

Temporary Abdominal Closure in the Critically Ill Patients with an Open Abdomen

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Abstract- The emergent abdominal surgeries from either of traumatic or non traumatic causes can result in situations in which the abdominal wall cannot initially be closed. Many techniques have been reported for temporary coverage of the exposed viscera, but the result of various techniques remains unclear. During 94 months, 19 critically ill patients with an open abdomen underwent surgery using plastic bags (Bogotá bag). The study population comprised of 11 (57.9%) male and 8 (42.1%) female with an average age of 32.26±14.8 years. The main indications for temporary abdominal coverage were as follows: planned reoperation in 11 (57.9%) patients, subjective judgment that the fascia closure is too tight in 6 (31.6%) patient's damage control surgery in one patient (5.3%) and development of abdominal compartment syndrome in one patient (5.3%). Surgical conditions requiring temporary abdominal closure were severe post operative peritonitis in 9 (47.4%) patients, post operative intestinal fistula in 4 (21.1%) patients, post traumatic intra abdominal bleeding in 3 (15.8%) patients and intestinal obstructions in 3 (15.8%) patients. Length of hospitalization was 45±23.25 days and the mean total number of laparotomies was 6.2±3.75 times per patient. Three bowel fistulas occurred due to a missed injury at the time of initial operation that was discovered during changing the plastic sheet. They were unrelated to coverage technique. All of them were treated by repair of the defect and serosal patch by adjacent bowel loop. Only one (10.0%) patient underwent definitive closure within 6 months of initial operation. The remaining survivor has declined to have hernia repaired. There were 4 (%21.1) early postoperative deaths that were not related to the abdominal coverage technique. Also, there were 5 (26.3%) late deaths that were due to dissemination of malignancy with a mean survival time of 20.8±13 (range 2-54) months. Currently 10 patients (52.6%) are alive at a follow up of 45 (range 1-94) months. Only one (10.0%) patient underwent definitive closure within 6 months of initial operation. The remaining survivor has declined to have hernia repaired. Bogotá bag technique is a rapid, simple and inexpensive technique for temporary abdominal coverage.

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Introduction

The emergent abdominal surgeries from either of traumatic or non traumatic causes can result in situations in which the abdominal wall cannot initially be closed (1-3).

Attempts at force closure results in fascial necrosis or abdominal compartment syndrome (ACS), (4-5) on the other hand, repeated fascial opening and closing

often lead to fascial necrosis and necrotizing infection, with subsequent sepsis and dehiscence. Thus, closing the fascial of the abdominal wall under tension is potentially lethal (6-10).

Two common scenarios may occur. First, major abdominal wall tissue loss or compliance secondary to trauma and second, subsequent laparotomies planned as a part of aggressive approach for management of severe intra-abdominal infection, for further abdominal

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debridements and irrigation (11-13).

Approximation of the skin using the towel clips or a running skin suture with the use of a 2 nylon suture whenever feasible is the favored method of temporary abdominal closure (1,14).

Towel clip closure is a very rapid technique for approximation of the skin only, which consists of the sequential application of metal clips to one to two centimeters apart from the skin edges (4,15). The main disadvantage of these techniques is that the abdomen can be closed under tension, thus setting the stage for the abdominal compartment syndrome (1,14).

Multiple options have developed in the last decade as surgeons' solution to this increasingly frequent and fatal condition, but most have their own complications (16).

Open management (laparostomy) has emerged as a corollary to the policy of repeated relaparotomy (13) and has become a generally accepted way of managing a number of conditions in these critically ill patients. The term "laparostomy" was first used by Professor Y.N. Millard of Paris and has gained wide acceptance in the French literature. This term has permeated from the French into the English literature (17). In the open Abdomen approach, the fascia is kept open and the abdominal wound is packed open with saline gauze (18,19).

The abdomen can be continually reevaluated, allowing for prompt drainage of recurrent infection

before worsening of the patient's septic condition occurs (20). Evisceration of the abdominal contents is an important complication of the open method, so prolonged mechanical ventilation with muscle relaxation is used until adhesions grow firm enough to prevent evisceration (11).

A convenient compromise between risks and the potential benefits is the adoption of a semi-open technique which uses various temporary abdominal closure methods that do not leave the bowel exposed and yet avoid forceful approximation of the wound edges. Numerous techniques have been devised to assist in the temporary abdominal closure (13,21). That is a very much a matter of personal or institutional preference (22).

