUTE INTESTINAL FAILURE

### 3.1 Type 1 IF

Type 1 IF is common, and most frequently associated with acute disturbances in intestinal motility (ileus) that may occur as a consequence of surgery or in patients who are critically ill for other reasons (e.g. head injury, pneumonia, hip surgery, acute pancreatitis). Postoperative ileus has been reported to occur in as many as 15% of patients undergoing intestinal resection (**Wolff et al, 2007**) and mechanical intestinal obstruction in 10% (**Ellozy et al, 2002**). While the prevalence of ileus may be reduced with the use of enhanced recovery pathways, type 1 IF will be common in any hospital that carries out abdominal surgery.

### 3.2 Type 2 IF

There are, similarly, no reliable data available concerning the incidence or prevalence of type 2 IF. A Department of Health survey has suggested, however, that, using a surrogate marker of requirement for parenteral nutrition of 28 days or more, the annual incidence of type 2 IF in England is nine patients per million population (**NCG, Department of Health, 2008**). Unfortunately, since no attempt was made to correct these figures for the number of patients who had undergone surgical procedures (as opposed, for example, to patients receiving hospital parenteral nutrition for other reasons), the incidence of *postoperative* type 2 intestinal failure remains unclear.

In contrast to type 1 IF, type 2 IF generally develops as a consequence of an abdominal catastrophe. This may follow an acute event (such as mesenteric embolus, volvulus or trauma), necessitating massive enterectomy, or occur as a complication of intestinal surgery (anastomotic leak, unrecognised intestinal injury, fistula formation, abdominal wall dehiscence, laparostomy/open abdomen). An increasing proportion of patients develop type 2 IF as a consequence of complications of managing anastomotic leakage in a setting of considerable pre-existing co-morbidity. Almost half of all patients with severe acute type 2 IF develop IF as a result of surgical complications (**Carlson and Dark, 2010**).

### 3.3 Type 3 IF

The incidence and prevalence of type 3 IF, (or at least the prescription of HPN when used as an approximation) varies considerably between countries and even within different regions of the UK. Approximately eight patients per million population receive HPN in the UK. (BAPEN, 2009). The most common underlying cause of type 3 IF in the UK is Crohn's disease, which accounts for just over 25% of all cases. These data conceal important information for the surgeon managing patients with type 2 IF: The most common reason for a patient with Crohn's disease to develop type 3 IF is inadvertent bowel injury resulting from the management of type 2 IF, which, in turn, has developed because of complications of surgical resection (Agwunobi et al, 2001). Preventing type 3 IF is, thus, a key goal for the surgeon managing the patient with type 2 IF.

## CHAPTER FOUR: Management of Acute Intestinal Failure - General Principles

Since distinguishing type 1 from type 2 IF essentially relates to duration and severity of illness, and it may not be apparent, at least initially, whether a patient has type 1 or type 2 IF, it is appropriate to discuss management of both types 1 and 2 IF together, as they form a continuum of the same condition.

In general, if a patient has absent intestinal function after the 5th postoperative day:

1. Consider the underlying **cause** and the **realistic chances of resolution**.

e.g. ileus in a fit, previously well-nourished patient who presented with appendicitis and peritonitis, differs from that in a cachectic patient who has undergone major small bowel resection for ischaemia and has ongoing sepsis.

2. Decide early – is further **investigation** is required?

e.g. CT scan to exclude intra-abdominal sepsis; contrast study to exclude anastomotic leak from low rectal anastomosis.

3. Look for and treat **correctable metabolic factors**.

These may be contributing to IF, e.g. abnormal electrolytes/fluid balance, sodium overload.

4. Consider whether **nutritional support** is required.

TPN is indicated if a patient has failed, (or is expected to fail) to tolerate an adequate enteral diet for 5-7 or more days. The appropriate means of access for TPN may vary from delivery through a peripheral cannula, if resolution is anticipated within a few days, or a dedicated, tunnelled or peripherally inserted central venous line if a longer period of TPN is anticipated.

## CHAPTER FIVE: SPECIFIC MANAGEMENT ISSUES IN ACUTE INTESTINAL FAILURE

### 5.1 Postoperative small bowel obstruction and ileus

It can be difficult to distinguish postoperative ileus from small intestinal obstruction. In general, colicky abdominal pain and cessation of bowel action in a patient who has already opened their bowels postoperatively are indicative of mechanical obstruction. Mechanical obstruction (as opposed to ileus) is particularly likely in patients who have undergone laparoscopic surgery (**Augestad and Delaney**, 2010). Plain abdominal radiology is frequently unhelpful, though a CT scan may be useful, and CT with gastrografin administered via a nasogastric tube may be both diagnostic and therapeutic since the hyperosmolar gastrografin may stimulate peristalsis and result in resolution of ileus. Failure of contrast to reach the caecum within four hours of administration is strongly predictive of failure of mechanical obstruction to resolve and may help with decision making with regard to timing of further surgery.

While urgent surgery may be required if signs of increasing abdominal tenderness or sepsis develop, the majority (>70%) of patients who develop early (within 30 days of operation) postoperative small bowel obstruction will settle with nasogastric drainage and nutritional support, usually via a peripheral cannula or PICC line. The vast majority of cases do so within seven days (**Ellozy et al**, 2002). If obstruction fails to settle, operation may be required, but is potentially hazardous at this stage. It should be performed by a senior and experienced surgeon, during normal working hours, and great care exercised to avoid inadvertent intestinal injury, which is strongly associated with poor outcome.

