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• Case Report •

# Enteroatmospheric Fistula Associated with Open Abdomen

Jihun Gwak, M.D., Min A Lee, M.D., Dae Sung Ma, M.D., Kang Kook Choi, M.D.

*Department of Trauma Surgery, Gachon University Gil Medical Center, Incheon, Korea*

Enteroatmospheric fistula (EAF) is one of the most devastating complications in patients with an open abdomen and has associated morbidity and mortality rates. No gold standard therapy has been established for the treatment of EAF, and thus, treatment decision making is dependent on the experience of medical staff. Nevertheless, treatment involves the following; 1) sepsis must be managed, 2) sufficient nutritional support must be provided, and 3) effluent must be isolated from skin and open viscera. Here the authors present the case of a 29-year-old man who developed enteroatmospheric fistula after damage control laparotomy. [ J Trauma Inj 2016; 29: 195-200 ]

**Key Words**: Enteroatmospheric fistula, Open abdomen, Negative pressure wound therapy

## I. Introduction

Enteroatmospheric fistula (EAF) is one of the most devastating complications of open abdomen (OA) with a reported mortality of over 40%. The incidence of EAF in trauma patients with OA ranges from 4.5% to 25%.(1) The absence of a fistula tract and the lack of well-vascularized surrounding tissue are specific characteristics of EAF. As a result, the spontaneous healing of EAF is nearly impossible. Here the authors present the case of a 29-year-old man who developed enteroatmospheric fistula after damage control laparotomy.

## II. Case Report

A 29-year-old male patient was admitted to trauma surgery department after a motorcycle accident. On arrival, his pulse was 147 beats per minute and blood pressure was 70/40 mm Hg. His mental status was alert but he was hypothermic. Blood transfusion and warming were immediately instituted. Focused Assessment with Sonography (FAST) finding was positive in the abdomen. Resuscitative Endovascular Balloon Occlusion (REBOA) was implemented using the blind technique, a Coda balloon catheter (Cook Incorporated, Bloomington, IN) was placed in zone I for 30 minutes. After REBOA, the patient's blood pressure increased to 130 mmHg. Computed tomography revealed liver laceration, bleeding of mesentery, complete infarction of the right kidney, multiple rib fractures, and a pelvic bone fracture (Anterior Posterior Compression type III) (Fig. 1). Multiple perforations of small intestine and liver laceration were observed in operation. Temporary abdominal closure was performed after perihepatic gauze packing, resection of 50 cm of small intestine, and preperitoneal pelvic packing. External fixation of the pelvis was immediately followed by abdominal surgery. After 1 day in hospital (hospital day 1; HD1), Continuous renal replacement therapy was implemented due to acute kidney injury. On HD2, right nephrectomy

* Address for Correspondence : **Kang Kook Choi, M.D.**
Department of Trauma Surgery, Gachon University Gil Medical Center,
783 Namdong-daero, Namdong-gu, Incheon 21556, Korea
Tel : 82-32-460-3010, Fax : 82-32-460-2372, E-mail : choikangkook@gilhospital.com
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was performed due to complete infarction of the right kidney, but abdomen closure was unsuccessful due to severe bowel edema. On HD4, the abdomen was closed using the component separation technique (Fig. 2). However, on HD10 wound dehiscence occurred.

We focused on treating sepsis and coagulopathy, and on HD17, a liquid diet was introduced through the Levine tube as the patient's condition improved. On HD24, symptoms of peritonitis appeared and exploratory laparotomy was undertaken. Perforation of right colon at the hepatic flexure was observed and right hemicolectomy with ileostomy was performed. On HD26, a perforation was observed 3 cm below the ileostomy. Ileostomy and the perforation were resected emergently and a stoma was created at midline (Fig. 3). However, on HD44, the midline incisional wound necrotized and wound dehiscence re-occurred. Finally, on HD64, OA with multiple EAF was made (Fig. 4).

