Surgical management of enterocutaneous fistula

The surgical management of enterocutaneous fistulae is centred on teamwork. Restoration of deranged physiology with aggressive treatment of sepsis, early and adequate nutrition, followed by delayed but planned surgery are key steps in the care of these complex patients. This article will explore these issues in greater detail.

Enterocutaneous fistulae are abnormal communications between the gastrointestinal tract and the skin. Although rare, they are associated with considerable morbidity and mortality, and present a considerable challenge in their management. Patients frequently undergo several operative procedures, and their physiological, nutritional and psychological reserves are often severely compromised. Management of these complex patients is multidisciplinary, and success achieved by a combined intestinal failure team, comprising medical, surgical and specialist nursing staff, dieticians, pharmacists as well as social support.

Aetiology

The majority of enterocutaneous fistulae (75–85%) form after operation, usually as a result of bowel injury, inadvertent enterotomy or anastomotic leakage. Fistula formation is more commonly associated with surgery in the presence of malignancy or inflammatory bowel disease, and with attempted division of dense adhesions (Berry and Fischer, 1996). In the remaining instances (15–25%), enterocutaneous fistulae form spontaneously secondary to underlying pathology. Inflammatory bowel disease, in particular Crohn's disease, is the most common cause of spontaneous enterocutaneous fistulation (Berry and Fischer, 1996); other causes include radiation enteritis, diverticular disease, malignancy, intra-abdominal sepsis and trauma (Edmunds et al, 1960; West et al, 1961; Galland and Spencer, 1986; Berry and Fischer, 1996). In developing countries, spontaneous fistulation may complicate infectious conditions, such as abdominal tuberculosis, amoebiasis and typhoid (Haffejee, 2004).

Classification

There is no universally accepted classification scheme for enterocutaneous fistulae. Characterization is usually made on the basis of anatomy (site of origin, simple or complex fistula, end or lateral fistula, and presence or absence of distal obstruction) or fistula output (with high output usually defined as more than 500 ml/24 hours). The majority of fistulae arise from the small bowel (Hollington et al, 2004; Lynch et al, 2004). The exact anatomy of an enterocutaneous fistula is usually delineated by a combination of clinical observation, biochemical analysis of fistula effluent and radiological investigation, of which contrast studies, including fistulogram, computed tomography (CT) and magnetic resonance imaging, are the most commonly used (Bartram and Buchanan, 2003). Thorough initial characterization of an enterocutaneous fistula is important as it provides prognostic information as well as planning for future potential surgery.

Mr V Datta *is Clinical Fellow and* **Mr ACJ Windsor** *is Consultant Surgeon in the Department of Surgery, University College London Hospitals, London NW1 2BU*

Correspondence to: Mr ACJ Windsor

Management

The initial imperative is stabilization of the patient. This should focus on correction of fluid depletion and any electrolyte imbalance. With high-output enterocutaneous fistulae dehydration and hyponatraemia are common. There may also be significant loss of potassium, chloride and bicarbonate ions, depending on the exact site of origin of the fistula, and the content of the effluent must be accounted for when calculating electrolyte replacement (Foster and Lefor, 1996; Gonzalez-Pinto and Gonzalez, 2001). Blood transfusion may be required if there is significant anaemia. Radiological characterization of the enterocutaneous fistula should only be contemplated once the patient has been adequately resuscitated and stabilized.

Sepsis

Sepsis is the biggest cause of death among patients with enterocutaneous fistula (Nightingale, 2003; Hollington et al, 2004; Lynch et al, 2004). This can be a result of intra-abdominal catastrophe or collections, or the result of other interventions, such as line (in particular central line) sepsis. Therefore early and aggressive treatment of sepsis is very important. Intra-abdominal collections should be drained, if possible by percutaneous drainage using either ultrasound or CT imaging. Occasionally, formal surgical drainage is required, and in the presence of ongoing sepsis a defunctioning stoma should be considered. In the case of central line sepsis, parenteral feeding (if this is appropriate) should be discontinued, the line cultured and appropriate antibiotics commenced.

