

## Original Article

# Operative Management of Small Bowel Fistulae Associated with Open Abdomen

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**BACKGROUND:** Gastrointestinal fistulae associated with open abdomen are serious complications following trauma or other major abdominal surgery. Management is extremely difficult and the mortality is still high in spite of modern medical advances. Patients who survive initial physiological and metabolic derangements require operative closure of the fistula, which is technically demanding and poorly described in the literature.

**METHODS:** A retrospective study of patients with small bowel fistulae associated with open abdomen was performed. Only patients who were stabilized sufficiently to undergo surgical closure of the fistula were enrolled in the study. The operative techniques comprised three important steps: exploratory laparotomy and resection of small bowel fistulae with end-to-end anastomosis; bridging the abdominal wall defect with a sheet of polyglycolic acid mesh; and covering the mesh with bilateral bipedicle anterior abdominal skin flaps.

**RESULTS:** Eight patients were included in the study. The number of operations before surgical closure of the fistula ranged from one to six (mean, 3.6). The time from first operation to surgery for fistula closure ranged from 2.5 to 7.5 months (mean, 4.4 months). Three patients had recurrent fistula, and one died (mortality, 12.5%). Hospital stay ranged from 101 to 311 days (mean, 187 days).

**CONCLUSION:** We present a method of closure of small bowel fistulae associated with open abdomen and hope that this will provide surgeons encountering such complications with a good alternative for surgical management.

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**Key Words:** gastrointestinal fistula, open abdomen, polyglycolic acid mesh, small bowel fistula

## Introduction

Open abdomen is a condition in which the intra-abdominal organs are exposed to the external environment. The causes of open abdomen are one or more of the following: inability to obtain fascial closure owing to massive visceral oedema in trauma or nontrauma situations, laparostomy for treatment of severe intra-abdominal infections, and abdominal wall defect from trauma or abdominal wound sepsis.<sup>1-5</sup> Gastrointestinal fistulae are the worst complications of open abdomen, with reported mortality of 36-64%.<sup>1,2,6-8</sup> Management of

gastrointestinal fistulae associated with open abdomen is extremely difficult and remains a challenge to experienced surgeons. Unlike gastrointestinal fistulae with an intact abdominal wall that spontaneously close in 50-80% of cases with conservative therapy,<sup>6,7,9</sup> these fistulae do not close without proper surgical treatment.<sup>1-7</sup>

Expected problems during operative closure of gastrointestinal fistulae associated with open abdomen are massive adhesions of the abdominal viscera and a large abdominal wall defect demanding proper management. Massive adhesions require careful and meticulous dissection in order to mini-

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mize operative trauma and blood loss in critically ill patients. Reconstruction of the abdominal wall defect needs appropriate decision making to diminish postoperative complications. Several techniques for dealing with abdominal wall defects have been reported, with variable outcome.<sup>2,3,5,10</sup>

Herein, we present the surgical techniques for fistula closure and management of the abdominal wall defect that we have employed with satisfactory outcome since our first report in 1993.<sup>10</sup> These techniques include three important steps. The first step is formal exploratory laparotomy, adhesion lysis, and resection of the small bowel segment responsible for fistulae with end-to-end anastomosis. The second step is to close the abdominal wall defect with an absorbable mesh (polyglycolic acid, Dexon). The third step is to mobilize the skin and subcutaneous tissue from both sides of the abdominal wound to cover the absorbable mesh.<sup>5,10</sup>

## Patients and methods

This was a retrospective study of patients who had small bowel fistulae associated with open abdomen at the Surgical Unit, King Chulalongkorn Memorial Hospital, Bangkok, Thailand. Only patients who survived initial catastrophic metabolic and physiological changes and stabilized sufficiently to undergo surgical closure of the fistula were enrolled in the study. Our surgical techniques for fistula closure and management of the abdominal wall defect in these patients have been described previously.<sup>10</sup> The methods are briefly outlined below.

### Preoperative management

Patients who have gastrointestinal fistulae associated with open abdomen are usually in a critical condition. Sepsis, malnutrition and fluid and electrolyte imbalances must be corrected expeditiously. The skin around the open abdominal wound should be well protected from the digestive effect of direct contact with the fistula contents. Surgery should be performed when intra-abdominal sepsis has been eradicated and the patient is in a state of positive nitrogen balance with a serum albumin level above 3 g/dL. The proper time for fistula closure may be several weeks or several months after the initial wound, depending on the patient's physical status.

