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Clinical Images

Treatment of small-bowel fistulae in the open abdomen with topical negative-pressure therapy

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Open abdomen;
Enteroatmospheric fistula;
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Abstract

BACKGROUND: An open abdomen (OA) can result from surgical management of trauma, severe peritonitis, abdominal compartment syndrome, and other abdominal emergencies. Enteroatmospheric fistulae (EAF) occur in 25% of patients with an OA and are associated with high mortality.

METHODS: We report our experience with topical negative pressure (TNP) therapy in the management of EAF in an OA using the VAC (vacuum asisted closure) device (KCI Medical, San Antonio, TX). Nine patients with 17 EAF in an OA were treated with topical TNP therapy from January 2006 to January 2009. Surgery with enterectomy and abdominal closure was planned 6 to 10 weeks later.

RESULTS: Three EAF closed spontaneously. The median time from the onset of fistulization to elective surgical management was 51 days. No additional fistulae occurred during VAC therapy. One patient with a short bowel died as a result of persistent leakage after surgery.

CONCLUSIONS: Although previously considered a contraindication to TNP therapy, EAF can be managed successfully with TNP therapy. Surgical closure of EAFs is possible after several weeks.

There are several situations for open management of the peritoneal cavity: abdominal compartment syndrome, trauma, severe secondary peritonitis, postoperative abdominal wound dehiscence, and major abdominal wall defects secondary to necrotizing fasciitis or trauma. It effectively allows for damage control and the abdomen can be re-evaluated, allowing for prompt re-intervention when needed. However, when early closure cannot be performed, it can be associated with serious complications including intestinal fistulization, giant hernia formation, and wound infection.[1,2]

The formation of a small-bowel fistula in an open abdomen (OA) is the most critical complication. These fistulae have been called *enteroatmospheric fistulae* (EAF) because there is no overlying soft tissue.[3–6] This complication occurs in 25% of patients with a reported mortality rate of 42%.[7] If fistulae are associated with distal obstruction, malignancy, Crohn's disease, radiation enteropathy, or when mucosa is protruding, spontaneous closure will not occur. Up to 75% of other fistulae may heal, leaving another group needing delayed repair and abdominal reconstruction.[8]

An OA complicated with EAF results in a complex wound with inflammation of the surrounding skin because of persistent soiling and chemical irritation by intestinal

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Table 1 Patients with EAFs treated with TNP therapy

Patient	Age, y	Etiology of OA	Initial classification OA*	t(TNP), d	Elective surgery	Abdominal closure
1	89	ACS	Grade 1A	51	Partial enterectomy	Primary closure
2	42	ACS + peritonitis	Grade 4	63	Partial enterectomy	SCT
3	81	Burst abdomen + anastomotic leakage	Grade 4	42	Partial enterectomy	Primary closure
4	77	Burst abdomen + anastomotic leakage	Grade 3	40	Partial enterectomy	Primary closure
5	49	Peritonitis	Grade 4	61	Partial enterectomy/ fistula closure	†
6	83	Peritonitis	Grade 4	56	Partial enterectomy	Skin graft
7	55	Peritonitis	Grade 3	70	Partial enterectomy	SCT
8	78	Peritonitis	Grade 2B	40	fistula closure	Skin graft
9	62	Peritonitis	Grade 4	46	—	Composite mesh

ACS = abdominal compartment syndrome; SCT = separation of components technique; t(TNP) = duration of TNP therapy. d = days. — = spontaneous closure of fistula, no bowel resection or fistula closure.

*Classification of OA as proposed by Björck et al[14]: grade 1A, clean OA without adherence between bowel and abdominal wall or fixity (lateralization of the abdominal wall); grade 1B, contaminated OA without adherence/fixity; grade 2A, clean OA developing adherence/fixity; grade 2B, contaminated OA developing adherence/fixity; grade 3, OA complicated by fistula formation; and grade 4, frozen OA with adherence/fixed bowel, impossible to close surgically, with or without fistula. Patients 1 and 8 initially did not have a fistula within their open abdomen but eventually a small-bowel fistula developed during the laparostomy.

†patient died.

content, local infection, systemic sepsis, and severe electrolyte, fluid, and nutritional depletion.

Controlling the fistula drainage and protecting the wound and surrounding skin may be extremely challenging.

When topical negative pressure (TNP) therapy was introduced, some considered fistulae to be a contraindication to the use of vacuum therapy. Recently, the use of TNP or vacuum therapy has been reported in several case reports and case series with good or even excellent results.[9–13] This report describes our experience with TNP therapy in the management of EAF in an OA.