### 5.2 Management of Abdominal Sepsis

Adequate management of abdominal sepsis is the most important factor that determines outcome in patients with acute IF (**Carlson**, 2003). Early and aggressive resuscitation, followed by extirpation of abdominal sepsis, is, therefore, vital. In many cases of type 2 IF, sepsis may present insidiously. The usual hallmarks of infection (fever, leucocytosis) are frequently absent in such cases, and patients manifest chronic intra-abdominal infection as persistent hypoalbuminaemia, hyponatraemia, jaundice (see below), or even progressive cachexia (**Carlson and Irving**, 1997). A very high index of suspicion should be maintained for the diagnosis of intra-abdominal infection in all patients with type 2 IF.

The treatment of abdominal sepsis requires source control, either by operative or radiologically-guided drainage, or a combination of both. The use of antibiotics is frequently an important adjunct to drainage, but is not an adequate substitute. Antimicrobial chemotherapy for abdominal sepsis requires the administration of antibiotics appropriate to the likely infecting organism (usually enteric pathogens), guided by the advice of an experienced microbiologist, and subject to review and later modification, if appropriate, depending upon the results of bacteriological culture of pus obtained from percutaneous or surgical drainage.

Localised intraabdominal collections should be treated by prompt radiologically-guided drainage. This may not be possible or helpful where there are multiple collections between loops of bowel, where collections are inaccessible, or where there is anastomotic leakage with discontinuity between the bowel ends (see below). In such cases, early return to theatre is usually mandatory. Delay in providing definitive surgical treatment is associated with poor outcome, especially in patients who are unstable, elderly or who have significant co-morbidity (**Koperna and Schulz**, 2000). In such cases, which are technically extremely challenging, reoperation should only be undertaken by, or at least with the immediate supervision of, an experienced consultant surgeon.

Anastomotic leakage in the small bowel or colon virtually always mandates early re-laparotomy and drainage of infection. Intestinal re-anastomosis should **not** be attempted, but the bowel ends should be exteriorised, ideally at a site manageable by the patient and enterostomal therapist. This “rule” may be modified if the anastomotic leak is from the upper GI tract, where it is usually not possible to exteriorise the intestine. Source control in this situation may be very difficult and formation of a controlled fistula, for example with a t-tube or large bore drain, may be an appropriate alternative to attempts to exteriorise an anastomotic leak. Key aspects of management in such cases include control of sepsis using large drains, with or without lavage, and provisional of nutritional support either parenterally or enterally, as determined by patient tolerance. The route of enteral provision will be determined by local expertise and experience.

If it is more than 7-10 days after the original laparotomy, the peritoneal cavity may be hostile and relaparotomy under these circumstances may be more hazardous than beneficial, resulting in multiple enterotomies or resection of considerable amounts of small intestine. When the abdomen is particularly hostile, and in patients who are unstable and hypoalbuminaemic, intestinal suture lines should not be left in continuity. Enterotomies should either be exteriorised or, if repaired, should be defunctioned proximally by a

loop or double-barrelled stoma. The minimum amount of surgery should be undertaken to enable adequate drainage of infective foci, resection of perforated intestine and creation of proximal defunctioning stomas.

Where resection of a leaking anastomosis would inevitably result in extensive injury to healthy, adherent, intestine, it may be preferable to drain the leak adequately and defunction the anastomosis proximally. In cases where there has been significant and persistent abdominal infection (tertiary peritonitis), particularly when combined with enterotomy, it may be appropriate to leave the abdomen open (laparostomy). Such patients will, almost inevitably, need initial management on the intensive care unit.

### 5.3 Intestinal Fistula

The appearance of bowel content via the wound or an abdominal drain causes consternation to both surgeon and patient. Immediate clinical priorities in the first 24-48 hours are as follows:

1. To monitor the patient for signs of sepsis, by means of regular nursing observations of temperature, pulse rate, blood pressure, haematological (full blood count) and biochemical (white cell count, C-reactive protein and serum albumin) investigations, and to promptly exclude an intra-abdominal collection by urgent CT scan, followed by equally urgent radiologically-guided drainage as appropriate.
2. To safeguard skin/wound care with the support of an expert enterostomal therapist, using either ordinary stoma appliances or a wound manager device.
3. To ensure adequate fluid and electrolyte balance. This requires careful charting of oral and intravenous fluid intake and urine output, together with rigorous measurement of fistula output, particularly in those patients with a high output fistula output (in excess of 500 ml/day). Maintenance of fluid balance and correction of electrolyte abnormalities is essential. In general, output from the small intestine in excess of 500ml per day should be replaced, by an equal volume of a balanced electrolyte solution (Hartmann's, Ringer lactate).
4. Once these measures have been taken, nutritional support should be instituted, preferably by referral to the hospital nutrition support team.

## 5.4 Obtaining a second opinion

Development of significant postoperative complications causes most surgeons considerable angst. When a patient develops a serious intraabdominal complication, the inclination is to accept not only responsibility (which is appropriate) but also feelings of guilt (which may not be). Under some circumstances, the surgeon's attitude to the development of serious postoperative complications may significantly complicate rational decision-making.

The consultant responsible for the case should, therefore, consider, as a matter of course, asking a similarly experienced colleague to give a second opinion about management, assist with further surgery where appropriate, and/or, in certain cases, to fully take over the patient's management. There are great potential benefits to both patients and surgeons in this becoming the official policy of a surgical unit. This should be managed in such away as to make clear to both patients and hospital management that treatment of complications in this manner, as part of a hospital team, is not an admission of underperformance.

