Origin of the Bogota Bag and Its Application

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Abstract

The open abdomen is used when the abdominal incision cannot be closed, when an early reoperation is necessary, to prevent an abdominal compartment syndrome, for the treatment of secondary or tertiary peritonitis, for the treatment of omphaloceles in neonates, and for the treatment of missing portions of the abdominal wall. The unique contribution of Oswaldo A. Borraez Gaona, MD, of Bogota, Colombia, was the application of a plastic bag over the open abdomen in injured patients. The bag allows for rapid access for a relaparotomy and covers and protects the viscera until edema and/or infection resolves.

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1.1 Historical Development of the Open Abdomen

1.1.1 Slow Clinical Recognition of the Abdominal Compartment Syndrome

As open abdominal surgery for elective, emergent, and trauma indications progressed in the latter half of the nineteenth century, there was no mention of leaving the abdomen open. This seems surprising as surely some patients in that era had distension of the midgut at completion of operation.

Numerous historical reviews of the abdominal compartment syndrome, however, have documented that the adverse consequences of increased intra-abdominal pressure were recognized in the early twentieth century [1, 2]. In 1911, Emerson's experiments in small animals documented that an increase in intra-abdominal pressure from 27 to 46 cm H_20 led to a respiratory and cardiovascular death [3]. Later studies by Thorington and Schmidt [4] in 1923 and by Overholt [5] in 1931 noted that renal failure was another adverse effect of experimentally induced increases in intra-abdominal pressure. There were subsequent similar laboratory studies [6–9] and an occasional clinical study [10] over the next 50 years. But, clinical relevance was first established at the University of Virginia in the early 1980s. After observations in four patients

J. Duchesne et al. (eds.), *Damage Control in Trauma Care*,
https://doi.org/10.1007/978-3-319-72607-6_1

later reported [11], the authors noted the beneficial effect on renal function by relieving elevated intra-abdominal pressure in mongrel dogs [12]. A similar report on four patients at the University of Maryland occurred at the same time [13]. The analogous clinical situation would be to reopen a recent abdominal incision in a patient with oliguria or anuria in the presence of elevated intra-abdominal pressure—the later named abdominal compartment syndrome.

1.1.2 Inability to Close the Distended Abdomen

The dangers of closing an abdominal incision under tension in military conflicts were first described by W.H. Ogilvie. Ogilvie was first a surgeon in civilian life at Guy's Hospital in London but subsequently became a Major General in the Royal Army Medical Corps in World War II. In the first of several legendary papers in the 1940s, he described the use of retention sutures to buttress a closure of the abdominal wall when the sides of the incision were "3 inches" apart [14]. Also, he commented that "when the gap exceeds three inches, closure by direct suture is usually impossible." Because of his concern about necrosis if skin flaps only were used, he suggested a "dodge" that had been used in two patients. Using a "light canvas or stout cotton cloth sterilized in Vaseline … a double sheet of this is cut rather smaller than the defect in the muscles, and sutured into place with interrupted catgut sutures" [14]. Ogilvie recognized that some open abdomens could still not be closed even after edema of the midgut resolved. In such patients, he suggested a version of the visceral packing technique described at Detroit Receiving Hospital over 50 years later [15, 16]. He took "gauze swabs sterilized in and impregnated with Vaseline" and laid them over the bowel with the edges tucked under the edges of the incision [14]. The sides of the incision were then brought together with "strips of Elastoplast or even with stitches over the Vaseline" [14]. Ogilvie specifically noted that "Vaseline gauze makes an admirable peritoneum" [14]. He further described the use of "pinch grafts," presumably partial-thickness skin grafts, applied to the granulating wound after removal of the Vaseline gauze and delayed repair of the incisional hernia that was left [14].

1.1.3 Open Abdomen Treatment for Secondary or Tertiary Peritonitis

Over the past 110 years, a number of approaches to the patient with secondary or tertiary peritonitis have been described. The first of these was debridement and lavage for acute appendicitis described by J. Price in 1905 [17]. Of historic interest, it was, once again, W. H. Ogilvie who was one of the first surgeons to describe leaving the abdomen open temporarily (1–4 days) when sepsis was present [18].