Patients and Methods

Patients

Nine patients with 17 EAF in an OA were treated with TNP therapy using the (vacuum assisted closure) VAC device (KCI Medical, San Antonio, TX) from January 2006 to January 2009. Most patients had multiple comorbidities and the mean age of the patients was 68 years (range, 42–89 y) (Table 1, Classification of OA as proposed by Björck et al[14]).

Two patients had an OA after decompressive laparotomy for abdominal compartment syndrome. In one of these patients (patient 1), a fistula developed in the OA 7 days after a decompressive laparotomy and in the other patient (patient 2) a small-bowel laceration was found in a frozen abdomen. Two patients had a burst abdomen and all other patients had severe secondary peritonitis complicated with small-bowel fistulae. All patients received total parenteral nutrition from the moment the fistula was diagnosed. Patients with high-output fistulae received somatostatin intravenously (6 mg/24 h).

Methods

The abdominal wound was rinsed with saline irrigation and covered with 3 layers of paraffin gauze dressing (Jelonet; Smith and Nephew Medical, Hull, UK).

Small fistulae without protruding mucosa were covered with a patch of hydrophilic polyvinyl alcohol foam (Fig. 1).

Figure 1 For small fistulae, the abdominal wound is rinsed with saline irrigation and covered with 3 layers of paraffin gauze dressing. The area of the fistula is covered with a patch of hydrophilic polyvinyl alcohol foam. The entire wound is covered with PU foam and an adhesive drape is placed to create a sealed environment (not shown). Negative pressure at −125 mm Hg is applied.