Central venous lines must be removed in non-resolving sepsis, although many can be salvaged with antibiotic treatment. Colonization and infection by *Staphylococcus aureus* organisms is a bad prognostic indicator for line patency (Maki and Crnich, 2003).

Wound management

The enzyme content of fistula effluent, coupled with prolonged exposure of the skin around a fistula to moisture, can lead to rapid tissue breakdown around it. This prevents spontaneous closure and predisposes the patient to infection. It is also painful and distressing to the patient. Effective skin care can be achieved with a combination of appliances and barrier products; in the hands of an experienced practitioner the results can be dramatic (*Figure 1*). In addition, the collection of fistula effluent allows output to be measured accurately, thereby assisting fluid and electrolyte replacement. The benefits of vacuum-assisted closure (VAC) in managing surgical wounds are well documented (Webb, 2002; Heller et al, 2006). Advances in technology have allowed their application in enterocutaneous fistula wounds, where the bowel is protected against direct suction, and the results have been encouraging (Chavarria-Aguilar et al, 2004).

Control of fistula output

Manipulation of fistula output is important. Minimization of fluid and electrolyte fluxes aids in the management of accurate fluid and electrolyte balance, and may allow a patient to be weaned off parenteral nutrition and fluid support. In addition, reduction in the volume of irritant effluent facilitates skin care. However, it is debatable whether or not reducing output promotes spontaneous fistula closure. Although there is evidence that low-output fistulae have a greater rate of spontaneous closure than high-output fistulae (Fischer, 1983), the evidence that reducing output increases the likelihood of spontaneous closure is less convincing.

Intake of fluids low in sodium should be restricted and an electrolyte solution containing high concentrations of both sodium and glucose substituted to increase net water reabsorption from the small intestine. Gastric secretions can be reduced using H2 receptor antagonists or proton pump inhibitors, and bowel transit can be slowed with high doses of antimotility agents, such as codeine phosphate or loperamide, which can be used in combination (Campos et al, 1999). Somatostatin infusion may reduce fistula output, although this effect is not seen by its analogue octreotide, and neither agent has been shown to increase the overall likelihood of spontaneous fistula closure (Hesse et al, 2001). High volume outputs should be replaced intravenously with appropriate electrolyte supplementation.

Nutritional support

There are multiple factors that contribute to malnutrition in patients with enterocutaneous fistulae. The supply of nutrients may be limited, either as a result of anorexia or restriction of oral intake. Significant loss of protein, electrolytes and fluids can occur in fistula effluent as a result of loss of small bowel secretions that would ordinarily be reabsorbed (Windsor and Hill, 1988a). Loss of ingested nutrients through high-output fistulae originating from the small intestine effectively causes short bowel syndrome with resulting intestinal failure. Finally, patients often have increased energy demands as a result of ongoing sepsis and inflammation, although this is countered to a degree by reduced demands resulting from immobility. Adequate nutrition influences many aspects of care. It is widely accepted that malnutrition results in impaired wound healing and increases the risk of postoperative infection and complications (Windsor and Hill, 1988b; ASPEN Board of Directors and the Clinical Guidelines Task Force, 2002).

Figure 1. Complex fistula requiring significant skills to apply and maintain dressings.

There is ongoing discussion about which is the better route of nutrition, and linked to this is the debate about whether periods of bowel rest are beneficial or detrimental in patients with fistulae. It has been suggested that parenteral nutrition may decrease small bowel secretions and so not only decrease fistula output but also possibly increase the likelihood of spontaneous closure (Martinez et al, 1998). However, there have been no randomized trials comparing enteral *vs* parenteral nutrition and it is the authors' policy to introduce enteral nutrition as early as possible. In addition, there are scenarios where this is not possible, such as proximal fistula, distal obstruction and ongoing intra-abdominal sepsis, and the introduction of parenteral nutrition inevitable. The complications of feeding a patient intravenously through a central line should not be underestimated, with a significant morbidity and mortality associated with line sepsis, venous thrombosis and pneumothorax.