Postoperative peritoneal lavage for peritoneal sepsis became popular 60 years later and was much discussed in the surgical literature of the 1960s and 1970s [19–22]. At the same time, Hovnanian and Saddawi documented that the dissemination of bacteria associated with debridement and irrigation did not increase mortality [23]. A related operative treatment, radical peritoneal debridement (vigorous debridement of exudate on peritoneal surfaces), had a transient period of popularity in the late 1970s, until a later prospective randomized clinical trial did not confirm the benefits suggested in the original paper [24, 25].

In 1979, Steinberg [26] described leaving the abdomen open postoperatively in patients with "acute generalized suppurative peritonitis." Despite the adverse effects of this approach (fluid losses, persistent inflammation, enteroatmospheric fistulas, etc.), results were encouraging enough so that numerous centers around the world adopted this approach [27–30]. A variation of the open abdomen approach was the use of multiple repeat laparotomies through temporary abdominal wall closures described by Wittmann et al. [31]. Kreis et al. [32] have reviewed comprehensively the results of trials on the available techniques—i.e., open abdomen, multiple planned laparotomies through a temporary abdominal wall closure, and relaparotomy on demand. While the on demand strategy has been associated with shorter stays in the intensive care unit and hospital

and, therefore, a lower cost of hospitalization, Kreis et al. concluded that "planned relaparotomy has therefore not lost its indication for selected patients" [32].

1.1.4 Open Abdomen in the Treatment of Omphaloceles

In a landmark article in 1948, the legendary Robert E. Gross from Boston Children's Hospital described a two-stage operative approach (skin closure, then delayed fascial closure) to large omphaloceles [33]. This approach was based on Gross' recognition of the dangers of forced reduction of viscera and primary fascial closure. He stated the following: "In this way it is possible to avoid the devastating effects of a high intra-abdominal pressure which resulted from most of the types of surgical repair which have been previously employed and described in the literature" [33]. It is most interesting that Gross' recognition of the abdominal compartment syndrome in 1948 preceded that in trauma surgery by 35 years.

In the modern era, approximately 85% of infants with omphaloceles have bedside insertion of a preformed silo with a subfascial ring. The extra-abdominal bag is then rolled down each day. When the bag is flush with the skin, the infant is taken to the operating room for removal of the silo, closure of the midline aponeurosis, and, if possible, closure of the skin. The remaining 15% of infants undergo an early operation for the following: [1] omphaloceles too large for a silo, [2] small defects amenable to primary closure, or [3] for ischemia of the midgut in the omphalocele [34].

1.2 Contribution of Oswaldo Borraez, MD, Bogota, Colombia

1.2.1 Oswaldo A. Borraez G. MD

While many surgeons have contributed to the historical development of silos over the open abdomen, Oswaldo A. Borraez G, MD of Bogota, Colombia, is regarded as the modern "father" of the silo or Bogota Bag ("Bolsa de Bogota") for patients with trauma or abdominal sepsis [29, 30, 35–37]. Oswaldo Borraez was born in Cachipay, Cundinamarca, Colombia, on August 18, 1954. He studied medicine at the National University of Colombia from 1972 to 1978 and then completed his "internado" (internship) at the San Juan de Dios Hospital, Bogota (closed in 2001). He completed his obligatory medical service at a hospital near Bogota, studied "university teaching" at the Military University in Bogota, and assisted in surgery at the Misericordia (Children's) Hospital while a medical student and during the above activities from 1976 to 1982. He completed his residency in surgery from 1982 to 1985 at the National University of Colombia, primarily at the San Juan de Dios Hospital. Dr. Borraez's mentors were M.M. Manchola, MD, and E. Bonilla, MD, at the Misericordia Hospital and J. Ospina, MD, at the San Juan de Dios Hospital.

In addition to volunteering at San Juan de Dios Hospital from 1986 to 2001, Dr. Borraez has long practiced general and trauma surgery at the San Blas Hospital (public) in Bogota, where he has served as Chief of Surgery, also. His private practice is based at the Clinica Nueva in the center of Bogota, and he is a Professor of Surgery at the National University of Colombia. He has served as President of both the Colombian Trauma Association and the Colombian Surgery Association and is a seminal figure in surgery in Latin America.

