Complex abdominal wall repair using a combination of porcine dermal matrix and omentum flap in patient with digestive tract fistula: report of a case and review of the literature

Michele Bartoli∗, Gian Luca Baiocchi, Andrea Celotti, Nazario Portolani, Stefano Maria Giulini

Department of Clinical and Experimental Sciences, Surgical Clinic, Brescia University, Brescia, Italy

Received: November 16, 2015 DOI: 10.5430/crerp.v3n3p42
Accepted: January 5, 2016 Online Published: June 6, 2016
URL: http://dx.doi.org/10.5430/crerp.v3n3p42

ABSTRACT

Purpose: The purpose of this article is to propose an effective approach for giant abdominal wall defects repair in a contaminated field, using a combination of porcine dermal collagen graft (Permacol) and omental interpositional flap.

Case: We report a case of a 41-year-old woman submitted to emergency laparotomy, splenectomy and hepatic haemostasis for massive hemoperitoneum. She developed enteric fistula, cutaneous, muscular and fascial necrosis leading to evisceration. At the fourth intervention we finally reconstructed abdominal wall defect using a combination of Permacol and omental flap.

Conclusion: The reconstruction of large, full-thickness, eventually contaminated abdominal wall defects is often a challenging undertaking. Similar difficulties are usually encountered with early abdominal wall closure after damage-control surgery and/or open-abdomen management. In these situations the use of synthetic mesh is contraindicated; absorbable mesh can be used as temporary solution and some techniques of autologous tissue repair have been suggested. Therefore no ideal operative repair technique or prosthetic material for reconstruction of the fascial defect is currently available in the literature. Recently, the development of biologic meshes has shown successful rates in the management of these parietal wall defects. Also in this patient, porcine dermal collagen mesh combined with omental flap allowed us to reconstruct large abdominal wall defect.

Key Words: Abdominal wall defects, Biological mesh, Permacol, Omental flap

1. INTRODUCTION

The reconstruction of large, full-thickness, eventually contaminated abdominal wall defects is often a challenging undertaking. Such hernia defects include those associated with exposure to enteric contents owing to ostomy creation and take-down, fistula, incarcerated or strangulated hernias, those created after the excision of infected prosthetic mesh, and those associated with acute tissue loss for severe trauma.

Similar challenges are usually encountered with early abdominal wall closure after damage-control surgery and/or open-abdomen management.

In these situations, no ideal operative repair technique or prosthetic material for reconstruction of the fascial defect is currently available. The use of synthetic mesh is largely (but non unanimously) agreed to be contraindicated owing to an high rate of perioperative complications, including wound

∗Correspondence: Michele Bartoli, MD; Email: michelebartoli83@gmail.com; Address: Department of Clinical and Experimental Sciences, Brescia University III Chirurgia, P.le Spedali Civili 1, 25123, Brescia, Italy.
infection, fistula formation, adherence and erosion of the vis-
cera,[1–4] especially when, in absence of peritoneum or omen-
tum, the prosthetic device should be placed in direct contact
with the bowel.[5,6] Adsorbable mesh can be used in these sit-
uations; however, this solution is temporary and predisposes
the patient to multiple operations and a staged abdominal
wall reconstruction to achieve an acceptable functional re-
sult (sometimes, the very high operative risk precludes a
two-stage surgical procedure[7]). A number of techniques
such as component separation,[8] musculocutaneous[9,10] or
pedicled omentum[11–13] flaps have been suggested as a good
alternative for autologous tissue repair, but the size of the
defect often limit such possibilities, and the potential risk for
donor site morbidity should be taken into account.[14]

Recently, the development of biologic meshes has shown
successful rates in the management of these parietal wall
defects. Such meshes allow to achieve a tension-free repair
in a single-stage operation in the setting of contaminated
wounds and in case of skin deficiency.