In recent years there has been increasing interest in the use of specially formulated feeds, both enteral and parenteral, to modulate the immune response to injury and illness. Although no study has specifically examined the role of these feeds in patients with enterocutaneous fistula, there is increasing evidence that they may be beneficial in the management of malnourished surgical and critically unwell patients (Martinez et al, 1998).

Other factors

Psychological support is sometimes overlooked, but is of great importance. Patients with enterocutaneous fistula have usually undergone major surgery and suffered a significant complication. They also face the prospect of a prolonged hospital stay and, in many cases, transfer to a tertiary institution well away from their own locality. In addition, the combination of an open wound and the production of fistula effluent are likely to have a detrimental effect on body image. All of these features lead to psychological distress that must be addressed adequately.

Fistula closure

Spontaneous closure

Rates of spontaneous fistula closure range from 19% (Garden et al, 1988) to 92% (Reber et al, 1978), although the upper extremes reflect small studies with selected subgroups of patients. The bigger series suggests that, on average, 40–50% of fistulae will heal without the need for surgical intervention (Hollington et al, 2004; Lynch et al, 2004). The range of spontaneous closure rates in these studies suggests differences in patient populations and enterocutaneous fistula characteristics. Factors that have been shown to predict spontaneous fistula closure are shown in *Table 1*. They include a long fistula tract, intestinal continuity, lack of distal obstruction, and no evidence of active inflammatory bowel disease.

Surgical closure

Although many enterocutaneous fistulae close spontaneously, if the fistula remains open after 2 months, surgical intervention is likely to be needed as spontaneous closure is unlikely (Hill, 1983). The timing of corrective surgery in relation to the initial operation(s) is important, as it affects the incidence of further complications (Li et al, 2003). Major abdominal surgery stimulates the formation of dense adhesions, especially when complicated by intra-abdominal sepsis. This reaction is most severe between 3 weeks and 3 months after operation, and further surgery during this time is more likely to be complicated by fistula recurrence (McIntyre et al, 1984; Schaffner et al, 1994). Delayed surgery also allows time for metabolic and nutritional deficiencies to be corrected.

It is the authors' policy to delay surgical closure for at least 6 months after the fistula has arisen to allow for fistula maturation, resolution of inflammation within the peritoneal cavity, optimization of the patient's nutritional state and for residual sepsis to resolve. Signs that enough time has elapsed are the return of a soft abdomen, as well as prolapse of the fistulating bowel, indicating the formation of neoperitoneum, with any residual skin induration being limited to the perifistula region. Definitive surgery comprises laparotomy and careful adhenolysis (in particular avoiding further enterotomies), en bloc resection of the involved bowel and overlying skin, and anastomosis. All diseased bowel must be resected and reanastomosis only performed between healthy ends, irrespective of the amount of bowel lost. The remaining small and large bowel is measured to assess whether long-term nutritional support may be necessary during recovery.

In the presence of persistent active sepsis, Crohn's disease, persistent malnutrition or if multiple anastomoses are required, a temporary defunctioning stoma is brought out (Reber et al, 1978; Li et al, 2003). Some patients with significant abdominal wall defects, in particular those with laparostomy wounds, require the insertion of absorbable mesh to facilitate abdominal wall closure during definitive surgery. This can leave an incisional hernia, which can be repaired at a later date with a permanent mesh. Non-absorbable mesh is not used at the time of definitive fistula surgery because of the high risk of infection of the prothesis at this time.