## 5.5 Nutritional Support

The ability to supply adequate and uncomplicated nutritional support is essential in the management of acute IF. Regrettably, a recent NCEPOD survey (NCEPOD, 2010) has shown that current standards of care with respect to the delivery of parenteral nutrition (PN) are unacceptably poor. A good standard of care was noted in fewer than 20% of over 1,330 patients whose care was subjected to external peer review. There were unreasonable delays in commencing parenteral nutrition in almost 20% of patients, and in almost half the patients concerned the hospital nutrition support team was not involved in the decision to administer PN. Less than half the patients received adequate biochemical and nutritional assessment prior to commencement of PN, and requirements were inadequately documented in almost half the patients. Almost 40% of patients developed avoidable metabolic complications as a result of the manner in which PN had been delivered, while over 25% of patients developed avoidable complications of PN administration via central venous catheters, mostly suspected or confirmed catheter related sepsis.

The responsibility for these extraordinarily poor results must rest with the surgical team, as more than 50% of these patients were surgical patients and the indications for parenteral nutrition in these cases almost all related to perioperative types 1 or 2 IF. The development and delivery of safe and effective nutritional care must, therefore, be a key goal of any organisation aiming to treat

patients with even the simplest cases of type 1 acute IF, and the importance of the nutrition support team and thorough audit of performance with respect to the delivery of nutritional support is highlighted below.

### 5.5.1 Parenteral nutrition

Short term TPN can generally be delivered via a dedicated peripheral venous cannula. Most patients with type 2 IF require either a PICC line or central venous access for parenteral nutrition. Important issues include:

1. Venous access: The line should be inserted by an experienced operator, irrespective of whether they are a physician, surgeon, intensivist, radiologist or specialist nurse. Central lines should be inserted using ultrasound guidance to minimise complications related to line insertion. Dedicated tunnelled lines should be inserted under conditions of strict asepsis.
2. Avoidance of line complications, particularly catheter related sepsis. A dedicated line, or at least a dedicated lumen of a fresh multilumen line, should be used for TPN. Dedicated tunnelled lines, or the lumen of a multilumen catheter reserved for the administration of TPN should be employed for nothing else whatsoever.
3. Lines used for the administration of TPN should be handled only by an expert nursing team, responsible to, or (preferably) part of, the hospital nutrition team, according to a strict aseptic protocol. Rigorous arrangements should be in place for audit of line-related complications.
4. There should be appropriate arrangements, preferably by the hospital nutrition team, to ensure appropriate content of the parenteral nutrition. Requirements for protein and energy should be calculated by an expert dietitian. Grossly abnormal fluid and electrolyte balance should be corrected prior to commencement of TPN, if it is possible to do so within 24-48 hours. If the patient was undernourished on admission, or has had a prolonged period of inadequate intake, then initial feed composition should be modified to avoid refeeding syndrome. In most patients with acute IF, however, it should be possible to meet nutritional requirements within 48 hours of starting TPN. Excessive amounts of energy and of fat should be avoided, since overfeeding increases the risk of infection, respiratory failure and hepatocellular dysfunction.

5. A full description of nutritional regimens, requirements and complications is outwith the remit of this guidance and the reader should consult on of the many standard texts on the topic. The following general comments may be of value however:
  - A. **Energy:** The total energy requirements of stable patients with normal and moderately increased needs are approximately 20-30 kcal/kg/day. Very few patients require energy intakes in excess of 35 kcal/kg/day. In the majority of adult hospitalised patients in whom energy demands from activity are minimal, total energy requirements, are of the order of 1300-1800 kcal/day. Glucose is usually the preferred energy source, except in critical illness when ability to utilise glucose may be impaired as a result of insulin resistance.
  - B. **Carbohydrate requirements:** There is an obligatory glucose requirement of approximately 2 g/kg/day in order to meet the needs of the central nervous and immune systems. There is also a physiological maximum to the amount of glucose that can be oxidised of 4 mg/kg/min, with the non-oxidised glucose being primarily converted to fat, and there is little value in exceeding this. Indeed, doing so may result in excessive fat deposition in the liver, resulting in impaired liver function, as well as fever and respiratory impairment.
  - C. **Lipid requirements:** Safe and non-toxic fat emulsions based upon long chain triglycerides (LCTs) provide 9 kcal/g and are now routinely used to supplement the provision of non-protein calories during parenteral nutrition. Energy during parenteral nutrition should be given as a mixture of fat together with glucose. There is no evidence to suggest that any particular ratio of glucose to fat is optimal as long as under all conditions basal requirements of glucose (100-200 g/24hr) and essential fatty acids (100-200 g/week) are met. This 'dual energy' supply minimises metabolic complications during parenteral nutrition, reduces fluid retention, enhances substrate utilisation particularly in the septic patient and is associated with reduced carbon dioxide production.

Concerns have been expressed about possible immunosuppressive effects of LCT emulsions. These are more likely to occur if recommended infusion rates (0.15 g/kg/hr) are exceeded. Nonetheless, these concerns have prompted the development of newer lipid emulsions based upon medium chain triglycerides, omega 3 fatty acids and, most recently, structured triglycerides. The evidence of clinical benefit for these emulsions is currently tenuous.

D. **Protein requirements:** The basic requirement for nitrogen in patients without pre-existing malnutrition and without metabolic stress, is 0.10-0.15 g N/kg/day. The requirements increase to 0.20-0.25 g N/kg/day in critically ill patients. There is little evidence that the provision of nitrogen in excess of 14 g per day is beneficial, and failure to regain lean body mass in critically ill patients should prompt a search for a source of catabolism such as untreated sepsis.

