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MANAGEMENT OF BURST ABDOMEN AND ABDOMINAL WALL RECONSTRUCTION

(Review Article)

By

Ahmed Ibrahim Abbass El-Sayyad, Ahmed Ibrahim Shehata and Ahmed Abd El-Fattah Ahmed

Department of General Surgery, Faculty of Medicine, Al-Azhar University

Corresponding author: Ahmed Ibrahim Abbass El-Sayyad,

E-mail: sayyad.hammer@gmail.com

ABSTRACT

Background: In many surgical instances (e.g. emergencies), the use of the open abdomen technique becomes an ideal approach to save patient's life. There are many complications that follow the open abdomen technique in which abdominal wall dehiscence and/or complete burst abdomen is the most serious of them all being dependent on many factors related to patient, surgical technique, materials used, and surgeon's skills.

Objective: To provide the latest advanced information about the causes, prevention of burst abdomen and variable modalities to treat this grave postoperative complications.

Data Sources: In this review some of the most popular materials and methods used by surgeons all over the world to treat such serious complication were outlined. Many studies were done comparing 2 or more methods either in techniques of abdominal wall closure or in materials used for this purpose.

Conclusion: One of the best methods in closing the abdominal wall wound after operations was the mass closure technique as it carried the lower rate of post-operative complications especially wound dehiscence.

Keywords: Burst Abdomen, Abdominal Wall Reconstruction.

INTRODUCTION

Wound dehiscence is the failure of an injury to close appropriately. Wound dehiscence is an expensive and serious post- operative complication with high mortality and morbidity, dehiscence of wound occurs before cutaneous healing, and in this manner identification and appropriate management of the condition is key stone *(Sinha et al., 2015)*.

Wound dehiscence continues to be a serious complication of abdominal surgery despite significant progress in operative and perioperative care over the last few decades, Accompanied by high morbidity and mortality. Reported incidence differs between 0.2% to 6%. Associated with mortality rates between 10% and 40% *(Kaur et al., 2016)*.

It affects patients, their relatives and even hospital as following patients by increasing their distress and the percent of mortality, the attendants by increasing the treatment cost, the surgeon as it is a disturbing reality for him and the hospital resources by increasing health care cost

due to the prolonged patients' stay at hospitals.

Several randomized trials and meta-analyses have examined continuous versus interrupted closure. Continuous closure is typically recommended over interrupted closure, since it is faster and less costly. Dehiscence and wound complication rates are similar between both types of closure. There is a theoretical benefit of even distribution of tension across the entire incision with continuous sutures *(O'Dwyer et al., 2015* and *Israelsson et al., 2013)*.

The major differences between laparoscopic and open procedures are the method of access, the method of exposure, and the extent of operative trauma. Findings also have shown laparoscopy to be a physiologically superior operation compared with open surgery because it causes less impairment of immediate post-operative pulmonary function, less systemic stress, improved immunologic response, and less local tissue trauma. Hence, patients treated with laparoscopic procedure are less likely to experience SSI. After stratification by severity of illness, wound classification & admission status, laparoscopic techniques shows a protective effect against SSI *(Navadiya et al., 2013)*.

The aim of this work was to provide the latest advanced information about the causes, prevention of burst abdomen, and variable modalities to treat this grave postoperative complication.

When performing abdominal surgical procedures, it is necessary to understand the anatomy of the abdominal wall and how it relates to the specific surgical operation being performed. Understanding the muscular and fascial components of the abdominal wall is important for abdominal wall closure after surgical procedures and hernia repair *(Shestak et al., 2018)*.

The anterior abdominal wall forms the anterior boundary of the abdominal viscera. It runs, superiorly from the xiphoid process and costal cartilages of the 7^{th}, 8^{th}, 9^{th} and 10^{th} ribs to the iliac crest, inguinal ligament, anterior superior iliac spine, pubic tubercle, pubic crest and pubic symphysis inferiorly. The anterior abdominal wall is highly distensible and is involved in various functions ranging from support of the abdominal viscera to protection of the abdominal cavity. It is more flexible than the posterior abdominal wall, and supports lateral bending, flexion, extension and twisting *(Shikary and Hom, 2019)*.

Lying just below the skin and formed of two layers called Camper's fascia and Scarpa's fascia. The Camper's fascia is a superficial fatty subcutaneous tissue containing variable amounts of fatty tissue. This fatty tissue is generally more in females and also in the right and left lower quadrants. Next to the Camper's fascia is the Scarpa's fascia *(Varacallo and Al-Dhahir, 2019)*.