The purpose of this article is to propose an effective approach
for giant abdominal wall defects repair in a contaminated
field, using a combination of porcine dermal collagen graft
(Permacol®<sup>TM</sup>, Surgical Implant, Covidian, Minneapolis) and
omental inter-positional flap.

2. CASE REPORT

A 41-year-old woman was found in the street unconscious
(GCS 4+2+1) and was submitted to oral intubation and suc-
cessful cardiopulmonary resuscitation. At Emergency Room
admission the patient was haemodynamically stable. Ul-
trasound showed the presence of haemoperitoneum, con-
formed by CT scan, which found splenic (actively bleeding)
and hepatic tears and multiple rib fractures. The patient
was taken to the operating room. At this time no previous
medical history was recordable; abdominal wall inspection
revealed only a midline and a large suprapubic incisions.
Emergency bilateral subcostal laparotomy was carried out,
massive haemoperitoneum was confirmed (at least 2,000 ml
blood was drawn out), splenectomy and hepatic hemostasis
with surgical glue were performed.

Following the arrival of relatives to the hospital, the fol-
lowing important features were recorded: the patient was a
Jehovah’s Witness, had many risks factors including obesity
overweight (BMI 28), hypertension, diabetes, type II bipolar
disorder and hypokalemia arising from previous bariatric
surgical procedures (firstly, biliopancreatic diversion, and
secondly surgical revision for stretching common intestinal
loop), and had undergone also abdominoplasty by the supra-
pubic incision.

In 3<sup>rd</sup> post-operative day (pod) the surgical wound presented
cutaneous necrosis, followed by purulent secretion, leading
to a first re-intervention in 8<sup>th</sup> pod. Cutaneous and fascial
necrosis was found; surgical toilette and necrosectomy were
performed and vacuum-assisted (VAC Instill<sup>®</sup> Therapy Unit,
KCI Medical, Acelity Company, Milano) closure system was
applied. Six days after the second intervention the patient
was further taken to operation room for evisceration and
enteric fistula (see Figures 1–2). Intra abdominal adhesions
were lysed. Enteric fistula was located on the alimentary tract
10 cm far from the anastomosis with biliopancreatic tract.
The eviscerated bowel was completely covered by fibrin and
hurt, so ileal resection of the eviscerated bowel and jejunal re-
section of alimentary tract with enteric fistula (together about
130 cm) were performed. Intestinal continuity was restored
with a total of 3 entero-entero anastomosis. The avital skin,
subcutis and a part of abdominal wall involved by necrosis
were removed. Full debridement resulted in abdominal wall
defect of at least 20 cm × 14 cm. The resulting defect was
placed in the upper abdominal wall extending from the right
to the left anterior axillary line and from the xiphisternum to
the umbilicus. Primary fascial closure wasn’t possible. The
greater omentum was laid on bowel for protection. Above it
a large dual mesh (Gore-Tex<sup>®</sup>, ePTFE prosthesis, W.L. Gore
and Associates, Flagstaff, Arizona) was placed to close the
lack of the abdominal wall by suturing it to the remnant rim
of abdominal muscles with Vicryl 2 interrupted sutures. A
dermal substitute (Integra, IntegraTM Bilayer Matrix Wound
dressing, Integra LifeSciences Corporation, New Jersey) was
placed to cover the mesh. In 1st pod, VAC system was ap-
plied again by the plastic surgeon, but 3 days later the patient
developed another enteric fistula and underwent surgery for
the fourth time. After removing the contaminated dual mesh,
dehiscence of the ileo-jejunal anastomosis was evident. Ev-
ey kind of ostomy wasn’t possible for the lack of abdominal
wall. So, the anastomosis was resected and redo anastomosis
was performed and reinforced by a seromuscular defunc-
tionalized jejunal flap. The omentum was mobilized from
the transverse colon and the greater curvature of stomach
and pedicled on the left gastroepiploic vessels. At this time
a porcine dermal collagen implant (Permacol) was used to
achieve wound’s closure. A single Permacol piece was set
into abdominal cavity strictly above the bowel and fixed to
overlying anterior abdominal wall using polypropylene inter-
rupted sutures. The exit point of the omental flap was a little
slit located on the left subcostal site (see Figure 3).