We applied primary suture with cyanoacrylates (Dermabond, Ethicon, Somerville, NJ) to small EAF,

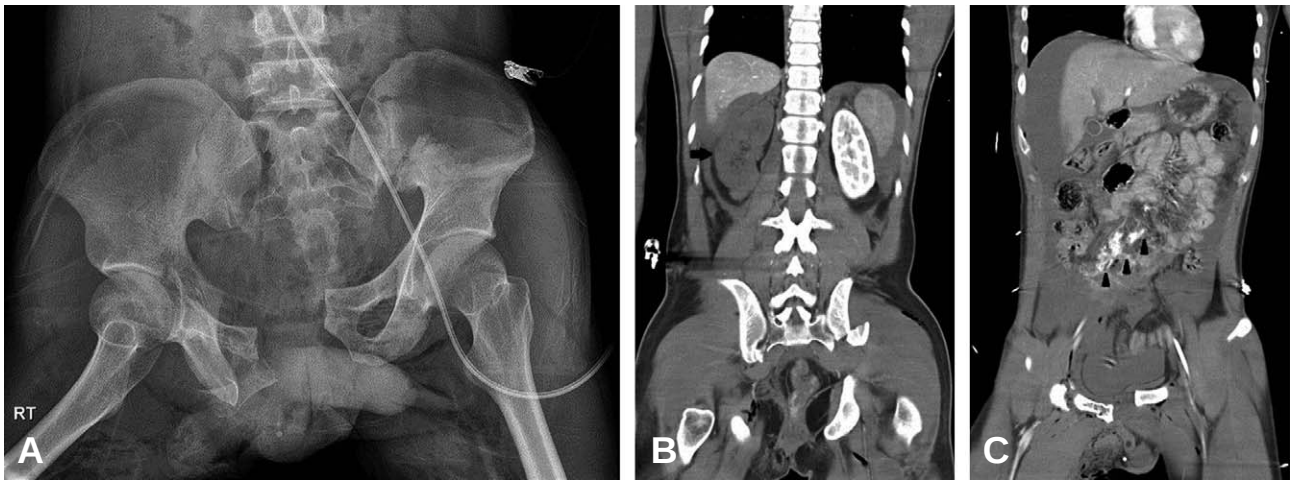


**Fig. 1.** Pelvic AP scan showing anteroposterior compression type 3 pelvic fracture (**A**). Coronal view abdominal CT scan showing complete infarction of the right kidney (**B**) and mesenteric bleeding (**C**).

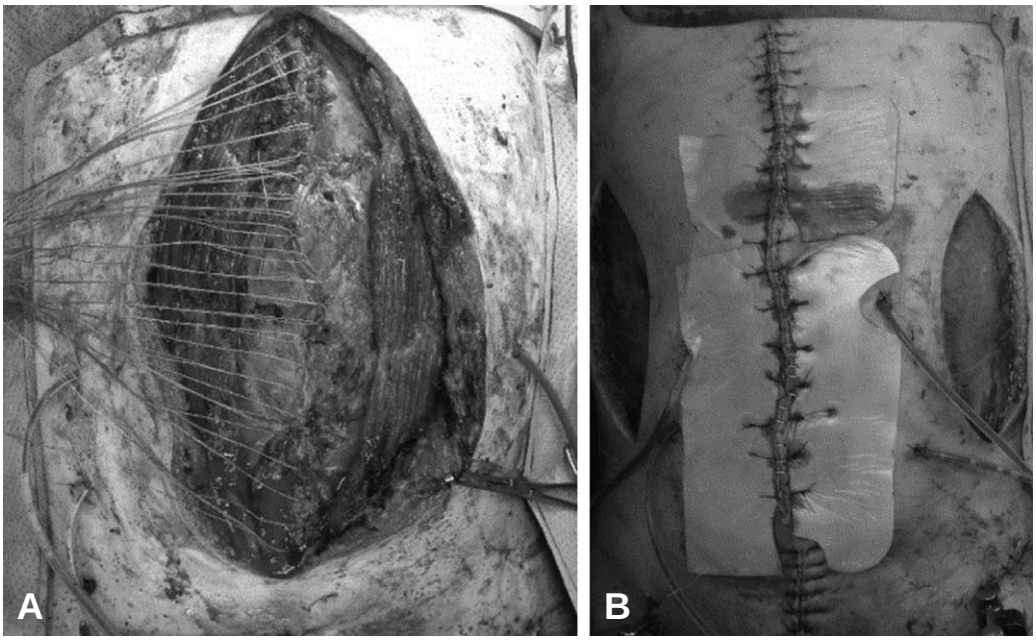


**Fig. 2.** Component separation technique using an anterior rectus sheath turnover (**A**). Lateral incisions were made to close skin at the midline incision (**B**).

