Development of Two Enteroatmospheric Fistulae After Split-thickness Skin Grafting: A Case Report

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Abstract
An enteroatmospheric fistula is a devastating complication in the open abdomen. Usually the fistula forms before the completion of split-thickness skin graft surgery. A 35-year-old woman admitted with pancreatic and liver injuries, and postoperative sepsis underwent open abdomen treatment and developed two enteroatmospheric fistulae 14 days after split-thickness skin grafting. The complication was believed to have occurred as a result of multiple surgical manipulations for intra-abdominal hemorrhage and skin graft dressing changes. One fistula, measuring 0.5 cm in diameter, was managed using a tailored 20-mL syringe, secured to the surrounding tissues with ostomy paste, and a suction catheter. The other fistula, measuring 1.8 cm in diameter, required insertion of a catheter to collect the effluent. Once the effluent was controlled effectively, a second split-thickness skin graft procedure was performed to facilitate fistula management. The patient remained stable until successful fistula repair 8 months later, and she is now awaiting elective abdominal wall reconstruction. This case study is an important reminder that patients with an open abdomen, even after split-thickness skin grafting, are at risk for enteroatmospheric fistula formation. Once this severe complication occurs, effective control of fistula effluent and subsequent split-thickness skin grafting procedures are needed.

Keywords: case study, enteroatmospheric fistula, intestinal fistula, open abdomen, split-thickness skin grafting

Case Report
History. Ms. K is a 35-year-old woman who underwent abdominal washout for blunt pancreatic and liver injuries at a local hospital and subsequently developed postoperative sepsis. On post-injury day 9, she was transferred to the author’s facility, a tertiary teaching hospital in China. An emergency pancreatic necrosectomy and abdominal washout were performed, followed by temporary abdominal closure using a modified vacuum pack technique.³ Four planned relaparotomies and abdominal washouts were performed in the subsequent 2 weeks, followed by the creation of an ileostomy for colic fistula on post-admission day 61. On post-admission day 74, a split-thickness skin graft was harvested from her scalp and applied to cover the open wound. Unfortunately, Ms. K had intra-abdominal hemorrhage on post-grafting day 6 while the skin graft was immature. Abdominal packing was provided and removed without re-bleeding 5 days later.

Two EAFs were identified on post-grafting day 14 (see Figure 1). The one without protruding mucosa (fistula A), measuring 0.5 cm in diameter, was located in the center of

Enteroatmospheric fistula (EAF) is defined as an abnormal communication between the gastrointestinal tract and the atmosphere.¹ As a subtype of enterocutaneous fistula (ECF) occurring exclusively in the open abdomen, an EAF usually forms before the patient receives split-thickness skin grafting. Once a split-thickness skin is applied and becomes mature, it protects underlying bowels and granulation tissue effectively, substantially decreasing the risk of EAF formation.² No reports have been published demonstrating EAF occurrence after skin grafting, nor has experience in managing this devastating complication at this phase been described. To illustrate and document the effects of this complication, a case study involving a 35-year-old patient is presented.

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the open wound. It initially presented as an intestinal desvascularization and subsequently developed into a fistula. The fistula with protruding mucosa (fistula B), measuring 1.8 cm in diameter, was located in the right lower area of the open wound, where abdominal packing had been previously provided. The output volume of fistula A and B were approximately 50 mL and 300 mL per day, respectively.

**Treatment.** For fistula A, the care plan included collecting effluent and protecting surrounding tissue. Specifically, the tip of a 20-mL syringe was cut, and the syringe was placed over the fistula and secured to surrounding tissue using ostomy paste (Coloplast Corp, Denmark). A suction catheter then was placed into the syringe to drain fistula effluent. For fistula B, a suction catheter was inserted for effluent drainage, and petrolatum gauzes were packed around the fistula opening. In this way, the effluent of both fistulae was effectively collected and drained, preventing contamination of the open wound.

Once the effluent was controlled effectively, 15 days after identifying the fistulae, a second split-thickness skin graft procedure was performed (see Figure 2). Post-graft management of fistula A continued as previously described using a cut-to-fit syringe. As soon as the second skin graft matured, the suction catheter in fistula B was removed, and an effluent control method similar but not exactly the same as the one for fistula A was used for fistula B — specifically, a polypropylene cup, 9 cm in diameter, was cut, secured on surrounding tissue by ostomy paste, and fixed by an elastic “girdle” (see Figure 3). A suction catheter then was placed into the cup for effluent drainage.