The greater omentum was laid on the mesh, sutured to
the abdominal wall using interrupted sutures and overlaid by fat
gauze. After 22 days the wound was covered by granulation
tissue so plastic surgeon covered skin defect with free thigh
skin graft.

Figure 1. Frontal CT scan before the third intervention
A large parietal defect leading to evisceration can be seen. The absence of muscular, subcutaneous and cutaneous plane is more evident on the left side.

Figure 2. Sagittal CT scan before the third intervention
A small seroma spontaneously drained and self-limited after 5 month. At 10-month follow up the abdominal reconstruction is intact, there aren’t signs of herniation, infection or fistula formation and the patient is able to perform normal daily activities.

Figure 3. This picture taken in operating room shows the lost of substance of the abdominal wall at the fourth intervention
Permacol is just placed on bowel within peritoneal cavity and fixed to the overlying anterior abdominal wall. Omental flap exteriorized from the left subcostal site is going to be laid on the mesh and sutured to the abdominal wall using interrupted sutures.

3. DISCUSSION

Abdominal wall reconstruction in case of digestive tract fistula is a complex problem. Multiple techniques are available, including use of synthetic materials, free flaps and grafts. In literature there aren’t randomized trial or guidelines about this issue, but only case series or some retrospective studies with small sample. Thus we have to use our best judgment and the available data to make treatment choices.\[15\] The recently available biologic meshes, which can theoretically improve the results in such cases.

Lopez Cano et al.\[16\] has recently proposed a new definition of acute postoperative open abdominal wall (POAW). It is defined as the disjunction of all the abdominal wall’s layers (cutaneous, muscular and peritoneal layers) that occurs after surgery. It can be intentional or unintentional depending on surgical-related actions. Intentional acute POAW or “open abdomen”\[17\] consists in the surgeon’s choice not to close the abdominal cavity and leave it open. Unintentional acute POAW (or “burst abdomen”, “evisceration”, “wound dehiscence”, “wound disruption”) is a common postoperative complication in abdominal surgery that consists in the partial or total opening of the laparotomy.\[18\] Wound opening may be complete involving muscular and cutaneous layers or incomplete when the skin is not involved (“ventral hernia”). In unintentional acute POAW there are some different subgroups. Each group has different management regarding definitive early or delayed closure. The presence of intra
abdominal abscesses, the presence or absence of enterocutaneous or enteroatmospheric fistulas and the possibility of early closure without tension of the laparotomy are some of the possible scenarios in which the surgeon has to choose the right treatment strategy. Our patient should be included in the subgroup of patients with complete wound failure and enterocutaneous fistula. For this kind of patients there are no guidelines.

Reinforced repair is defined as use of mesh. The anatomic position of the mesh is defined as subcutaneous on the top of the anterior rectus fascia (“onlay”), between the rectus muscle and the posterior rectus fascia (“preperitoneal underlay” or Rives-Stoppa technique), behind the posterior rectus fascia (“intraperitoneal underlay”) or within the defect and sutured directly to the fascial edges (“interpositional” or “inlay”). Mesh’s use has significantly decreased recurrence rates of hernia repair. Synthetic materials, such as Polypropylene or ePTFE, are commonly employed but they can cause complications including wound infection, intra abdominal adherences, entero-cutaneous fistula and lack of tissue in-growth into the mesh.

After synthetic mesh repair, prosthesis removal is often mandatory when infection develops. In a meta-analysis of incisional hernia repair with synthetic prosthetics, infection requiring mesh removal occurred in 10.1%. However, a meta-analysis of the component separation technique for ventral hernia repair showed an 18.9% infection rate, contributing to an overall complication rate of 23.8%, including flap necrosis and donor-site related complications, thus even higher than synthetic mesh repair complication rate.