E. **Vitamins, minerals and trace element requirements:** These are all essential components of nutritional regimens. The water-soluble vitamins B and C act as coenzymes in collagen formation and wound healing. Postoperative vitamin C requirements increase to 60-80 mg per day. The fat-soluble vitamins A, D, E, and K are reduced in steatorrhea and the absence of bile. Trace elements may also act as co-factors for metabolic processes. Normally trace element requirements are met by the delivery of food to the gut, and so patients on long-term parenteral nutrition are at particular risk of depletion. Magnesium, zinc and iron levels may all be decreased as part of the inflammatory response. Supplementation is necessary to optimise utilisation of amino acids and to avoid refeeding syndrome.

### 5.5.2 Enteral nutrition

1. Some patients, who are unable to maintain their nutrition with normal food taken orally, may not require parenteral nutrition but may be fed enterally via a nasogastric or percutaneous endoscopic gastrostomy tube. Patients who have developed complications following oesophagectomy or gastrectomy may be fed adequately via a jejunostomy placed at the time of surgery. These fairly straightforward nutritional problems are not addressed further here.
2. Patients who have complex small bowel fistulation may have a reasonable length of intact small intestine distal to the fistula. It may be possible to safely deliver enteral nutrition into this segment, under a variety of circumstances. When there is very proximal duodenal or jejunal fistulation, a feeding tube may be passed either endoscopically or radiologically across the fistula into the distal segment. If the proximal small bowel has been exteriorized, e.g., as a result, for example, of an anastomotic leak, the jejunal distal mucus fistula can be intubated for "distal feeding".

3. In selected cases, a fistula can be cannulated, allowing access to the intestine distal to it, for direct infusion of enteral feed, with or without reinfusion of collected chyme from the proximal limb. This technique, referred to as “fistuloclysis” (**Teubner et al**, 2004) is ideally suited to fistulation in the open abdomen. It is safe, inexpensive and highly effective, but should never be attempted unless there is clear mucocutaneous continuity, otherwise it will result failure of the fistula to heal. In addition, preliminary contrast studies should be undertaken to establish that there are at least 100cm of intact, unobstructed intestine distal to the point of infusion.
4. Enteral feeding may be safer than TPN in acute IF, but ensuring that nutritional requirements are met is considerably more complex. It is important that patients are adequately fed and monitored. Enteral feeding should be undertaken with the support of the hospital nutrition team. Patients receiving distal feeding or fistuloclysis are unlikely to be able to tolerate elemental diet because of its high osmolality and polymeric or semi-elemental feed is preferable. There is no evidence to support routine collection and reinfusion of chyme, although this may be considered in patients with very short lengths of proximal small intestine and abnormal liver function.

### 5.5.3 Withholding oral diet and fluids

1. It is seldom appropriate to completely deny a patient with acute IF oral fluid intake. In patients with type 1 IF, a limited intake of oral fluid (e.g sips of water) is important for oral hygiene and comfort and should not complicate management if a nasogastric tube or gastrostomy is in place. Similarly, in type 2 IF, small amounts of oral fluids are important for morale and do not generally complicate management.
2. Although there is little or no scientific evidence to support it, it is customary to withhold oral fluids and diet from patients with a small intestinal fistula, in order to promote healing. It may be appropriate to do so, particularly if oral intake is likely to lead to sepsis (for example in the early stages of type 2 IF where intraperitoneal contamination is a possibility), or where wound management may be compromised by increased fistula output resulting from oral intake.
3. Once it is clear, however, that a small bowel fistula will not heal without further surgery (usually by six weeks, or if

there is mucocutaneous continuity at the fistula site), there is little merit in avoiding oral intake. Allowing the patient regular access to small amounts of appetising food, of their choice, may be of great help psychologically, in addition to the potential trophic effects on the gut mucosa.

4. If the fistula appears to be of low output and from distal ileum or colon, with no evidence of intra-abdominal sepsis, there is no merit in providing parenteral nutrition rather than adequate oral diet. It is customary to recommend a low fibre diet.

#### **5.5.4 Nutritional monitoring**

The goal of nutritional support changes with progress of the patient. Ultimately, it should be to preserve or restore normal body composition as fully as possible and, in particular, muscle mass and function. This will not be possible in the presence of sepsis or significant systemic inflammation when the goal is to limit the effects of catabolism.

After sepsis is controlled, the goal is anabolism, but slow and steady weight gain, with increase in muscle strength and mass, is more important than gaining fat. Assessment of nutritional recovery is frequently difficult as changes in weight are commonly related to fluid balance and oedema rather nutritional status, and assessment of albumin and micronutrient status is complicated by the acute phase response.

The assistance of an expert dietitian is valuable and, irrespective of the route used for nutritional support, should seek to determine whether the appropriate amount of calories and nitrogen are being supplied, whether the route used for nutritional support is still optimal, and whether there are specific nutrient deficiencies that need to be addressed, e.g. magnesium, selenium, vitamins D, K or B12.

## **CHAPTER SIX: WOUND, FISTULA AND STOMA CARE**

Many patients with IF associated with intestinal fistula find problems with wound care more traumatic than any other aspect of their illness. Difficulty with wound or fistula management alone may necessitate transfer to a specialised unit where expert nursing care is available. Inadequate stoma or wound management is not only demoralising for the patient, but may represent a serious source of morbidity, with patients experiencing severe pain due to excoriation and even digestion and necrosis of the wound due to corrosive fistula effluent. Superadded infection may quickly overwhelm the patient, leading to death from necrotising fasciitis.

The nursing staff must have sufficient expertise and resources to be able to competently manage urgent issues at weekends and overnight. Eakin bags and application of topical negative pressure (TNP) have been used for complex and troublesome wounds (see below).

In the most severe cases, it may be necessary to undertake a limited laparotomy through a left upper quadrant incision and construct the most distal loop jejunostomy that can be safely constructed, simply to facilitate wound care. A temporary very high output proximal loop stoma that can be drained into a stoma appliance is usually vastly preferable to a poorly controlled and frequently leaking fistula. It is particularly important that the patient's mobility is not compromised because of wound problems.