Lie deep to the external oblique muscles, and they are of the anterior and lateral parts of the abdomen. They originate in the thoracolumbar fascia, anterior two-thirds of the iliac crest, and the Iliopectineal arch and insert into the inferior borders of the lower three ribs and their costal cartilages, linea alba, and aponeurosis of the rectus sheath as well as the conjoined tendon to the pubic crest and pectineal line. Most of its fibers run at

a right angle to those of external oblique *(Arab et al., 2018).*

Burst abdomen, may be also known as abdominal wound dehiscence, wound failure, wound disruption and evisceration. It is defined as the disruption of an abdominal wound and usually occurs between the 5th and 8th days after an operation *(Wagar et al., 2015).*

Burst abdomen is a severe post-operative complication experienced by Surgeons and Gynecologist, who do a significant amount of surgery. The frequency as described in the international data ranged from 0.4% to 3.5% *(Swaroop et al., 2015)* and is also associated with a mortality rate in patients as high as 45% *(Yeung et al., 2020).*

Highly related factors to occurrence of burst abdomen include: Incorporate age more than 65, wound contamination, intra-abdominal sepsis, chest infection, hemodynamic unstability. Additional systemic risk factors that were found to be significantly included: hypoproteinemia, systemic infection, obesity, uremia, hyperalimentation, malignancy, ascites, steroid use, and conditions associated with abdominal distention *(Wennergren et al., 2016).*

Despite many advances in surgical techniques, equipment, and supplies, complications after abdominal wall closure remain a persistent problem. The ideal abdominal closure should be efficient, provide strength, and serve as a barrier to infection. It should have low rates of fascial dehiscence, infection, hernia formation, suture sinus formation, and incisional pain *(Williams and Hope, 2015).*

Suture materials: There has been much research and debate over the type of suture material that should be used in abdominal closures. Non-absorbable and slowly absorbable sutures can be used for fascial closure. These sutures can be either monofilament or multifilament. Multifilament sutures have greater tensile strength for a given size; however, they cause greater tissue reactivity and are more prone to infection and sinus formation. It is thought that bacteria can be harbored within the filaments of a multifilament suture *(Vilz et al., 2014).* Consequently, monofilament sutures are traditionally favored for abdominal closure *(Ceydeli et al., 2015)*. Ultimately, the choice of optimal sutures depends on the outcome that is being evaluated, with less hernia formation associated with permanent suture but increased infectious wound complications compared with the absorbable suture.

Types of sutures:

According to absorbability:

- Absorbable (e.g. Vicryl (polygalactin 910), chromic gut):
  - Degraded in tissue in less than 60 days.
  - Traditionally used for closure of subcutaneous tissues or injuries to the tongue or nailbed.
- Non-absorbable (e.g. Ethilon (nylon), silk, Prolene (polypropylene):
  - Lasts longer than 60 days.
  - Traditionally used for skin closure.

According to number of filaments:

- Monofilament (e.g. Prolene (polypropylene), plain gut):

- Made of one strand of material

- Multifilament (e.g. Vicryl Rapide (polygalactin 910), silk):
  - Made of multiple strands woven together in a braid.
  - More friction when pulled through tissues, however this adds greater security to knots than monofilament.
  - Greater risk for inflammation and infection than monofilament.

According to origin:

- Natural (e.g. silk, chromic gut):
  - Made of organic materials.
  - Traditionally more inflammatory than synthetic materials.
- Synthetic (e.g. Ethilon (nylon), Vicryl (polyglactin 910)):
  - Made of laboratory manufactured materials *(Masini et al., 2016)*.

Biologic mesh:

Prosthetic mesh allows for a tension-free repair of the fascial defect. Unfortunately, it is associated with a completely different set of problems. In addition, it does not bring any of the basic wound healing units (e.g., glycosaminoglycans, fibronectin) into the wound field. The mesh becomes only minimally integrated in the final wound and it is never truly an integrated implant. Several approaches have been developed in an attempt to address these problems. *Huang et al. (2014)* reported that re-implantation of a prosthetic into an already contaminated field or skin at risk for breakdown had a very high rate of re-infection. Therefore, an ideal prosthesis is one that augments the body's natural efforts to heal, provides structural support, allows for ingrowth, and is eventually replaced or fully integrated. Many of these characteristics are found in acellular dermal matrix (ADM).