**Results.** Fistula A reduced substantially in both size from 0.5 cm to 0.2 cm and in output volume from 50 mL to 5 mL per day. As such, use of the 20-mL syringe was discontinued, and the fistula opening was covered with dry gauze only. Management of fistula B continued using the tailored polypropylene cup, which was secured to surrounding tissues. Ms. K remained stable and underwent successful fistula repair 8 months later. Fistula A was repaired using 5-0 silk suture (Ethicon Inc, Somerville, NJ), and fistula B was resected along with adjacent bowel segments. Ms. K is now waiting for elective abdominal wall reconstruction at a rehabilitation center, and her general prognosis is good.

**Discussion**

Open abdomen treatment was initially used as part of “damage control surgery” in trauma patients. During the past two decades, the open abdomen treatment has been increasingly used in a variety of patients, such as those with abdominal trauma, intra-abdominal sepsis, and patients at a high risk of intra-abdominal hypertension after emergency general and vascular surgery. Nevertheless, the treatment is associated with a number of severe complications, including EAF, peritoneal contamination, intra-abdominal abscess, fluid and protein loss, and ventral hernia.

As for most cases, EAF develops when the open wound has not developed sufficient granulation tissue for skin grafting. At this phase, exposed bowels are prone to injury induced by dressing changes, surgical manipulation, friction from prosthetic materials, and exposure to air (desiccation). Once split-thickness skin is grafted and becomes mature, it provides protection to underlying bowels and granulation tissue, simultaneously decreasing the risk of fistula formation. In this case study, the formation of the two fistulae was believed...
to be associated with failure of the immature skin graft to protect underlying tissues, as well as unintentional trauma to bowels and granulation tissue during multiple surgical hemostatic manipulations and dressing changes.

Treatment options. A number of approaches have been reported in case studies dealing with EAF before split-thickness skin grafting, including use of acellular dermal matrix and fibrin glue,6 “floating stoma” technique (the fistula opening is sutured to a plastic silo intravenous fluid bag with a hole fitting the fistula opening),7 and conversion of a fistula to a controlled stoma using a Malecot catheter and mobilization of skin and subcutaneous flaps.8 More recently, negative pressure wound therapy (NPWT) has been utilized to manage EAF.9-13 In a case series of five patients, Goverman et al11 used a vacuum-assisted closure (V.A.C.® Therapy, KCI, San Antonio, TX) dressing with an opening for the fistula to collect fistula output using an ostomy device secured on the polyurethane drape of NPWT system while covering the open wound. NPWT can be further improved by inserting an appropriately sized Malecot catheter into the fistula opening, which then is tunneled through NPWT dressing12 or by placing a baby bottle nipple over the fistula, which is connected to a Malecot or Foley catheter with inflated balloon, as shown in several case studies.13,14 None of the current approaches have shown definitive benefit in managing EAF, and many have limited applicability due to surgical difficulty or device unavailability. Moreover, no report has been identified in the literature investigating the specific management of EAF after split-thickness skin grafting.

Several authors11 describe continued use of negative pressure devices to manage EAF after skin grafting until an ostomy device could be utilized. However, the application of a negative pressure device makes it difficult to visualize the viability of the skin graft, and there are reports of new fistula formation when using these devices.15

In the current patient, both fistulae were managed effectively. Because fistula A was superficial, small in size, and without protruding mucosa, a tailored 20-mL syringe with a suction catheter was used to collect and drain fistula effluent. Positioning and sealing of the syringe was achieved with the aid of ostomy paste, even when the skin graft was not fully mature. Fistula B was characterized by protruding mucosa and lacked surrounding granulation tissue, necessitating the insertion of a catheter for effluent drainage, and then managed with an ostomy device similar to the one for fistula A as soon as the second skin graft was mature. The ostomy device

Figure 2. Management of the two fistulae 16 days following the second split-thickness skin grafting procedure. Fistula A effluent was managed with a tailored 20-mL syringe, and a suction catheter was inserted into fistula B.

Figure 3. Management of the two fistulae 186 days after the second split-thickness skin grafting procedure. Fistula A was significantly smaller and output volume was reduced to approximately 5 mL per day. Fistula B continued to be managed with an ostomy device.
not only provided protection to the protruding bowel, but it also facilitated suction of fistula effluent. The approaches were easy to implement and useful in collecting fistula output as well as protecting surrounding tissues. The devices used are widely available and inexpensive. Furthermore, the second split-thickness skin grafting not only facilitated fistula management by providing a foundation for ostomy devices, but it also prevented new fistula formation by protecting underlying tissue.

**Conclusion**

As demonstrated in this patient, surgeons should be vigilant regarding EAF formation even after split-thickness skin grafting, especially when performing surgical manipulation or dressing changes on the open wound before the skin graft is mature. Once this severe complication occurs, an effective effluent control approach should be utilized until definitive repair of the fistula.

**References**