## CHAPTER SEVEN: HIGH OUTPUT STOMA OR FISTULA

A high output small bowel fistula produces more than 500ml of effluent per 24 hours. This figure is probably most useful in signalling to medical staff the need for careful fluid balance and the possibility that TPN may be needed. Since a healthy ileostomist may have losses of approximately 1000ml per 24 hours, fluid losses do not become a major problem until they are consistently higher than 1000ml unless the patient has chronic renal impairment, which may preclude compensatory concentration of the urine.

Most patients with a stoma or fistula output persistently in excess of 1000 ml will benefit from intervention designed to control effluent and reduce fluid and electrolyte losses. Suggested interventions are as follows.

1. Accurate fluid balance is essential, as is regular monitoring of serum urea and electrolyte concentrations, including potassium, magnesium and calcium. Fistula or stoma losses are most appropriately replaced by daily administration of a balanced electrolyte solution (e.g Hartmann's or Ringer lactate), together with supplementary potassium as required.
2. Serum magnesium is rapidly depleted by intestinal losses and intravenous replacement of magnesium is often necessary. This is best done by slow infusion of 10-20mmol per 24 hours. Sodium status is most effectively monitored by urinary sodium concentration, provided renal function is satisfactory. If insufficient sodium is being supplied, urinary sodium will be low (less than 15-20mmol/l).
3. Stoma/fistula output should be reduced by medical therapy. Regular oral loperamide, (starting dose of 2-4mg four times daily), is usually effective. Some patients find benefit from much higher doses, although a significant further effect is unlikely above 32mg per day. Similarly, codeine phosphate 30-60mg four times daily may help to reduce intestinal fluid losses. Proximal intestinal fistulation and short bowel syndrome may be associated with temporary gastric hypersecretion. High doses of proton pump inhibitors such as omeprazole, (given intravenously, orally dissolved in bicarbonate, or as sublingual FAST tabs) may reduce intestinal fluid losses. Effectiveness of therapy may be monitored by maintaining stoma/fistula pH above 6.0.

4. Limitation of oral hypo-osmolar fluids such as water, tea and juices – generally to 1000-1500 ml per day - is an important adjunct to medical therapy. This is essential for reduction of excessive stoma or fistula losses of water and sodium. In the absence of intact distal small intestine, intestinal losses from the jejunum tend to be isosmolar with plasma, so consumption of large amounts of hypo-osmolar fluids leads to “washing out” of sodium and, with it, water. As much oral fluid intake as possible should be substituted with an appropriate electrolyte solution, which should contain at least 100mmol/litre of sodium. St. Mark’s solution, and some of the commercially available electrolyte solutions, also contains some glucose, which facilitates active transport of sodium and water into the enterocyte. Commercially available solutions (e.g dioralyte) generally have insufficient sodium and should be consumed at double strength.
5. Oral magnesium replacement is problematic, as most magnesium preparations lead to increased intestinal output. If the patient is receiving TPN, magnesium is best replaced parenterally. Magnesium oxide or magnesium aspartate are the best absorbed orally and are usually started in a dose of 8 tablets/ two 10 mmol sachets daily.
6. Octreotide or other somatostatin analogues are rarely indicated for the treatment of either patients with an intestinal fistula or high output stoma. There is little evidence that they promote closure of an intestinal fistula (though they may expedite closure by a few days in a fistula that is likely to close spontaneously in any event). They may produce a significant reduction in fistula or stoma output in some, but not all, patients. They are painful to administer and very expensive. Their (limited) potential benefits seldom outweigh their cost and discomfort.

## CHAPTER EIGHT: REHABILITATION

Although initial management involves control of sepsis, skin care and nutritional support, an active programme of mobilisation and psychological support of the patient should be instituted as soon as initial management permits. Many patients with IF will have considerable depletion of lean body tissues (including muscle wasting) and an active, graded exercise programme under the supervision of physiotherapists will expedite recovery.

Many patients with severe acute type 2 IF may have considerable psychological problems related to disordered body image as a result of stomas, open abdominal wounds etc., while some may express anger or even hostility if type 2 IF has developed as a result of postoperative complications. All patients require sympathetic, honest explanations of how they came about their condition, and benefit from repeated discussions with members of the medical and nursing team. It is imperative that these discussions are adequately documented and good communication between team members and the patient and their family are maintained. Some patients benefit from expert psychological support.

For some patients, particularly those with severe acute type 2 IF, notably those with open abdominal wounds, a considerable period of time is required before reconstructive surgery should be contemplated. Wherever possible, patients should be able to spend this period of rehabilitation at home. Patients and family members may require training in wound/stoma care and central venous lines management so that TPN or fistuloclysis can be administered at home, pending reconstructive surgery. Robust arrangements should be established for regular outpatient monitoring and patients should be given 24 hour contact details for support. There should be a clear mechanism in place to facilitate urgent readmission where required. The precise arrangements for the commissioning and management of home care will depend upon the part of the UK in which it is undertaken. For example, a managed clinical network for HPN has been established in Scotland and Wales, whereas parallel commissioning arrangements are currently being developed in England.

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ISSUES IN PROFESSIONAL PRACTICE

The Surgical Management of Patients with Acute Intestinal Failure

## **CHAPTER NINE: DEFINITIVE RADIOLOGICAL ASSESSMENT**

Initial radiological assessment in acute IF focuses on excluding and treating abdominal sepsis. Apart from identifying potential reasons for failure of a fistula to close spontaneously, there is usually little need to attempt to define fistula anatomy until reconstructive surgery is contemplated.