We present our most recent experience with a technique of plastic bag closure for temporary abdominal coverage in complicated cases.

Materials and Methods

Patients

This is a case series study conducted over a period of 94 months from November 2001 to August 2009. Finally, 19 patients were enrolled: 11 (57.9%) male and 8 (42.1%) female ranging from 15-70 (mean 32.26+14.8) years who had their peritoneal cavities managed temporarily in a semi open fashion (Table 1).

Table 1. Distribution of- sex in the study group

Sex	N	Mean	Median	Std. Deviation	Variance	Minimum	Maximum
Female	8	29.63	25.00	14.071	197.982	15	55
Male	11	34.18	31.00	15.670	245.564	16	70
Total	19	32.26	26.00	14.791	218.760	15	70

Surgical conditions requiring temporary abdominal closure (TAC) were as follows: (a) severe postoperative peritonitis in 9 (47.4%) patients. The primary reasons for laparotomy were perforated ileum due to typhoid disease in one (5.3%) patient, perforated sigmoid carcinoma in one (5.3%) patient, perforated stromal cell tumor of jejunum in one (5.3%) patient, iatrogenic injury of the colon and ureter after cesarian section in one (5.3%) patient, perforated rectal cancer in one (5.3%) patient, multiple perforation of small bowel due to tuberculosis enteritis (about 50 perforations) in one (5.3%) patient, enterocutaneous fistula through the mesh in one (5.3%) patient and posttraumatic gasterointestinal injuries in five (26.3%) other patients. (b) Post operative bowel fistula after surgery in four (21.1%) patients including adhesiolysis in two (50.0%) patients, repair of iatrogenic injury of the radiated ileum in one (25.0%) patient, and

closure of ileostomy in the other patient (25.0%). (c) Posttraumatic massive intra-abdominal bleeding in three (15.8%) patients included necrosis of repaired liver laceration in one (33.3%) case and peritonitis due to retraction of colostomy in one (33.3%) case and ruptured pelvic hematoma in the other patient (33.3%). (d) Bowel obstructions in three (15.8%) patients, due to recurrent rectal cancer in one (33.3%) patient and post operative in two (66.7%) patients (Table 2).

Table 2. Surgical conditions which required temporary abdominal closure

Variables	Values	NO
Surgical Condition	postoperative peritonitis	9
	Post operative bowel fistula	4
	Posttraumatic	3
	Bowel obstructions	3

The specific indications for TAC were: (a) Damage

control surgery (DCS) for peri hepatic packing for control of massive bleeding from liver laceration (one (5.3%) patient). (b) Planned reoperation for the need for further debridement in a severe contaminated peritoneal cavity (11 (57.9%) patients). (C) Fascial closure which was too tight, impossible or under a lot of tension due to

the combination of severe gut edema and missing abdominal wall tissue following debridement (six (31.6%) patients). (d) Development of abdominal compartment syndrome after packing of ruptured retroperitoneal hematoma (one (5.3%) patient) (Table 3).

Table 3. Indications for temporary abdominal closure (TAC)

Variables	Values	NO	Percent
Indications for TAC	Damage control surgery (DCS)	1	5.3
	Planned reoperation	11	57.9
	Fascial closure too tight	6	31.6
	Abdominal compartment syndrome	1	5.3

Technique

An empty 3 liter sterile smooth plastic bag such as the type applied for urological irrigation was properly cut to fit the size of the defect. Then, it was sewed with a continuous nylon suture to the skin dermis or edges of rectus sheath. When possible, the seams of the plastic bag were left intact to impede the sutures cutting through its margins and following containment failure. While the plastic bag was properly situated, the dressing changed to bulky dry gauze over the wound. In case of the need for reoperation, the plastic bag would be replaced with a new one. If no laparotomies were required, the plastic bag would be removed within 15 days. After this period, the granulation tissue will be well established enough to prevent evisceration.

The important point is that if any omentum was available, it would be placed over the viscera and if an intestinal anastomosis was planned, the suture lines would be buried in the depth of the wound or put a side (in order) to not be in contact with the plastic material for fear of anastomotic leakage. --After removing the plastic bag, a paraffin gauze dressing was applied to prevent adhesion formation between the exposed intestine and the dressing itself. The dressing was usually changed every 48 hours. The split-thickness skin graft was performed when a healthy granulating bed free of sepsis was evident, or the minimal or nil purulent discharge from granulation tissue was observed.