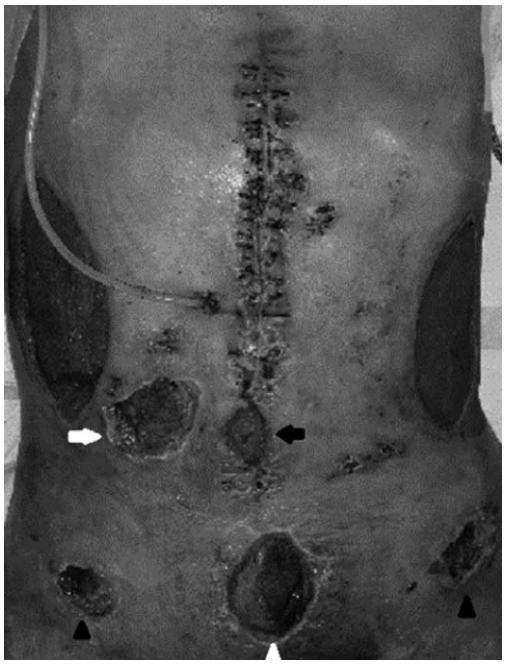

**Fig. 3.** Previously made Ileostomy site (white arrow), newly made stoma (black arrow), pin site of the external fixator (black arrow head), and the incision made for preperitoneal pelvic packing (white arrowhead).

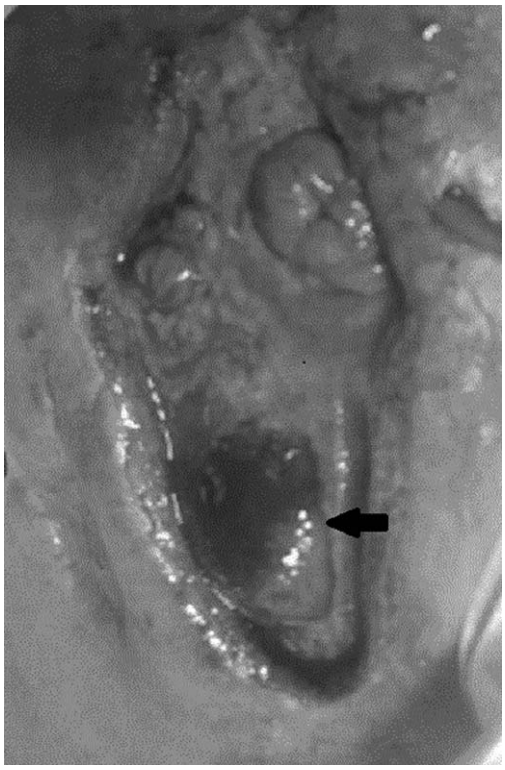

**Fig. 4.** Multiple enteroatmospheric fistulas with open abdomen. The black arrow indicates a newly formed stoma (black arrow of Fig. 3).

but one day later the EAF reopened. Subsequently, wound crown method was applied to divert effluent of EAF,(2) but failed because perforation sites adjoined the abdominal wall. Then, a fistula plug was applied, but it was difficult to fix the plug in the EAF. A baby bottle nipple method was tried and quite successful somedays but fixation of the nipple on the EAF was not easy. Lastly, we applied a large colostomy bag or frequent gauze dressing. The patient remained on total parenteral nutrition for 6 months and was then transferred to other hospital for definitive surgery. Segmental resection of the perforated bowel was performed successfully. 6 months after his accident, the patient was taking solid food and his body weight had increased to pre-accident state. He remained in a bedridden state awaiting pelvic surgery.

## III. Discussion

Considerable difficulty was experienced managing EAF in the described patient, primarily due to a lack of experience. In retrospect, the Vaseline gauze barrier between the reticular foam of vacuum assisted closure (VAC) and open viscera was inadequate, and the sometimes high negative pressure (100-120 mmHg) applied to drain effluent resulted in injury and bleeding of serosa. The patient had a high output EAF and the EAF was adjoined to the wound, made it more difficult to manage.