### Surgical techniques

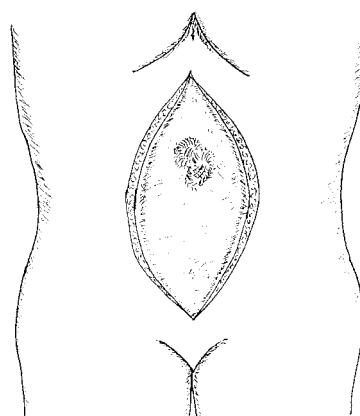
The surgical procedures may be divided into three steps: exploratory laparotomy, closure of the abdominal wall defect with absorbable mesh, and covering the absorbable mesh with bilateral bipedicle anterior abdominal skin flaps.

### Step 1: Exploratory laparotomy

An incision is made around the granulating tissue of the open abdominal wound (Figure 1). The peritoneal cavity is carefully entered and the intra-abdominal adhesions cautiously dissected. If a proper preoperative period is selected, lysis of the adhesions will not be too difficult since acute inflammatory reaction of the oedematous small and large bowel in the hostile intra-abdominal environment would have subsided with time. The most difficult part of this step is to dissect the small and large bowel that densely adhere to the overlying granulation tissue formed in the bed of the open abdomen. Care must be taken to avoid inadvertent injury to the bowel. Each loop of the small and large bowel should be separated by cutting the granulation tissue between them. It is not necessary to attempt to remove all the granulation tissue from the serosa of the bowel wall. The dissections are considered to be complete when segments of the small bowel in which the fistulae arise have all been identified and isolated. Any existing distal obstructions should also be corrected. Subsequently, limited resection of the small bowel segment containing the fistula with end-to-end anastomosis is carried out. In cases of multiple small bowel fistulae, all should be included in one resected segment. However, if this will lead to too much sacrifice of normal small bowel, multiple resections with multiple anastomoses are recommended. All serosal tears should be repaired with 4-0 silk interrupted sutures.

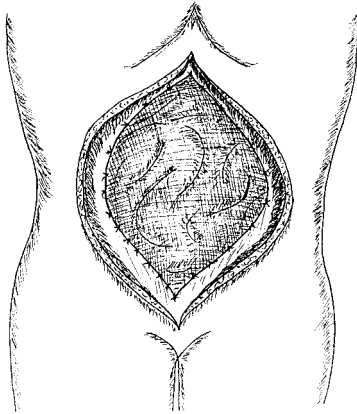
### Step 2: Closure of abdominal wall defect with absorbable mesh

Direct fascial closure of the abdominal wall should be avoided since the extreme tension created further jeopardizes the remaining abdominal wall. We do not recommend the use of nonabsorbable mesh as it may become infected or result in graft-enteric erosion and subsequent graft infection. We use a sheet of absorbable mesh (Dexon) to bridge the abdominal



**Figure 1.** Incision around the granulating tissue of the open abdominal wound.

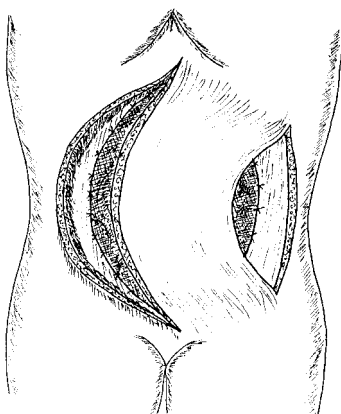
wall defect, support the immediate postoperative integrity of the abdominal wall and prevent evisceration of the abdominal contents. The absorbable mesh is sutured to the rectus muscle, which forms the edge of the abdominal wall defect, with 1-0 Dexon interrupted sutures (Figure 2).



**Figure 2.** Polyglycolic acid (Dexon) mesh is sutured to the rectus abdominis muscle, which forms the edge of the abdominal wall defect, with Dexon 1-0 interrupted sutures.

**Step 3: Covering the absorbable mesh with bilateral bipedicle anterior abdominal skin flaps**

To protect the abdominal viscera contained in the abdominal cavity under the absorbable mesh from the external environment, the skin and subcutaneous tissue are mobilized from both sides of the abdominal wound and sutured together in the midline. To prevent too much tension in the midline suture line, a relaxing incision of the skin flap should be made at the anterior axillary line, making it a bipedicle anterior abdominal skin flap (Figure 3).<sup>5,10</sup> After the bilateral bipedicle anterior abdominal skin flaps are sutured together in the midline without tension, four small vacuum drains (Redivac drains) are placed under the skin flaps. Both lateral borders of the bipedicle skin flaps are sutured to the underlying exposed abdominal wall fascia and muscle to prevent evisceration