Results

There were 4 early postoperative deaths (21.1%), none related to the abdominal coverage technique. Three (15.8%) patients died within 48 hours from persistent shock, and cardiac arrest, one (5.3%) patient did stabilize enough within two days after TAC, but had in-hospital death due to adult respiratory syndrome.

The length of hospital stay was 2-95 days (mean

45+23.25 days).

The mean total number of laparotomies was 6.2+3.75 (range 2-17) times per patient and the mean number of repeat laparotomies before plastic bag insertion and after the abdomen had been left open were respectively 2.9+1.25 and 3.5+3 (range 1-6 and 0-12) times. Also, there was no significant difference between the mean number of repeat laparotomies before and after plastic bag insertion ($p=0.431$).

The technique of TAC was undertaken at the first reoperation in 6 (31.5%) patients and at the second relaparotomy in 3 (15.7%), at the third relaparotomy in 5 (26.3%), at the fourth relaparotomy in 2 (10.5%) and at the fifth relaparotomy in two (10.5%) and at the sixth relaparotomy in one (5.3%) patient. In no patient, the TAC was performed at the primary operation.

There was no significant correlation between the patients who has too tight situation and the status of mortality (early death and alive- $p=0.255$). Also, there was not any significant relation between indication for TAC (planned or no planned) and mortality status ($p=0.103$).

Five (26.3%) patients experienced complications. Small bowel fistula developed in four (21.1%) cases, which resulted from a missed injury of the bowel at the time of initial laparotomy. All of them were treated by repair of the defect and serosal patch by adjacent bowel loop. The repaired segment was buried away from the open wound in order to prevent their break down. One (5.3%) patient developed a pancreatic fistula due to the missed pancreatic trauma, which was treated conservatively. No significant correlation ($p=0.572$) was found in evaluating the relation between the procedure with plastic insertion and outcome of surgery.

Five (26.3%) patients died because of widespread malignancy after a mean time of 20.8+13 (range 2-54) months after their surgery. One (5.3%) patient developed a stromal cell tumor of jejunum after 23

months of follow up, which was not related to the primary operation. He was alive for 26 months after resection and anastomosis of the small bowel and died due to widespread malignancy. There are currently 10 (52.6%) patients alive at a mean follow up of 45+19.5 (range 16-94) months. There was no relation between the conditions of the patients (abdominal trauma, bowel perforation and peritonitis ...) and the mortality status ($p=0.246$).

For the 13 (68.4%) early survivors who required multiple laparotomies, the abdomen could not be closed, so a split thickness skin graft was placed over the granulating wound at a mean time of 17.2+8 (range 5-37) days after the last operation. Only in one (5.3%) patient, simple closure of the abdominal skin was possible within 5 days of the second operation, and simple fascia repair was achieved after 4 months of the initial operation and until now all other survivors have declined to have their hernia repaired. There are currently 10 (52.6%) patients alive at a mean follow up of 45+19.5 (range 16-94) months. There was no relation between the conditions of the patients (abdominal trauma, bowel perforation and postoperative) and the mortality status ($p=0.246$).

Discussion

Damage control surgery and decompressive laparotomy for the abdominal compartment syndrome represent recent advances in trauma care of patients who could have previously died but whose lives were saved. However, these courageous measures have led to an epidemic of open abdomen in the trauma center worldwide (21,23).

The DCS is defined as the intentionally abbreviated laparotomy prior to the definitive repair of abdominal injuries with obligatory reoperation (24) usually at intervals of 24 to 72 hours (13). Although damage control incorporates the staged approach in a trauma patient (15), however, this approach also can be referred to as the planned reoperation or the staged repair.

Making the decision on when to use DCS, however, is usually a matter of major difficulty. The decision for an abbreviated laparotomy should ideally be made within the first few minutes of the operation (15,22). The abbreviated laparotomy is performed by quick closure of the abdomen with temporary means (3). The objective is to gain time in which the patient can be stabilized before subsequent early surgery for definitive repair (25). However, the optimal method of the abdominal wall reconstruction remains doubtful (26).