Collagen-based biological materials have been developed to overcome these problems. The concept behind biological implants is to provide a collagen and other extracellular matrix scaffold in which the host fibroblasts can create angiogenesis and deposit new collagen. Currently available bio synthetic mesh include human cadaveric dermis (AlloDerm), porcine dermal (Permacol® and Strattice®) and submucosal (Surgisis®) sources. In a recent literature review by Slater, biologic prosthesis for ventral hernia repair perform similarly to other surgical options. However, they were associated with higher salvage rate in cases of infection. Infection is the most common postoperative complication even with biologic grafts (overall rate of 15.9%), but the majority of infections are superficial, and the biologic mesh could almost always be savaged (grafts are removed in only 4.9% of infected cases).

In a literature review by Smart et al., Permacol® surgical implant has the lowest failure rate and the longest time to failure, particularly in contaminated fields. These results are concordant with findings from high-quality animal studies. Permacol® surgical implant is a cross-linked porcine-derived acellular dermal sheet predominantly composed of Type I collagen. It is resistant to the collagenase enzymes responsible for the breakdown and resorption of implanted collagen and is also able to support host cell infiltration and revascularization, and within a few months it becomes an integral part of body. Permacol® does not facilitate the formation of a biofilm in the presence of infection and thus is ideal for use in operations with a high risk of infection.

Permacol®, as all type of biological mesh, can be left to direct contact with bowel and adipose tissue but needs to be covered and can’t stay exposed to air. Cross linked biologic prosthetics are more resistant and have higher bursting strengths, whereas noncross-linked biologies support host cellular ingrowth. Cross linked mesh become encapsulated as opposed to incorporated into host tissues. Totally cross-linked mesh will not incorporate into host tissues at all, whereas partly cross-linked prosthesis will incorporate to some degree. A major issue surrounding Permacol and all the other biologic grafts is their high price. According to the type of mesh, the price varies between $ 2.845 and $ 5.311 for 150 cm² prosthesis. This kind of prosthesis is not largely used in Europe because of their high costs. More convincing evidence of their performance and accurate indication is awaited. The Food And Drug Administration reported adverse events with the use of these meshes that warrant caution and judicious decision making. Because of the theorized structural remodeling of biologic graft, the long term integrity of abdominal wall after reconstruction remains unknown. So we need studies with longer follow-ups to really determine the durability of biologic meshes given their biodegradable nature.

In the presented case there was no sufficient skin or tissue to cover the mesh; thus, pedicled omentum flap was used. In many cases, owing to the large size of defect, the use of abdominal wall flaps to cover prosthetic mesh is not possible, while a pedicled omentum flap is easy to prepare, and it can reach defects over all quadrants of the abdominal wall. Lower abdominal wall defects may be managed with flaps from thigh such as tensor fascia lata flap, instead the upper abdominal wall is more challenging although extended tensor fascia lata or latissimus dorsi flaps or extended deep inferior epigastric flap have all been described. The omentum consists of abundant blood vessels, fat, and lymphatic tissue and is known for its unique immunologic and angiogenic properties. Therefore it can be used in infected or contaminated situations and an additional free skin flap necrosis and donor-site related complications, thus even higher than synthetic mesh repair complication rate.
graft could easily placed over it. The utility of the omentum as a flap in reconstructive surgery is well documented, but also this technique presents donor-site complications such as abdominal wall infection, hernia, delayed splenic rupture, gastrointestinal hemorrhage, and, later, small bowel obstruction, early satiety and transient gastric outlet obstruction. In a retrospective series, C. Scott Hultman et al.[36] found a donor-site complication rate of 18.5%.

4. CONCLUSION

In conclusion, in the management of large, infected abdominal wall defect, the use of Permacol® combined with omentum flap offer a safe and effective alternative to traditional hernia repairs.

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