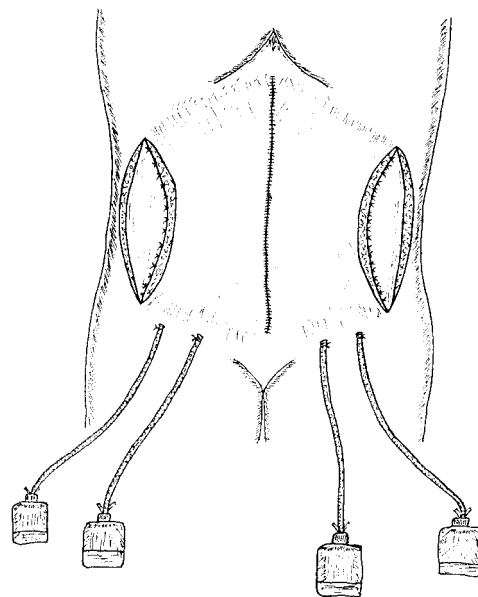


**Figure 3.** A bipedicle anterior abdominal skin flap is made by dissecting the skin and subcutaneous tissue from the underlying rectus abdominis fascia and making a relaxing incision at the anterior axillary line.

when the absorbable mesh later disintegrates and is absorbed (Figure 4). After mobilization of the skin flaps, the raw surfaces lateral to the skin flaps on both sides of the abdomen should be left undisturbed. Only wet dressing is required and no skin grafting is necessary. These raw surfaces will gradually decrease in size and eventually heal without any intervention.

**Postoperative care**

Care in the immediate postoperative period should be the same as after other major abdominal operations. Patients should receive adequate pain control for extensive dissection of the intraperitoneal and abdominal wall. Mechanical ventilatory support is recommended during the first postoperative day, and then the patient should be rapidly weaned until the endotracheal tube is finally removed. Total parenteral nutrition should be started on the second postoperative day and continued until enteric feeding is well tolerated. Prolonged postoperative ileus is expected in these patients owing to vigorous adhesion lysis around the small and large bowel, with subsequent inflammatory reaction and oedema. All vacuum drains should be removed on the fifth postoperative day. The dressing on raw surfaces on both sides of the abdomen should be changed daily. An abdominal supporting device (abdominal binder) will enhance the patient's ambulation by increasing abdominal wall integrity and improving respiratory effort and pain relief.



**Figure 4.** The medial edges of the bipedicle anterior abdominal skin flaps are sutured together. The lateral edges are sutured to the underlying rectus abdominis muscle and fascia. The raw surfaces on both sides of the abdomen are covered with wet dressing and heal spontaneously without skin grafting.

## Results

From January 1993 to December 2004, eight patients entered the study. Five were male and three were female, with ages ranging from 25 to 86 years (mean, 54 years). The open abdomen resulted from trauma in two patients and nontrauma in six (Table 1). The number of operations before surgical closure of the fistulae ranged from one to six (mean, 3.6). All patients had small bowel fistulae. The time from the first operation to fistula closure ranged from 2.5 to 7.5 months (mean, 4.4 months). Three patients had recurrent fistulae. The first required a second operation for reclosure of the fistula and later died from sepsis and multiple organ failure (mortality, 12.5%). The second underwent conservative treatment and was discharged home with a controlled fistula. He subsequently underwent a successful operation for fistula closure 15 months later. The third had a stormy postoperative course from anastomotic leakage and, at the time of writing, is under intensive supportive therapy, hospitalized while waiting for reoperation and reclosure of the fistula. All six patients who had successful fistula closure survived and were discharged home. The hospital stay ranged from 101 to 311 days (mean, 187 days). All developed ventral hernias, and three underwent subsequent ventral hernia repair 9,