EAF presents a huge challenge and requires a multidisciplinary - surgical, metabolic, nutritional, and nursing - approach. Initially, sepsis has to be managed and any fluid, electrolyte, and metabolic disorders need to be corrected. Oral intake must be stopped until EAF was controlled and total parenteral nutrition introduced. Due to hypercatabolism and the losses caused by laparostomy and the fistula, appropriate calorie, protein, vitamin and microelement supplies must be ensured.(3)

Recently, negative pressure wound therapy was introduced to manage OA. For many years, the application of negative pressure wound therapy (NPWT) was considered to increase the possibility of fistula formation, but additional studies have demonstrated that NPWT is safe.(4-7)

All techniques described aim to completely divert

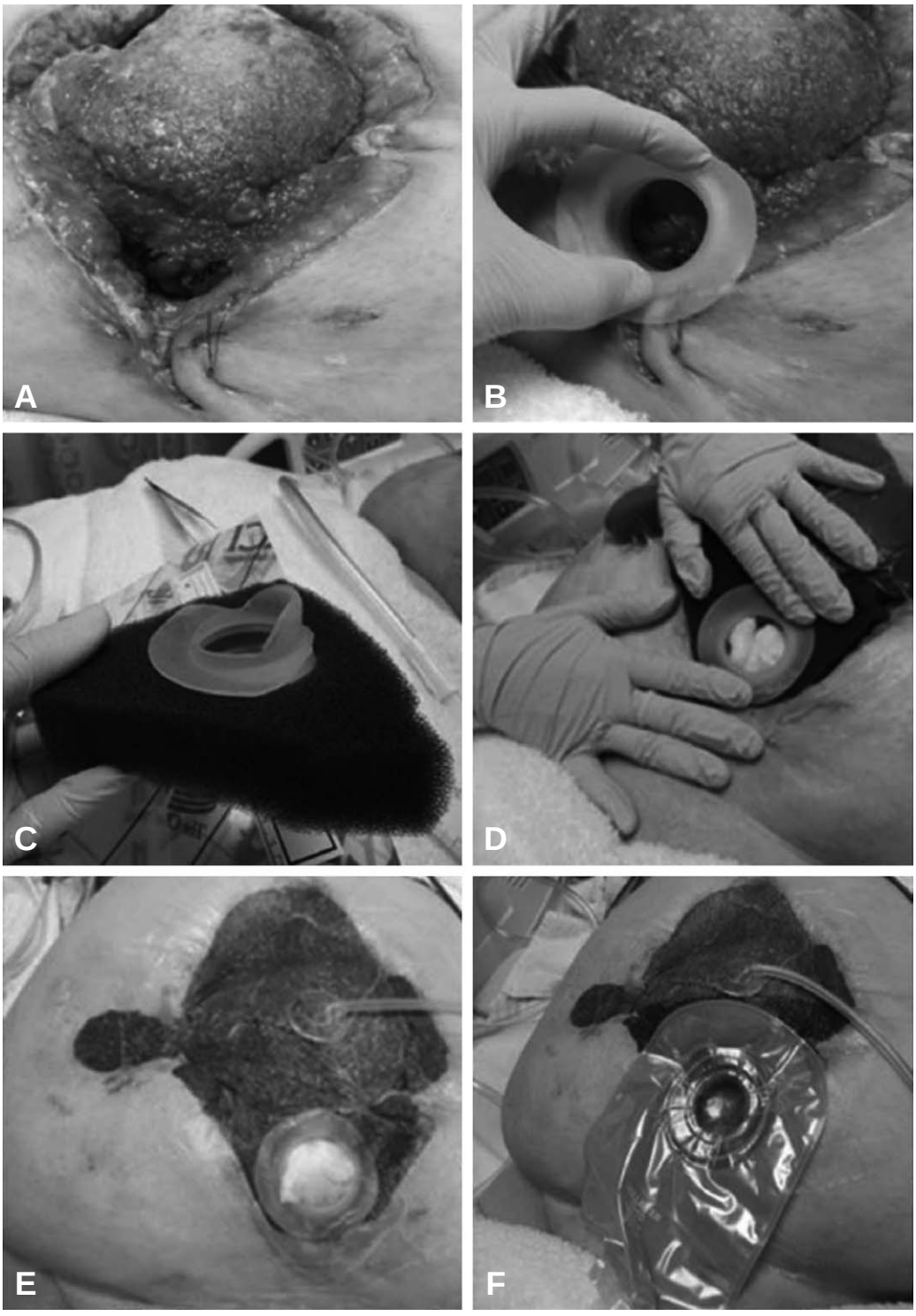


**Fig. 5.** Application of the collapsible fistula isolation device on a patient with a large open abdominal wound after surgical ileostomy. (**A**) Bowel opening at the 6 o'clock position at the skin edge. (**B**) Wound crown positioned over the fistula stoma. (**C**) The wound crown was tailored to mirror the base of the wound bed and was placed in reticulated open cell foam. (**D**) The dressing assembly was placed into the wound bed. Gauze was temporarily placed in the wound crown opening to allow cutting an opening in the clear drape. (**E**) Negative pressure wound therapy was initiated. Note the effluent on the white gauze inside the isolation device. (**F**) The clear drape was cut free and the gauze removed, which left the bowel open to the pouching system.

fistula output to protect surrounding viscera and allow clean granulation of exposed bowel, thus causing the fistula to become chronic and controlled.(8) While treating the described patient we attempted the following techniques.