Recent retrospective reviews have described overall rates of successful enterocutaneous fistula closure (spontaneous combined with surgical closure) ranging from 69 to 93% (Reber et al, 1978; Berry and Fischer, 1996). The two largest series, from St Mark's Hospital (Hollington et al, 2004) and the Cleveland Clinic (Lynch et al, 2004), have both shown successful surgical closure rates of about 80%. In addition, both these studies have shown that patients operated on between 2 and 12 weeks after their last surgery had an enterocutaneous fistula recurrence rate double that of those whose operation was delayed for at least 24 weeks (recurrence rate 28–35% *vs* 15–20% respectively) (Hollington et al, 2004; Lynch et al, 2004). Complications of surgery are common, in par-

Continued on p. 31

Table 1. Factors that influence spontaneous closure of enterocutaneous fistula

Favourable	Long fistulous tract
	Intestinal continuity
	Absence of distal obstruction
	No sepsis
	Low fistula output (<500 ml/24 h)
	No malnutrition
	Anastomotic leakage
	Absence of inflammatory bowel disease
Unfavourable	Short fistulous tract
	Bowel discontinuity
	Distal obstruction
	Sepsis
	High fistula output (>500 ml/24 h)
	Malnutrition present
	Fistula arising from inflammatory bowel disease, malignancy or radiation enteritis

Continued from p. 30

ticular wound sepsis and ileus. More recently, operative mortality rates have improved to 3–3.5% (Hollington et al, 2004; Lynch et al, 2004).

Conclusions

The goal of enterocutaneous fistula management is closure with minimal morbidity and mortality. Treatment of enterocutaneous fistula should concentrate initially on correction of fluid and electrolyte imbalances, drainage of collections, treatment of sepsis and control of fistula output. Malnutrition is common, and nutritional assessment and provision are essential. Enteral nutrition should be used if possible, although high-output small bowel fistulae usually require supplemental parenteral nutrition.

Early recognition and control of sepsis, management of fluid and electrolyte imbalances, meticulous wound care, nutritional support and the delay of definitive surgery for at least 6 months have resulted in the observed low mortality rates of patients with enterocutaneous fistula. Multidisciplinary care for these patients is of great importance, with team members investing significant amounts of time and resources in their management. The overall mortality from enterocutaneous fistulae in the larger series is about 10%, the majority of these patients dying from sepsis before surgery can be contemplated (Windsor and Hill, 1988b; Hollington et al, 2004; Lynch et al, 2004). **BJHM**

Conflict of interest: none.

ASPEN Board of Directors and the Clinical Guidelines Task Force (2002) Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *J Parenter Enteral Nutr* **26**(Suppl): 1SA–138SA

Bartram C, Buchanan G (2003) Imaging anal fistula. *Radiol Clin North Am* **41**(2): 443–57

Berry SM, Fischer JE (1996) Classification and pathophysiology of enterocutaneous fistulas. *Surg Clin North Am* **76:** 1009–18

Campos AC, Andrade DF, Campos GM, Matias JE, Coelho JC (1999) A multivariate model to determine prognostic factors in gastrointestinal fistulas. *J Am Coll Surg* **188(5):** 483–90

Chavarria-Aguilar M, Cockerham WT, Barker DE, Ciraulo DL, Richart CM, Maxwell RA (2004) Management of destructive bowel injury in the open abdomen. *J Trauma* **56**(3): 560–4

Edmunds LH Jr, Williams GM, Welch CE (1960) External fistulas arising from the gastro-intestinal tract. *Ann Surg* **152***:* 445–71

Fischer JE (1983) The pathophysiology of enterocutaneous fistulas. *World J Surg* **7:** 446–50

Foster CE III, Lefor AT (1996) General management of gastrointestinal fistulas. Recognition, stabilization, and correction of fluid and electrolyte imbalances. *Surg Clin North Am* **76:** 1019–33

Galland RB, Spencer J (1986) Radiation-induced gastrointestinal fistulae. *Ann R Coll Surg Engl* **68:** 5–7