It is vital that as much information as possible is obtained prior to embarking on a potentially difficult reconstructive laparotomy. Contrast imaging (barium follow-through, fistulography, contrast enemas) are usually required, together with further cross sectional imaging, as appropriate, to gain a detailed understanding of the anatomy, the state of the intestinal tract distal to the fistula and the presence of abscess cavities.

The amount of apparently healthy intestine below the fistula is a major factor determining the likelihood of nutritional independence (as opposed to type 3 IF) after successful reconstructive surgery. Assessment of the urogenital and biliary tracts may require further investigation, for example with ERCP and intravenous urography, respectively.

## CHAPTER TEN: RECONSTRUCTIVE SURGERY

Reconstructive surgery in type 2 IF should not be attempted until the patient has recovered fully. In many cases, this will necessitate a lengthy period of convalescence, during which time nutritional deficiencies are corrected, and abdominal wound healing occurs. When the abdomen has been left open, the process of neoperitonealisation (formation of a new peritoneal cavity from mesenchymal stem cells) commonly takes six months (**Scripcariu et al**, 1994). The best indicator that this process is complete is bulging or prolapse of intestine at the site of small bowel fistulation in the abdominal wound when the patient coughs. Attempts to explore the abdomen should be strongly resisted until this process has occurred, as the abdomen will be exceptionally hostile until then.

Similarly, reconstructive surgery should be contemplated **ONLY** when fistula anatomy has been fully assessed (see above), the condition of the bowel distal to the fistula confirmed, and inflammatory bowel disease (if relevant) treated adequately. It is important that any psychological problems associated with previous hospitalisation have been adequately addressed.

Intestinal reconstruction may range from simple resection of a small intestinal fistula and reanastomosis, to resection of multiple fistulating segments of small bowel and/or colon, together with reconstruction of large, contaminated abdominal wall defects. The most complex cases are technically very challenging and should only be undertaken in specialised centres where there is appropriate expertise and support (see below).

General principles are that there should be an adequate number of experienced surgeons and assistants (many units now require that two consultant surgeons are available for such cases), as well as suitably experienced senior anaesthetic support. Many patients will require at least a period of postoperative management on the intensive care unit. Blood loss may be considerable from extensive dissection of raw surfaces and is often underestimated. Dissection should be gentle and unhurried, in order to avoid enterotomy. Anastomotic technique should be meticulous and anastomoses should be kept out of old abscess cavities. Defunctioned small intestine distal to fistulas may be atrophic and extremely friable and, if multiple anastomoses are constructed, a defunctioning proximal loop stoma or drainage gastrostomy should be considered, as significant delay in the return of gastrointestinal function can be anticipated.

Where there has been fistulation into an open abdominal wound, preoperative assessment should include development of a strategy for closure of the associated abdominal wall defect. This will usually involve assessment of the size and nature of the abdominal wall defect using CT and/or magnetic resonance imaging. Reconstruction of the abdominal wall defect is an important part of these operations and failure to do so adequately may result in an increased risk of refistulation (**Connolly et al**, 2008), as well as poor functional outcome related to a large incisional hernia and inadequate cosmesis.

Detailed discussion regarding the techniques applicable to abdominal wall reconstruction are beyond the scope of this document. In general, however, techniques which employ autologous tissue, such as components separation (**Ramirez et al**, 1990) and suture repair, are most appropriate and appear to be safest and most effective. Larger defects may require plastic surgical reconstruction using pedicled flaps. The role of biologic implants (e.g. porcine dermal collagen) to repair large contaminated abdominal wall defects under these circumstances is unclear and has not been evaluated adequately (**Rosen**, 2010). Some initial reports have, however, been less than favourable, with a significant incidence of refistulation and mechanical failure (**Connolly et al**, 2008). Biologic implants are not currently recommended in the absence of more robust, independent data on clinical effectiveness. Synthetic non-absorbable mesh is absolutely contraindicated because of the risks of infection and refistulation.

Intestinal reconstruction may be required to restore patients with type 2 IF to enteral autonomy. In other cases, reconstruction of the intestinal tract may still be considered, even if the patient has insufficient small intestine to be independent of TPN. In these cases, closure of a stoma may considerably improve quality of life.

Bringing distal small intestine or colon back into continuity may also reduce TPN requirements and increase the likelihood of weaning over a prolonged period. These advantages have to be weighed against the risk of surgery and the possibility of unwanted consequences such as intractable diarrhoea (which may be more difficult to cope with than a well sited stoma), as well as renal calculi (which may develop if the colon is brought back into circuit distal to a short small intestine, as a consequence of oxaluria).

## CHAPTER ELEVEN: TROUBLESHOOTING IN TYPE 2 IF

### 11.1 The open abdomen

Under some circumstances, it may be inappropriate to close the abdomen after surgery in type 2 IF. When there has been extensive abdominal contamination, and particularly when there have already been previous attempts to treat abdominal sepsis (tertiary peritonitis), leaving the abdomen open (laparostomy) may facilitate further control of infection. Similarly, in some cases, swollen, inflamed intestinal loops and marked generalised oedema, including that of the abdominal wall, may make it impossible or undesirable to close the abdominal wall because of the risks of abdominal compartment syndrome. If it is possible to safely close the abdomen, leaving it open appears to confer no benefit and may increase morbidity (**Robledo et al**, 2007).