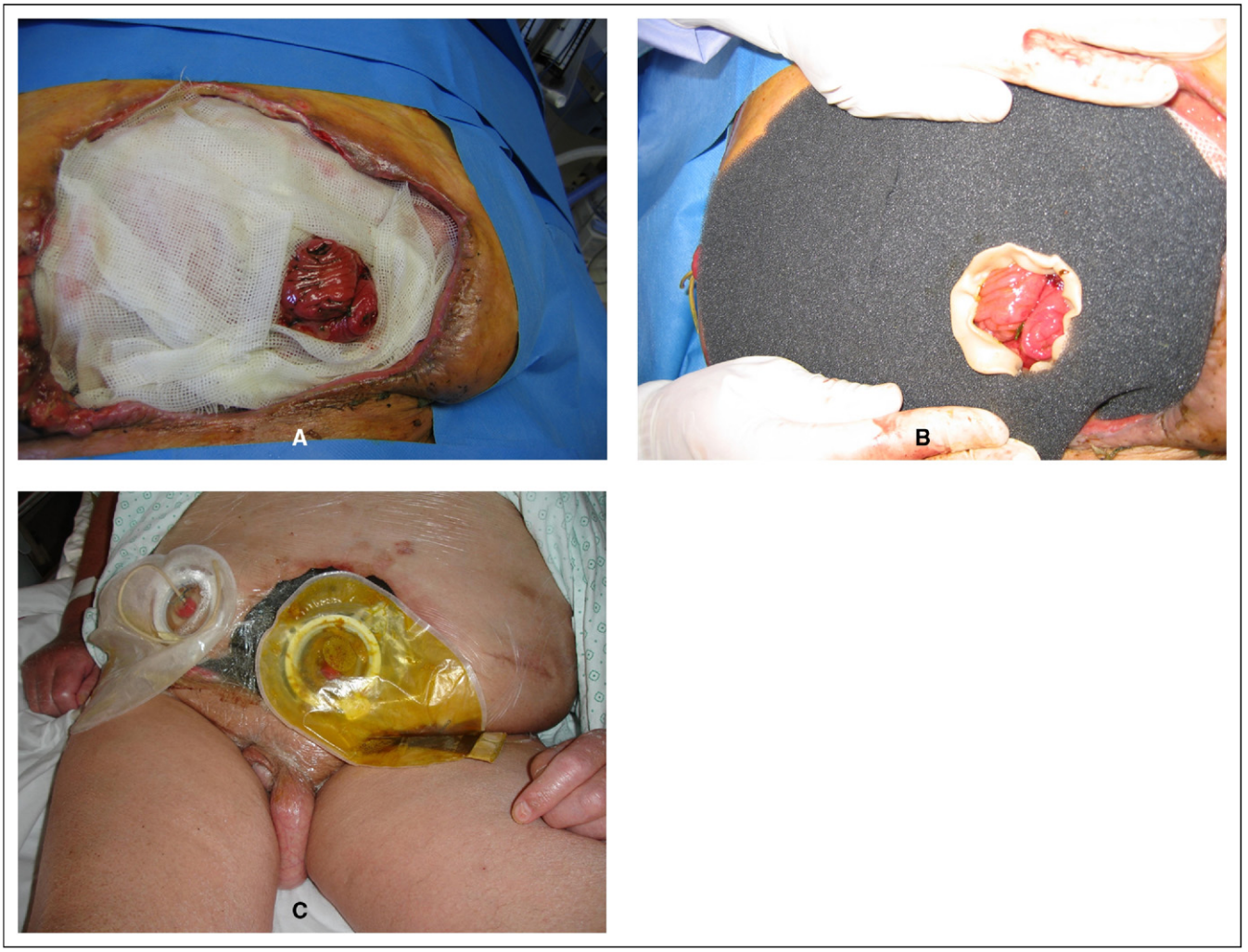

Figure 2 **(A)** For large fistulae with protruding mucosa, the laparostomy is covered with 3 layers of paraffin gauze dressing. **(B)** A hole is cut in the PU foam to match the fistula mouth and the PU foam is placed onto the fatty gauzes. Stomal paste is placed on the PU foam next to the protruding mucosa. **(C)** The foam is covered with an adhesive drape and continuous negative pressure at −125 mm Hg is applied. Finally, a hole is cut into the adhesive drape at the site of the fistula and an ostomy bag is placed over the fistula mouth.

The entire abdominal wound was covered with polyurethane (PU) foam, which promotes granulation of the wound and seals the OA, preventing further spillage of enteric contents. The foam was covered with an adhesive drape to create a sealed environment and continuous negative pressure at −125 mm Hg was applied.

For large fistulae with protruding mucosa a hole was cut in the PU foam to match the fistula mouth and the PU foam then was placed onto the fatty gauzes (Fig. 2). Stomal paste was placed on the PU foam next to the protruding mucosa to minimize direct suction on the mucosa. The foam was covered with an adhesive drape and continuous negative pressure at −125 mm Hg was applied. Finally, a hole was cut into the adhesive drape at the site of the fistula and an ostomy bag was placed over the fistula mouth. Dressings were changed every 4 days, always by the same surgeon. Surgery with enterectomy or fistula closure and abdominal closure was planned 6 to 10 weeks later.

Results

Granulation tissue surrounded the fistula mouth after 3 days, preventing further intra-abdominal spillage of enteric contents. No additional fistulas occurred during TNP therapy (Tables 1 and 2).

Spontaneous closure occurred in 3 of 17 fistulae (Table 2). Absence of protruding mucosa and low output (< 500 mL/24 h) were associated with statistically significantly increased EAF closure rates ($P = .0015$ and $P = .0147$, respectively). Serum albumin level and EAF location had no significant effect on closure rates ($P = .515$ and $P = .228$, respectively).

The mean time to closure was 12 days. A decrease of fistula output was observed in all these fistulae within the first days.

Definitive surgical management for EAF that did not close spontaneously was performed several weeks later

Table 2 Characteristics of EAFs

Patient	Albumin level: >3 g/L = 1; <3 g/L = 0	Number of fistulas	Fistula characteristics		
			Protruding mucosa: yes = 1	Output	Spontaneous closure
1	0	2	1	High	No
			1	High	No
2	0	3	1	High	No
			1	High	No
			1	High	No
3	1	1	1	Low	No
4	1	1	1	High	No
5	1	5	1	High	No
			1	High	No
			1	High	No
			1	High	No
			1	High	No
6	1	1	0	Low	Yes
7	1	2	0	Low	Yes
			1	Low	No
8	0	1	1	High	No
9	1	1	0	Low	Yes

High-output fistula, >500 mL/24 h; low-output fistula, <500 mL/24 h. Absence of protruding mucosa and low fistula output (<500 mL/24 h) were associated with statistically significantly increased EAF closure rates ($P = .0015$ and $P = .0147$, respectively). Serum albumin level and EAF location had no significant effect on closure rates ($P = .515$ and $P = .228$, respectively).

when patients were free of sepsis and when patients had a clinically soft abdomen. The mean time elapsed from the onset of fistulization to elective surgery was 52 days (median, 51 d; range, 40–70 d). The abdomen was entered at a distance from the existing fistula sites. All granulation tissue was removed (Fig. 3). The entire small bowel was mobilized from the ligament of Treitz to the ileocecal junction. Dissection of adhesions was performed sharply using scissors. Most of the adhesions encountered were loose and only rarely were dense adhesions found, making adhesiolysis relatively easy. In most cases the diseased bowel containing the fistula was resected and in 2 patients a small fistula was closed without enterectomy. One patient, who ended with a short bowel died postoperatively of anastomotic leakage. In 3 patients primary fascial closure could be performed after extensive lateral dissection. In 1 patient the abdomen was closed using an underlay composite mesh (Gore-Tex Dual Mesh, Gore & Associates, Flagstaff, AZ).