Wittmann patch: It is a type of temporary abdominal closure that is used to gradually close an open abdomen. It is a device that consists of two adherent Velcro sheets, one consisting of loops and the other of hooks. The sheets are cut to the length of the incision and sewn to the fascia. The sheets are then pulled from either side, allowing them to overlap and be pressed together. This provides continuous fascial tension along the length of the incision and attempts to prevent loss of the retracted fascia. The process is then repeated with serial tightening of the sheets every 24 to 48 hours, hence gradually pulling the fascial edges closer together until primary abdominal closure can be successfully performed **(Figure 1)** *(Coleman, 2015)*.

Figure (1): Wittmann patch sheets before applying to the wound *(Coleman, 2015)*.

TRADITIONAL METHODS OF ABDOMINAL WALL CLOSURE

The best abdominal closure technique should be fast, easy, and cost-effective, while preventing both early and late complications. Traditionally, individual authors have advocated one technique over another for theoretical or practical reasons, but until recently, evidence-based principles have not been applied to the subject as a whole. Relevant factors for review include:

1. Layered closure, mass closure, and retention sutures;
2. Continuous closure and interrupted closure;
3. Suture material, and;
4. Suture thickness and the suture length-to-wound length ratio **(Figure 2)** *(Ceydeli et al., 2015)*.

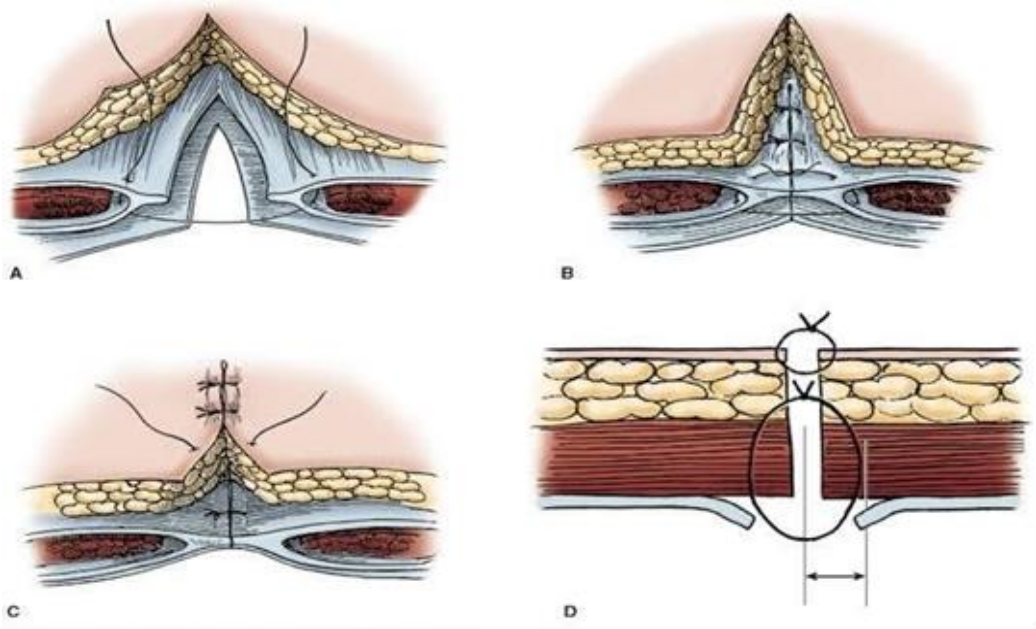

Figure (2): Abdominal wall closure. (A) Single layer abdominal wall closure, containing rectus sheath and peritoneum; **(B)** Mass closure in progress; **(C)** Skin closed as separate layer; **(D)** The sutures are inserted one CM apart and kept one CM away from the edge of incision *(Ceydeli et al., 2015).*

Bogota Bag: It is so named by Mattox while observing in Bogota, Colombia, uses a large intravenous (IV) bag to cover the abdominal viscera. After the initial operation, a pre-sterilized, soft 3-L IV bag is cut to an oval shape and stapled with a standard skin stapling device or sutured with monofilament suture to the skin edges of the wound. Sterile, antibiotic soaked towels are placed over the silo, which is then covered with an iodine-impregnated adhesive plastic drape. The wound is inspected and the dressing is changed every 24 hours. IV bag silos may be replaced in the intensive care unit setting using standard sterile surgical techniques and equipment. This is a variation of the silo closure used for repair of gastroschisis and omphalocele *(Huang et al., 2016).*