Garden OJ, Dykes EH, Carter DC (1988) Surgical and nutritional management of postoperative duodenal fistulas. *Dig Dis Sci* **33:** 30–5

Gonzalez-Pinto I, Gonzalez EM (2001) Optimising the treatment of upper gastrointestinal fistulae. *Gut* **49**(Suppl 4): iv22–iv31

Haffejee AA (2004) Surgical management of high output enterocutaneous fistulae: a 24-year experience. *Curr Opin Clin Nutr Metab Care* **7:** 309–16

Heller L, Levin SL, Butler CE (2006) Management of abdominal wound dehiscence using vacuum assisted closure in patients with compromised healing. *Am J Surg* **191**(2): 165–8

Hesse U, Ysebaert D, de Hemptinne B (2001) Role of somatostatin-14 and its analogues in the management of gastrointestinal fistulae: clinical data. *Gut Dec* **49**(Suppl 4): iv11–21

Hill GL (1983) Operative strategy in the treatment of enterocutaneous fistulas. *World J Surg* **7:** 495–501

Hollington P, Mawdsley J, Lim W, Gabe SM, Forbes A, Windsor AJ (2004) An 11-year experience of enterocutaneous fistula. *Br J Surg* **91**(12): 1646–51

Li J, Ren J, Zhu W, Yin L, Han J (2003) Management of enterocutaneous fistulas: 30-year clinical experience. *Chin Med J (Engl)* **116:** 171–5

Lloyd D, Gage S, Windsor ACJ (2006) Nutrition and management of enterocutaneous fistula. *Br J Surg* **93**(9): 1045–55

Lynch AC, Delaney CP, Senagore AJ, Connor JT, Remzi FH, Fazio VW (2004) Clinical outcome and factors predictive of recurrence after enterocutaneous fistula surgery. *Ann Surg* **240:** 825–31

Maki DG, Crnich CJ (2003) Line sepsis in the ICU: prevention, diagnosis, and management. *Semin Respir Crit Care Med* **24**(1): 23–36

Martinez D, Zibari G, Aultman D et al (1998) The outcome of intestinal fistulae: the Louisiana State University Medical Center—Shreveport experience. *Am Surg* **64:** 252–4

McIntyre PB, Ritchie JK, Hawley PR, Bartram CI, Lennard-Jones JE (1984) Management of enterocutaneous fistulas: a review of 132 cases. *Br J Surg* **71:** 293–6

Nightingale JM (2003) The medical management of intestinal failure: methods to reduce the severity. *Proc Nutr Soc* **62:** 703–10

Reber HA, Roberts C, Way LW, Dunphy JE (1978) Management of external gastrointestinal fistulas. *Ann Surg* **188:** 460–7

Schaffner A, Hocevar BJ, Erwin-Toth P (1994) Small-bowel fistulas complicating midline surgical wounds. *J Wound Ostomy Continence Nurs* **21:** 161–5

Webb LX (2002) New techniques in wound management: vacuum-assisted wound closure. *J Am Acad Orthop Surg* **10**(5): 303–11

West JP, Ring EM, Miller RE, Burks WP (1961) A study of the causes and treatment of external postoperative intestinal fistulas. *Surg Gynecol Obstet* **113***:* 490–6

Windsor JA, Hill GL (1998a) Protein depletion and surgical risk. *Aust N Z J Surg* **58:** 711–15

Windsor JA, Hill GL (1988b) Risk factors for postoperative pneumonia. The importance of protein depletion. *Ann Surg* **208:** 209–14

KEY POINTS

- Sepsis is the commonest preventable cause of death in patients with enterocutaneous fistulae.
- Patients are often septic and catabolic with high outputs, good fluid and nutritional management is essential.
- Defining the anatomy of the tract and the anatomy of the small bowel is essential for planning care.
- Good quality stoma and wound care is critical.
- Following restitution of physiology planned reconstructive surgery is usually delayed for up to 6 months.