**Table 1.** Details of patients and results of treatment

| Age/<br>Gender | Original<br>disease or<br>injury                              | Cause of open<br>abdomen   | Operations*<br>(n) | Time from 1 <sup>st</sup><br>operation to<br>surgical fistula<br>closure (mo) | Immediate<br>complications<br>of fistula<br>closure | Reoperation<br>for fistula<br>closure | Outcome                        | Hospital<br>stay (d) | Late<br>complications   | Subsequent<br>ventral hernia<br>repair/timing<br>(mo) |
|----------------|---|--|--------------------|---|---|---------------------------------------|--------------------------------|----------------------|-------------------------|---|
| 20/Male        | Motor vehicle accident  | Anastomotic leakage,<br>intra-abdominal sepsis                               | 6                  | 7   | None  | No                                    | Survived                       | 274                  | Large ventral<br>hernia | Yes/48  |
| 52/Female      | Tuberculous peritonitis                                       | Small bowel perforation,<br>intra-abdominal sepsis                           | 1                  | 2.5   | None  | No                                    | Survived                       | 110                  | Large ventral<br>hernia | Yes/14  |
| 35/Female      | Multiple stab wounds<br>to the abdomen                        | Anastomotic leakage,<br>intra-abdominal sepsis                               | 5                  | 4   | None  | No                                    | Survived                       | 174                  | Large ventral<br>hernia | Yes/9   |
| 38/Male        | Large seminoma<br>involving abdominal<br>wall                 | Abdominal wall defect,<br>small bowel perforation,<br>intra-abdominal sepsis | 4                  | 4.5   | Recurrent<br>fistula                                | Yes                                   | Survived<br>without<br>fistula | 233                  | Large ventral<br>hernia | No  |
| 72/Male        | GU perforation  | Leakage from sutured GU,<br>intra-abdominal sepsis                           | 3                  | 3.5   | Recurrent<br>fistula                                | Yes                                   | Died                           | 121                  | -                       | -   |
| 86/Female      | DU perforation  | Wound sepsis, intra-<br>abdominal sepsis                                     | 3                  | 2.5   | None  | No                                    | Survived                       | 101                  | Large ventral<br>hernia | No  |
| 68/Male        | Diverticulosis, with<br>lower GI bleeding,<br>right colectomy | Anastomotic leakage,<br>intra-abdominal sepsis                               | 5                  | 4   | None  | No                                    | Survived                       | 174                  | Large ventral<br>hernia | No  |
| 59/Male        | Spindle cell tumour<br>of small bowel                         | Anastomotic leakage,<br>intra-abdominal sepsis                               | 2                  | 7.5   | Recurrent<br>fistula                                | No                                    | Survived<br>with fistula       | 311                  | -                       | -   |

\*Not including fistula closure. GU = gastric ulcer; DU = duodenal ulcer; GI = gastrointestinal.

14 and 48 months after fistula closure. The remaining three were waiting for the appropriate time for ventral hernia repair at the time of writing.

## Discussion

Gastrointestinal fistulae associated with open abdomen have long been a surgical challenge. Patients suffering from this condition are seriously ill and mortality is high in spite of advanced medical support.<sup>8</sup> To date, there have been few reported series with a large number of patients (Table 2). The largest series, reported by Schein and Decker in 1990, included 43 patients and reported a mortality rate of 60%.<sup>2</sup> We first reported our experience with successful closure of complex gastrointestinal fistula associated with open abdomen in 1993.<sup>10</sup> The techniques we used in that study formed the basis of this study.

Management of these patients during the early period of fistula formation includes infection control, correction of fluid and electrolyte imbalances, administration of total parenteral nutrition, controlling and containing the fistula effluent and protection of the skin from digestive enzymes. Early skin grafting directly onto the granulated abdominal viscera may improve patient comfort and simplify wound care while awaiting operative closure of the fistula.<sup>4</sup> Skin protection may be enhanced by the use of a vacuum-assisted closure system, which can be an effective method of containing fistula effluent.<sup>12</sup> Timing from fistula occurrence to surgical closure depends on improvement in the physical status of the patient after intensive supportive therapy. Patients should, at least, recover from clinical sepsis and have markedly improved nutritional status and normal or near normal skin appearance

around the granulating open abdomen. These positive signs may take as little as 1 month or up to 7 months to achieve.<sup>11,13</sup> Decision making for timing of fistula closure requires careful and thorough judgement by the attending surgeons. Too early an operation leads to an unnecessarily extremely difficult surgical situation in a fragile patient, while leaving surgery too late may jeopardize the patient because of prolonged abstinence from enteric feeding, the deleterious metabolic effects of total parenteral nutrition and repeated catheter-related sepsis.

Surgical closure of gastrointestinal fistulae associated with open abdomen is a painstaking procedure even in the hands of experienced surgeons. Failure of fistula closure may lead to serious complications or mortality. The only death in the current study was a 72-year-old patient who was desperately ill and had failure of the first fistula closure and underwent a subsequent operation for reclosure of the fistula. He died after the second operation for fistula closure from recurrent fistula, sepsis and multisystem organ failure. Of the other two recurrent fistulae, one was closed by subsequent operation and one was awaiting reoperation for fistula closure at the time of writing.