1.2.2 Story of the Bogota Bag

In March, 1984, at the San Juan de Dios Hospital in Bogota, Colombia, Doctor Oswaldo A. Borraez G. was a second year resident in General Surgery. He had to manage a young patient who was crushed by a vehicle when trying to change a tire. The patient was admitted in a state of hypovolemic shock due to hepatic rupture caused by the blunt abdominal trauma. Initially, the patient underwent a right hemi-hepatectomy, with large drains left in situ. The patient subsequently required a repeat laparotomy for rebleeding. A few days later, the patient bled again and

underwent another surgical procedure. A few days later, he presented with intra-abdominal sepsis, which led to a fourth operation for debridement and lavage of the abdominal cavity. Due to edema of the midgut, it was impossible to close the abdominal wall. Doctor Borraez decided to cover the exposed abdominal viscera with a plastic intravenous fluid bag. This was fixed to the musculoaponeurotic layers and was the first procedure of its kind in the world [28–32]. To the faculty at San Juan de Dios, this did not seem like a good idea initially (Fig. 1.1).

On the morning after the procedure, Dr. Borraez was called to a meeting with the Chief of Surgery at the University to explain why he had not been able to close the fascia in the abovementioned patient. After a review by the respective professor and the corresponding academic group, it was decided that further procedures were not to be undertaken on the patient. The patient subsequently had peritoneal lavage and reapplication of the plastic sheet. This plastic sheet was removed from the patient when there was satisfactory granulation of the abdominal viscera, which took approximately 6 months.

Two weeks later Doctor Borraez was called to aid the gynecology service in the management of an obese patient with abdominal sepsis of gynecological origin. Due to extensive edema of the midgut, the incision could not be closed. Once again, a plastic bag was used to cover the open abdomen. This patient survived, as well. The plastic silo technique has subsequently been widely accepted throughout the world.

It was Dr. David Feliciano who observed several patients managed with this technique at San Juan de Dios Hospital and then referred to it as the "Bolsa de Bogota." The technique was subsequently renamed the "Borraez bag," by which it is now known in Colombia and throughout the world [36].

In 1994, a decade after having introduced the technique, Dr. Borraez added the placement of a second bag, left free and loose, covering all intra-abdominal organs and below the abdominal wall, while the other bag is placed and fixed to the skin. The purpose of this inner bag was to prevent adhesions and facilitate later closure of the abdominal wall.

After the appearance of this technique, many variants have appeared in different parts of the world, and the basic element is the plastic bag.

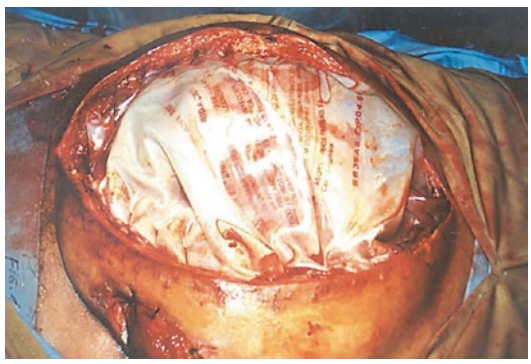

Fig. 1.1 First trauma patient with Bogota bag over open abdomen after laparotomy for blunt hepatic rupture, Hospital San Juan de Dios, Bogota, Colombia (Courtesy of Oswaldo A. Borraez G., MD)

1.3 Modern Indications for the Open Abdomen

Many of the indications to leave the midline linea alba open under a bag/silo or vacuum-assist device have been described in the aforementioned historical review.

In patients on the modern Trauma Service (Table 1.1), the inability to close the midline incision due to the risk of creating an abdominal compartment syndrome continues to be a prime indication. The historic reasons that have been felt to contribute to distension of the midgut after major laparotomies for trauma are as follows: [1] resuscitation with crystalloid solutions, [2] failure of the sodium pump in the cell membrane secondary to shock, [3] interstitial edema, [4] reperfusion injury, and [5] postoperative ileus. In the modern era of "damage control resuscitation," infusions of crystalloid solutions are eliminated or

Table 1.1 Indications for open abdomen in trauma patients

• Unable to close midline incision secondary to edema and distension of midgut (and to avoid primary abdominal compartment syndrome)
• Need for reoperation as part of "damage control" sequence
• Loss of continuity or substance of abdominal wall

minimized, and blood component replacement is directed by thromboelastography. Therefore, edema and distension of the midgut as an indication for the open abdomen are much decreased.