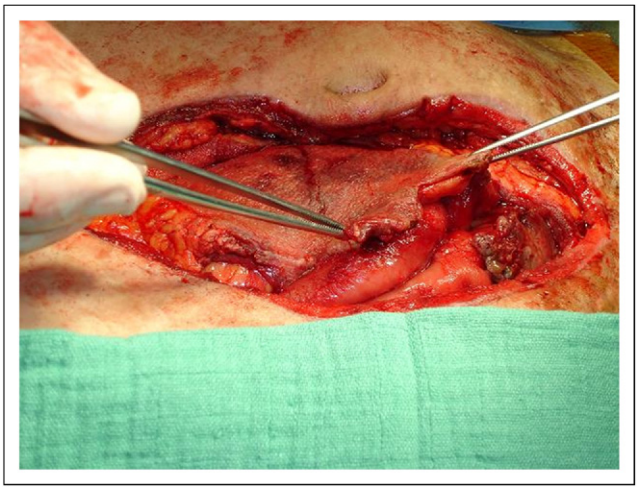

Figure 3 The abdomen is entered at a distance from the existing fistula sites and all granulation tissue is removed. A partial enterectomy or fistula closure is performed.

At the 30-month follow-up evaluation no ventral hernia developed. In 2 older patients with significant comorbidity in whom only partial abdominal closure could be achieved a skin graft was used. In 2 other patients reconstruction of the abdominal wall was achieved by using the separation of components technique described by Ramirez et al[15] (Table 1). At a mean follow-up period of 27 months (median, 28.5 mo; range, 10–47 mo) no subsequent fistulas developed. All patients who had primary closure of the abdominal wall, reconstruction of the abdominal wall using the separation of components technique, or using a composite mesh, did not develop a ventral hernia.

Comments

There are several situations that may result in an OA: damage control laparotomy, second-look laparotomy, severe intra-abdominal infection, and intra-abdominal hypertension. However, the OA is inherently fistulogenic because the bowel in an OA or laparostomy is exposed to desiccation and to frequent dressing changes that may damage the bowel.[16,17] EAFs occur in 25% of patients with an OA, with an associated mortality rate of 42%.[7]

Several reports suggest a higher fistula rate when TNP therapy is used to treat the OA.[18–20] However, in their prospective analysis of 42 patients, Shaikh et al[21] concluded that TNP therapy appeared to be safe and was not associated with a high incidence of enteric fistula. Only 2 of 42 patients developed enteric fistulae. As in our series, certain steps were taken to prevent mechanical trauma to the bowel when TNP therapy was used to treat an OA. The use of continuous TNP therapy may reduce the repeated mechanical deformation to the bowel surface compared with intermittent TNP therapy. A nonadherent layer such as fatty gauzes provides a protective barrier between the foam dressing and the bowel whereas excessive fluid can egress through the pores. The nonadherent layer also prevents ingrowths into the foam itself. Negative pressure is limited to a maximum of −125 mm Hg.

Since 2000, case reports and small case series have been published reporting treatment of small-bowel fistulae using TNP therapy.[9–13,22] As in our series, Gunn et al[13] showed a significant correlation between visible mucosa and nonclosure of enteric fistulas. Indeed, in the present series absence of protruding mucosa and low output were associated with statistically significantly increased EAF closure rates. Fourteen of 17 fistulas had visible mucosa and did not close spontaneously with TNP therapy. However, in these patients the TNP dressing was used to collect the effluent, protect the surrounding skin, and to promote fast granulation on top of the visceral block preventing further inflammation of the surrounding tissue, adhesion formation, and further sepsis.

In general, if a patient is free of sepsis, well-nourished, and fistula closure did not take place within 6 weeks, then surgical intervention will be mandatory. There is a lot of debate regarding the timing of re-intervention but definitive surgery often is delayed until a minimum of 6 months have passed to reduce the risk of encountering a frozen abdomen owing to dense adhesions.

In other series with large fistulas with visible mucosa patients mostly received a split-thickness skin graft, leaving the fistula as a controlled stoma.[19] Definitive surgery was delayed for 6 to 10 months. We performed definitive surgery for large fistulas with restoration of gastrointestinal continuity after several weeks, once nutritional status had improved and the abdomen had become soft. Thus, the TNP strategy for OA with intestinal fistulization seems to prevent the need for long-term total parenteral nutrition and the development of planned large ventral hernias.

Although previously considered a contraindication to TNP therapy, the OA complicated with EAF can be managed successfully with TNP therapy. Covering the abdomen with a nonadherent layer of fatty gauzes and a tailored application of the polyvinyl alcohol and PU foam as well as reduced negative pressure (−125 mm Hg) seems to allow a safe and reliable way to manage EAF. Spontaneous closure of low-output fistulas without protruding mucosa is possible. Surgical closure of larger fistulas with visible mucosa is possible within several weeks.

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