The traditional methods of closure carried high incidence of complications like infection, hernias and burst abdomen, hence, techniques were used and proven low rates of complications like mass closure technique and wide usage of meshes in closure. In this chapter we will discuss some of these new techniques that might also be used in preventing and treating a complication like burst abdomen *(Sörelius et al., 2013).*

Fascial Bridge Techniques for Primary Fascial Closure: The primary goal of progressive reduction of the fascial defect is to achieve a definitive closure of open abdomen within the initial hospitalization. Closure of the fascia should be performed without undue tension because excessive tension on fascial closure can result in increased IAP, ventral hernia, or fascial dehiscence. As described above, through

the appropriate use of the TAC techniques, patients with open abdomen can undergo multiple reoperations with progressive and final closure of the fascial defect. However, patients who have ongoing intra-abdominal infection, visceral edema, loss of abdominal domain or fascia, or complicated wound problems; delayed abdominal fascial closure (DAFC) may not be possible. Under such conditions, the limited available surgical options include performing an acute abdominal wall reconstruction using the component separation technique; bridge repair of fascial defect using synthetic/prosthetic mesh or biologic mesh; or a planned ventral hernia *(Huang et al., 2016)*.

Fascial Bridge Using Prosthetic Mesh: Under the situation that the abdominal fascia does not gather together, the first choice of primary fascial closure is fascial bridge with a prosthetic mesh or a biological mesh, or the other option is a planned ventral hernia. The ideal permanent prosthetic mesh for abdominal fascial bridge should have the following properties: chemical inertness, no allergic or inflammatory reaction, ability to resist mechanical stress, ability to be sterilized, lack of physical modification by body tissues, lack of carcinogenicity, convenience for clinical use, and inexpensiveness *(Rutherford et al., 2014)*.

Delayed closure: A study has shown that delayed abdominal fascial closure (DAFC) before 8 days was associated with fewer complications: 12% in those closed before 8 days and 52% in those after 8 days *(Diaz et al., 2011)*.

Wittmann Patch: Many methods have been advocated to maintain abdominal integrity and to facilitate fascial approximation, including the use of zippers, slide fasteners, and a Velcro analog. *Wittmann et al. (2010)* compared these several devices for TAC and concluded that the Velcro analog was the most practical option.

Vacuum-Assisted Wound Closure and Mesh-Mediated Fascial Traction: The vacuum-assisted closure technique for handling open abdomen has improved the care and increased the possibility of fascial closure in the open abdomen. Unfortunately, occasional failures with this technique occur in patients with severe visceral swelling which requires long treatment periods with open abdomen *(Huang et al., 2014)*.

CONCLUSION

Minimizing the risk of wound dehiscence development is strongly related to the patient's overall condition, the type of operation and incision and the technique used to close the abdominal wound in the first instance.

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علاج انفجار البطن وإعادة بناء جدار البطن (مثال مرجعي)

أحمد ابراهيم عباس الصياد، أحمد ابراهيم شحاتة، أحمد عبد الفتاح أحمد

قسم الجراحة العامة، كلية الطب، جامعة الازهر

E-mail: sayyad.hammer@gmail.com

خلفية البحث: في العديد من الحالات الجراحية (مثل حالات الطوارئ)، يصبح إستخدام تقنية فتح البطن طريقة مثالية لإنقاذ حياة المريض. وهناك العديد من المضاعفات التي تتبع تقنية فتح البطن والتي يكون فيها تفكك جدار البطن و/ أو إنفجار كامل للبطن هو أخطرها، ويعتمد جميعها على العديد من العوامل المتعلقة بالمريض والتقنية الجراحية والمواد المستخدمة ومهارات الجراح.

الهدف من البحث: توفير أحدث المعلومات المتقدمة حول الأسباب والوقاية من إنفجار البطن والطرق المتغيرة لعلاج هذه المضاعفات الخطيرة بعد الجراحة.

مصادر البيانات: في هذا البحث تم توضيح بعض المواد والطرق الأكثر شيوعًا التي يستخدمها الجراحون في جميع أنحاء العالم لعلاج مثل هذه المضاعفات الخطيرة. وتم إجراء العديد من الدراسات لمقارنة طريقتين أو أكثر إما في تقنيات إغلاق جدار البطن أو في المواد المستخدمة لهذا الغرض.

الاستنتاج: إحدى أفضل الطرق في إغلاق جرح جدار البطن بعد العمليات هي تقنية الإغلاق الجماعي لأنها تحمل معدل أقل من مضاعفات ما بعد الجراحة وخاصة تفزر الجرح.

الكلمات الدالة: انفجر البطن، إعادة بناء جدار البطن.

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