Formal closure of the abdomen at the end of an abbreviated laparotomy, which wastes precious time, is unnecessary (1). Fascial closure after the initial damage control procedure was associated with an 11 times increase in ACS as compared to skin or Bogotá bag abdominal closure (14, 27). The ACS occurred in 80% of patients who underwent fascial closure as compared to 24% and 18% in patients for whom the skin closure and Bogotá bag placement was respectively performed (14).

However, the major question remains as to what the ideal temporary abdominal wall substitute is for this group of patients.

The ideal substance should be strong but pliable to prevent erosion into underlying structures. It should be resilient enough to maintain its integrity. In addition, it should be non carcinogenic and biologically inert to avoid the inflammatory response (7). Besides, the prosthesis should be inexpensive and provide secure protection of the viscera, can be conducted rapidly and readily, will not adhere to or damage the underlying visceral tissues and can be repetitively entered if necessary (3,28).

So many authors have used a variety of prosthetic materials to achieve a pressure free abdominal closure (6). These prostheses include reinforced silicone rubber (silastic), preserved human dura, polyester fiber mesh, stainless steel mesh (29), polyvinyl sheet (intestinal bag) (19), nylon (30,31), latex rubber (26), nylon reinforced silicone elastomer sheet (16). Also, some investigators prefer to use an absorbable woven polyglactin mesh (vicryl) (28,32,33) or polyglycolic acid mesh (Dexon) (34). Enteric fistula may occur with absorbable mesh when positioned over exposed gut (26). The progressive acceptance that no material meets the criteria of an ideal prosthesis has made many surgeons find some simple resolutions to this challenging problem. The Bogotá bag eponym for plastic bag stands for one of these resolutions (33). It was first described by Londoni, at the time he was a chief resident in Bogotá, Colombia and now known as the Bogotá bag (35).

Currently, the most popular materials used included the sterilized, opened 3 liter irrigation genitourinary bag or 3 liter viaflex intravenous bag (1). This device actually costs nothing and is available in any operating room (35). Placement of plastic drape takes only a few minutes. During abdominal re-entry, the drape could be simply removed, so the tissues are thoroughly secured from desiccation and heat loss (3).

This material is the authors preference that is unfolded and is trimmed to the appropriate size and then

to the patient's fascia (1) or skin edges (22) using running monofilament nylon suture closure with split-thickness skin grafts over a granulating abdominal wound. It results in a satisfactory albeit temporary solution since late hernia formation almost always occurs (29).

There are definitely potential complications with this technique. Because the adhesive is not as strong as sutures, increasing abdominal pressure could lift the drape off resulting in evisceration (3). This complication did not occur in our series.

To obtain a definitive abdominal closure is the remaining challenge. Every rational attempt should be made to obtain a definitive abdominal closure within 3 or 4 days (35). Fabian et al suggested that attempts at primary fascial closure should not be made further than 7 to 10 days. Therefore, if fascial closure is not achieved hereunto, an inherent hernia defect must be recognized (28). The procedure of delayed fascial closure is usually undertaken 6 to 12 months after hospital discharge. The time for reconstruction can be determined by the ability to pinch the split-thickness skin graft from the underlying viscera. It suggests the resolution of dense adhesions allowing for relatively easy removal of the split-thickness skin graft (5). The current study showed that only in one patient, simple closure of the abdominal skin was possible within 5 days of the second operation, and simple fascial repair was achieved after 4 months of the original operation; other survivors did not return to have their hernia repaired.

Enteric fistulas are the inherent complications attributed to the management of the open abdomen. The bowel is exposed to desiccation and to frequent dressing changes which may debride the exposed bowel (20) or cause erosion of the mesh into bowel (5).

Having incidence of spontaneous closure of enterocutaneous fistula of approximately 30%, the management of such fistula is so difficult (20).

Three patients of our series developed bowel fistula due to missed iatrogenic injury of the bowel which were unrelated to the coverage technique. They were treated by repair of the defect and serosal patch by adjacent loop and buried away from the open wound with good results.

Mortality and morbidity associated with the various techniques of TAC remain unclear (2).

The early mortality rate of 21% in the present study is similar to that published by Saadia et al (12). So, the results of this study compare favorably with other published series using various materials and techniques for temporary abdominal closure (12,17).

The Bogota bag technique is an ideal method for management of patients with open abdomen. This is an inexpensive, safe and simple method which can be applied rapidly. In addition, it provides simple re-entry to the abdomen and finally a good nursing care. It is also a life – saving technique for closure of the complex abdomen in the critically ill patients.

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