The need for a planned reoperation as part of the "damage control" sequence remains a major indication to leave the midline incision open after a first operation [37]. Classical trauma patients in this category include those with the following: [1] perihepatic, extraperitoneal pelvic, or diffuse intra-abdominal packing, [2] disconnected segments of small bowel or stapled off segments of the colon, and [3] presence of an intravascular intraluminal shunt.

The third category of trauma patient in whom an open abdomen would be appropriate would be one with transection of the rectus muscle(s) and/or subcutaneous tissue by a lap seatbelt or loss of the abdominal wall from a close-range shotgun wound. In both groups, extensive debridement of frayed muscle and necrotic subcutaneous tissue and skin may be necessary after a laparotomy. Open packing of the resultant defect over absorbable mesh or temporary rayon cloth is appropriate with definitive closure in 3–6 months [15, 16].

In patients on the Acute Care Surgery Service (Table 1.2), the indications are similar (Table 1.2). Reclosure of the midline incision after a dehiscence or evisceration is always preferred. It is often true, however, that necrosis of the midline linea alba, distention of the midgut, or a concurrent intra-abdominal abscess or fistula prevents reclosure. Once again, such a patient will benefit from the application of a temporary bag/silo and early application of a vacuum-assist device.

As noted in the section on history, some centers continue to perform sequential operations in the open abdomens of patients with secondary or tertiary peritonitis. This practice allows for vigorous cleansing of purulence, debridement of necrotic tissue, and localization of further sites of infection. When intraperitoneal sepsis has been controlled, the patient's bag/silo is switched to a vacuum-assist device.

Some centers continue to utilize the "chronic open lesser sac drainage" (COLD) technique in preference to repeated percutaneous drains or video-assisted retroperitoneal debridements in a patient with a pancreatic abscess or infected pancreatic necrosis [38]. This open abdomen technique allows for granulation and gradual filling in of the lesser sac as retroperitoneal sepsis resolves.

An occasional necrotizing soft tissue infection results in full-thickness loss of the abdominal wall. The time-honored management of repeated debridements of the abdominal wall should be accompanied by absorbable mesh coverage and compression of the midgut below the musculoaponeurotic wall. The subsequent conversion to a vacuum-assisted device makes little sense in such patients, as there is a fixed loss of tissue.

Table 1.2 Indications for open abdomen in acute care surgery patients

• Failed primary closure (delayed dehiscence or evisceration)
• Secondary or tertiary peritonitis
• Pancreatic abscess or infected necrotic pancreatitis
• Loss of abdominal wall from necrotizing soft tissue infection

1.4 Options for Coverage of the Open Abdomen

A comprehensive list of all options for coverage of the open abdomen for one of the indications discussed is beyond the scope of this chapter. Table 1.3 includes historic and current choices.

Table 1.3 Options for coverage of the open abdomen

Temporary silos
Adherent plastic drape
Fabric with zipper sewn in
Genitourinary irrigation bag (Fig. 1.2)
Human cadaveric acellular dermis
"Permanent" prosthesis, especially polytetrafluoroethylene
X-ray cassette bag
Wittmann patch
Temporary soft cover
Absorbable mesh
Parachute silk
Porcine xenograft
Vacuum-assisted closure
Visceral packing

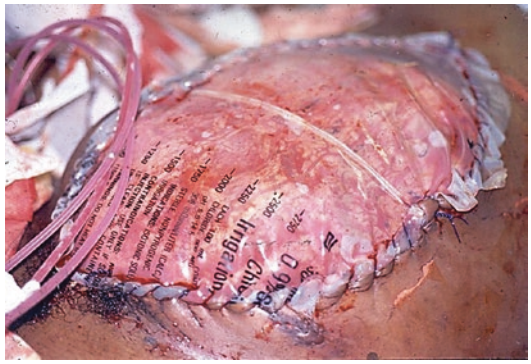

Fig. 1.2 Plastic irrigating bag sewn to the skin edges of the abdominal incision makes an excellent temporary silo. Damage control and alternate wound closures in abdominal trauma (Used with permission. Feliciano DV, Moore EE, Mattox KL. In Feliciano DV, Moore EE, Mattox KL (eds): Trauma. Third Edition. Stanford, CT, Appleton and Large, 1996, pp. 717–32)

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