1. Biologic dressing with fibrin glue or cyanoacrylate with primary sutures, which have been described to produce good results, particularly for small and low output (<200 mL/24 hrs) fistulas.(9) Fibrin glue can improve the outcomes of biologic dressings, help keep them in place, and effectively seal fistula. Cyanoacrylates can be beneficial for small EAFs, especially as an adjunct to primary suturing.(10)

2. Crown VAC uses a collapsible fistula isolation device (Wound Crown, Fistula Solution) with a separation technique based on negative pressure wound therapy and the use of reticulated open cell foam (NPWT/ROCF) on fistulas with moderate to high output levels (Fig. 5). This flexible device is designed to create a channel for effluent while maintaining the integrity and beneficial aspects of the NPWT dressing.(2)

3. Fistula plug: This is a plug designed to seal the EAF from inside, and consists of a circular disk of 1-mm thick silicone of diameter of 2 to 5 cm (Fig. 6). A Vicryl suture is passed through the center of the silicon circle and then tied to a rubber band attached to bridge of foam-covered aluminum. The silicone plug is then rolled and inserted into the fistula, the plug is hung on the bridge using a suspension suture and the rubber band. The bridge is fixed to the abdominal wall using a self-adhesive plaster. Eventually, when the fistula is closed, the suture is cut off and the silicon plug is discharged at time of defecation.(11)

4. Baby Bottle Nipple VAC: A baby bottle rubber nipple is placed over the fistula opening and a Pezzer tube, Malecot, or Foley catheter is placed through a small hole cut into the tip of the nipple (Fig. 7). A layer of colostomy paste can be placed under the