The vast majority of patients with an open abdomen will be managed initially on the ICU. A patient with an open abdomen presents a considerable challenge, particularly for nursing staff. Managing the open abdominal wound presents particular problems and avoidance of enteric injury is vital. Development of fistulation within the open abdomen is a catastrophic event. The combination of an open abdomen and an “enteroatmospheric fistula” within it is particularly difficult to manage and associated with a very considerable risk of death (**Rao et al**, 2007). A variety of techniques have been described for management of the open abdomen. Topical negative pressure (TNP) may be appropriate where the abdominal wall is intact or there are already open loops of bowel within an open abdominal wound, although the evidence to support this treatment is scarce and of generally poor quality. TNP should not be employed in open abdominal wounds where there are exposed but intact loops of bowel, because of the risk of inducing fistulation.

If TNP is to be used in the open abdomen, it should only be undertaken by staff with specialist training. Dressings should not be applied directly to bowel and arrangements should be put in place for rigorous audit as required by current guidelines published by the National Institute for Health and Clinical Excellence (**NICE**, 2010). In general, equivalent results may be obtainable by the use of simple layered non-adherent dressings, with suction catheters positioned outside the dressings to allow collection of exudate using low grade suction. If fistulation has already occurred in the open abdomen, wounds are ideally managed with a large Eakin bag, cut to size and perforated so that suction catheters can be placed inside the bag to control effluent. Patients with fistulation into the open abdomen require complex, specialist management and should be discussed with (and ideally referred to) a specialist centre as soon as possible.

## 11.2 Jaundice

Abnormalities of liver enzymes are common in patients with acute IF receiving TPN. Although the precise mechanisms are unclear, intrahepatic cholestasis may occur and hepatic steatosis and hepatomegaly have been reported. Many of these patients have sepsis (see below). If liver enzymes continue to deteriorate, TPN should be temporarily discontinued and the energy provision evaluated. There is increasing evidence to support the view that overfeeding is a major factor in the causation of liver problems and other metabolic complications associated with TPN.

A proportion of patients (typically 25%) with acute IF develop frank clinical or biochemical jaundice. Although this may be due to unrelated causes, including gallstones, jaundice is most frequently associated with inadequately treated sepsis (see above) and is an ominous prognostic sign. Any patient with type 2 IF and unexplained jaundice should be assumed to have an intraabdominal collection until this has been excluded by CT scan.

In some cases, where gallstones, drug reactions and sepsis have been excluded, progressive and unexplained liver dysfunction may develop. This is most frequently associated with a very short length of proximal intestine (typically <50 cm) and risk of progression to hepatic fibrosis with portal hypertension and, ultimately, liver failure. Liver biopsy is seldom helpful, showing non-specific periportal inflammation, lipid deposition and piecemeal necrosis. Attempts to improve bile excretion using ursodeoxycholic acid given orally or via infusion into distal bowel (if possible) may be of value, as may distal feeding with chyme reinfusion.

The outlook for patients who fail to respond to these measures is poor without combined liver and small bowel transplantation and referral to a specialist centre for assessment is appropriate.

## CHAPTER TWELVE: RESOURCES AND EXPERTISE REQUIRED FOR MANAGEMENT OF ACUTE IF

### 12.1 The Multidisciplinary Team

Management of patients with type 2 acute IF may be complex, prolonged, time-consuming and expensive (Carlson, 2001; Heriot & Windsor, 2005). Successful treatment requires a multidisciplinary team approach (Carlson, 2001). Surgeons who plan to manage patients with type 2 IF, rather than refer their patients to specialist units elsewhere, should ensure that appropriate expertise and resources are in place within their own organisation to enable them to do so safely and efficiently, within a governance framework which supports regular audit of clinical outcome.

Any organisation planning to provide definitive treatment for patients with type 2 IF should appoint a **nominated lead surgeon**, who will have undergone specific training, have the support of a surgical unit with the necessary skills and facilities, and have access to specialist multi-disciplinary teams within the hospital.

### 12.2 The Lead Surgeon

Specifically, the nominated lead surgeon should:

1. Be fully trained in general surgery **and** upper or lower gastrointestinal surgery.
2. Be a member of the Association of Surgeons of Great Britain and Ireland (ASGBI), the Association of Coloproctology of Great Britain and Ireland (ACPGBI) or the Association of Upper Gastro-Intestinal Surgeons (AUGIS).
3. Have spent at least six months of dedicated specialist training in intestinal failure surgery in a unit with expertise in managing acute intestinal failure (undertaking >10 cases per year).
4. Be the lead surgeon on the hospital nutrition support team and have spent at least six months working previously as a formally recognised member of a hospital nutrition support team.
5. Attend continuing medical education in intestinal failure and nutrition support (for example, courses at the national centres - Salford Royal and St Marks Hospitals - and symposia at national or international meetings, including meetings of the British Intestinal Failure Alliance, BAPEN, ESPEN, ASPEN, etc.)
6. Be familiar with the referral procedures for, and be prepared to discuss patients with colleagues in, national centres for severe intestinal failure (Salford Royal and St Marks Hospitals); and centres for Intestinal Transplantation (Oxford, Cambridge).

7. Have at least one supporting consultant surgical colleague who is a member of the same clinical team.

### 12.3 The Surgical Unit

The surgical unit looking after patients with acute intestinal failure should:

1. Be based in one ward which will be staffed by a nursing team with a specific interest in Gastrointestinal Surgery.
2. Have allocated foundation doctors and senior trainee(s) in General Surgery.
3. Be involved in regular morbidity and mortality meetings.
4. Regularly assess their quality of work at unit audit meetings, using the clinical outcome measures indicated in chapter thirteen.
5. Be accredited for providing postgraduate surgical training.
6. Have an interest in research, either by encouraging individual research projects or collaborating with existing clinical research projects.