Although it is well appreciated that the principle of fistula closure is to resect the small bowel segment containing the fistulae with end-to-end anastomosis, many details of the surgical techniques are scarcely mentioned. Very few papers in the English literature about gastrointestinal fistulae associated with open abdomen describe operative techniques for practical use.<sup>10,11</sup>

Recently, Demetriades presented a technique for surgical closure of complex intestinal fistulae in the open abdomen in two patients undergoing surgery 5 and 7 months after fistula occurrence.<sup>11</sup> Generally, the principle is the same as our technique but the author used Marlex mesh for closure of the abdominal wall defect. We disagree with the use of nonabsorbable mesh in these patients for two reasons. First, surgical closure of the fistula is not a clean operation and a non-absorbable mesh carries a potential risk of graft infections. Second, the small and large bowels may adhere to the nonabsorbable mesh resulting in graft-enteric erosion and subsequent fistula formation.<sup>14,15</sup> Recently, a bilayer expanded polytetrafluoroethylene and polypropylene mesh has been introduced for reconstruction of abdominal wall defect. The expanded polytetrafluoroethylene is placed against the bowel surface and causes fewer adhesions. Excellent results with no intestinal obstruction, no enteric fistula and no recurrent hernia were reported in one study of ventral hernia repairs in

**Table 2.** Reported mortality of patients with gastrointestinal fistulae associated with open abdomen

| First author (year)                | Patients (n) | Mortality (%) |
|------------------------------------|--------------|---------------|
| Sitges-Serra (1982) <sup>6</sup>   | 10           | 60            |
| Mastboom (1989) <sup>1</sup>       | 14           | 64            |
| Schein (1990) <sup>2</sup>         | 43           | 60            |
| Prickett (1991) <sup>7</sup>       | 11           | 36            |
| Sriussadaporn (1993) <sup>10</sup> | 1            | 0             |
| Sleeman (1995) <sup>3</sup>        | 12           | 0             |
| Dumanian (1996) <sup>4</sup>       | 10           | 10            |
| Sriussadaporn (2003) <sup>5</sup>  | 3            | 0             |
| Demetriades (2003) <sup>11</sup>   | 2            | 0             |
| Sriussadaporn (2006, this study)   | 8            | 12.5          |

102 patients. The mean follow-up time was 28 months (range, 12–42 months).<sup>16</sup> In our opinion, such prosthetic materials are a good alternative for large ventral hernia repairs but not in cases of closure of small bowel fistulae associated with open abdomen, which are potentially contaminated operations. Moreover, the long-term complications of nonabsorbable mesh still need to be addressed.<sup>17,18</sup> Although some investigators do not recommend the use of absorbable mesh for fear of late ventral hernias, we accept these late consequences since uneventful recovery and survival in these critically ill patients are our goals. From our experience, all patients who survived these operations for fistula closure were intensely satisfied even in the presence of late ventral hernias. Late ventral hernia repair may be performed when the patient's condition returns to normal, which may take months or even years.<sup>5,19</sup> We prefer to repair these large ventral hernias using "retrorectus prosthetic mesh repair".<sup>5,19,20</sup>

Since prosthetic materials have some drawbacks, closure of the abdominal wall defect with autogenous tissue, if feasible, may be an ideal procedure. In 1990, Ramirez et al first reported a method of repairing large ventral hernias by sliding a myofascial flap of the rectus abdominis muscles on both sides of the abdominal wall defect to suture together.<sup>21</sup> This so-called components separation technique is accomplished by splitting the external oblique muscle at the anterior axillary line bilaterally and separating the external oblique from the internal oblique muscle in a relatively avascular plane. The compound flap of rectus muscle with its attached internal oblique-transversus abdominis muscle is advanced medially to suture to the opposite flap in the midline. The procedure was subsequently performed with satisfactory results and recommended by several investigators for management of large abdominal wall defects.<sup>22–24</sup> Furthermore, it was also successfully used in complicated abdominal wall problems.<sup>25,26</sup> We believe that this technique is an excellent alternative and might have been suitable for some of our patients. Skin coverage after this technique may be accomplished by bilateral bipedicle skin flaps, simple approximation of the undermined skin flaps or skin grafting, depending on the status of the skin and subcutaneous tissue of the patient.

In conclusion, small bowel fistulae associated with open abdomen are highly lethal. Few surgeons have extensive experience and surgical techniques for fistula closure are infrequently mentioned in detail in the literature. We present our technique for fistula closure that we think will benefit patients and surgeons encountering these catastrophic surgical complications.

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