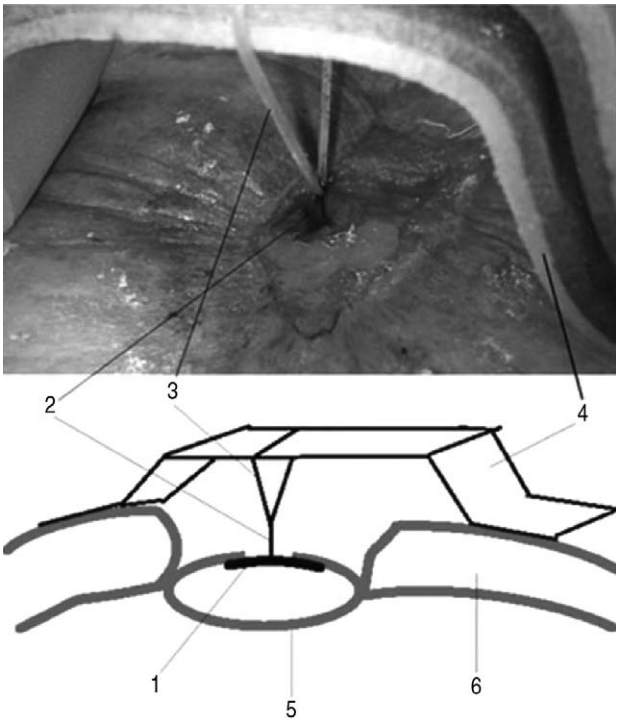


**Fig. 6.** Fistula plug suspended from bridge: 1. Circular silicone plug; 2. suspension suture; 3. suspensory rubber band; 4. bridge; 5. fistulized bowel, and 6. abdominal wall.

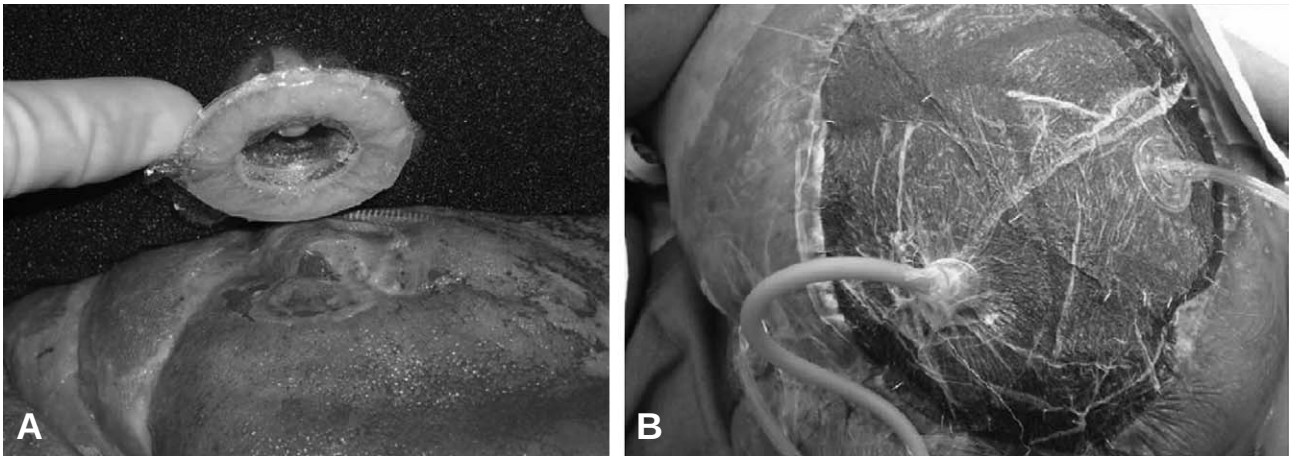


**Fig. 7.** Appropriate positioning of the drainage catheter tip to avoid bowel contact. (**A**) A completed dressing showing gravity drainage of fistula with vacuum dressing (Wound Vac: KCI, Corp, San Antonio, TX) of the surrounding frozen abdomen. (**B**)

nipple to ensure a better seal. Petroleum impregnated gauze or clear Telfa sheet is then placed over the bowel and the entire wound is covered using a commercial VAC dressing. A small hole is shaped into the VAC sponge to hold the nipple in place.(12)

The AAST (American Association for the Surgery of Trauma) Open Abdomen Study Group reported that large-bowel resection, large-volume resuscitation, and a greater number of re-explorations were significant predictors of development of a fistula within an open abdomen after trauma.(1) Furthermore, minimizing bowel manipulation and local trauma to an edematous, friable bowel may decrease the rate of fistula development,(13) and likewise, early primary fascial closure has been associated with lower complication rates.(5,16)

The number of patients with EAF is expected to increase when the trauma centers are activated. Despite advancements in critical care and surgical management, EAF-related mortality remains in excess of 40%,(14) and EAF may lead to pro-longed ICU and hospital stays, and substantially increase hospital costs.(15) Various treatment methods have been described for the treatment EAF, but the method chosen depends on the patient's situation. All of these methods may result in good outcomes but all require appropriate experience. When treating patients with risk factors, efforts should be made to prevent EAF development and devise better techniques for diverting effluent.

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