### 12.4 The Nutrition Support Team

The ward nursing staff, specialist nutrition nurses and the nutrition support team (NST) are the backbone of the delivery of care to these patients and their families (**Heriot & Windsor, 2005**). Patients with acute IF should not be managed in hospitals without a NST. The NST needs to have the capacity to facilitate the transition of the patient's care from a hospital environment to a home environment (**Heriot & Windsor, 2005**).

As a minimum, a NST should consist of:

1. A clinician able to understand the surgical issues and advise about the appropriateness of either complex enteral or parenteral nutrition. A gastroenterological surgeon, medical gastroenterologist or biochemist may assume this role, but an understanding of the likely progress of the surgical problem and the ability to consider a variety of means of nutritional support is needed, rather than simply the ability to order parenteral nutrition. Where the clinician concerned is not a surgeon, arrangements should be made by the surgical team to provide appropriate surgical advice.
2. A dietitian with experience in estimating nutritional requirements and with expertise in the administration of enteral nutrition, by all routes, including nasoenteric and jejunostomy feeding.

3. A nutrition nurse specialist with expertise in management of access for both enteral and parenteral nutrition, an ability to train staff and patients in these techniques, to identify patients in need of psychological support and to refer patients for this or, wherever possible, provide counselling and support to the patient themselves.
4. A pharmacist with an understanding of the compounding and stability of parenteral nutrition and the interactions of both enteral and parenteral nutrition with other pharmacological treatment.

### **12.5 The Hospital/Organisation**

To support the unit in looking after these complex patients, the hospital/organisation should have:

1. Access to an emergency operating theatre on site, 24 hours a day, with a fully staffed recovery room.
2. An operating theatre with nursing (and/or technical) staff with a specific interest in gastrointestinal surgery.
3. An anaesthetic department with at least one member of anaesthetic staff with a particular interest in gastrointestinal surgery and pain management.
4. Critical Care facilities, including Intensive Care beds.
5. An imaging department with facilities for x-ray screening, CT scan, MRI scan and interventional radiology, and individual radiologists trained in interventional radiological techniques (notably percutaneous drainage).
6. Clinicians with expertise in venous access techniques.
7. Stomatherapy and tissue viability services.
8. A nutrition support team (NST) - see above.
9. A medical gastroenterologist with training in clinical nutrition.
10. Other surgical specialties (urology; hepatobiliary; plastic, gynaecology).
11. Other support specialties (notably microbiology).
12. Appropriate allied health professionals (physiotherapy; occupational therapy), social work, clinical psychologists.
13. Pharmacy facilities which permit a TPN compounding service.
14. Facilities for clinical audit (including, but not limited to, clerical support, IT facilities).

## CHAPTER THIRTEEN: MEASURING THE QUALITY OF CARE

Acute IF is associated with considerable morbidity and mortality. Many of the factors that are associated with morbidity and mortality are preventable (notably hospital acquired infection) and it is, therefore, imperative that robust arrangements are in place for audit.

The **quality of care** for patients with intestinal failure should be regularly assessed by the surgical team according to the following clinical indicators:

- (a) Infection rate in central and PICC lines used for administration of parenteral nutrition (role of Nutrition Support Team).
- (b) Unplanned return to theatre after surgery for type 2 IF (notably for bleeding; anastomotic leakage; intra-abdominal abscess).
- (c) Recurrent fistulation rate (after surgery for enterocutaneous fistula).
- (d) Success in discontinuation of artificial nutrition support (parenteral nutrition; parenteral fluids and electrolytes; fistuloclysis) in patients undergoing reconstructive surgery for type 2 IF.
- (e) Hospital and 30 day mortality, unplanned intensive care and hospital readmission rates.

## CHAPTER FOURTEEN: REFERRAL TO SPECIALIST CENTRES

The vast majority of patients with type 1 IF are currently managed satisfactorily in acute hospitals of differing sizes throughout the UK. The management of type 2 IF is more problematic. Different organisations and surgeons will vary in their threshold for seeking specialist advice for the management of patients with type 2 IF. This will depend upon their own training, availability of resources and support and relationships with patients and colleagues. Referral to a specialist centre with the facilities outlined above should certainly be considered for all patients who are considered to have type 2 IF in hospitals without a functioning nutrition support team. Additionally, we would recommend that when a clinician recognises that a patient may require prolonged parenteral nutrition that they should critically assess whether or not their institution has the multidisciplinary back up needed to optimise the care of such patients. Where doubt exists, it is advisable to seek a second opinion.

There are currently two national centres for managing patients with acute severe (type 2) IF (Salford Royal and St. Mark's). These have been established on the basis of a set of criteria which recognise a group of patients with particularly complex and challenging problems, such that management in a centre specifically designated and funded for treatment is appropriate.

These criteria are as follows:

1. Any patient with intestinal failure beyond the expertise of the referring hospital.
2. Recurrent intestinal fistulation after failed surgical treatment of type 2 intestinal failure.
3. Persistent intestinal failure requiring parenteral nutrition for more than 28 days, complicated by venous access problems due to catheter sepsis or thrombosis.
4. Multiple intestinal fistulas within a dehiscenced abdominal wound.
5. Total or near total (< 50cm) enterectomy.
6. Persistent abdominal sepsis.
7. Persistent nutritional or metabolic problems associated with a high stoma or fistula output.

In certain cases, surgeons may feel it appropriate to manage patients meeting any (or all) of the above criteria in their own hospital. This document is not intended to limit the scope of the individual surgeon to do so, but to set out the training, skills, and resources required to do so safely and effectively, in a group of patients with very considerable healthcare needs and hospital mortality. In the absence of the training and facilities described above, the prime responsibility of the surgeon managing a patient with type 2 is to stabilise the patient, particularly with regard to the management of sepsis and fluid balance, and arrange urgent transfer to an appropriate centre.

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