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CASE REPORT

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Abdominal Wall Defect Reconstruction with Use of Biological Mesh and Negative Pressure Wound Therapy: a Case Report

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ABSTRACT

Objectives: *Complex abdominal wall reconstruction cases constitute a challenging issue, with high morbidity and mortality rates.*

Materials and methods: *A young trauma patient presented abdominal dehiscence after multiple laparotomies. The fascial defect was managed with the use of a biological mesh, while initially primary wound closure was attempted. Due to cutaneous dehiscence, the use of negative pressure wound therapy was decided.*

Results: *Granulation tissue formation was noticed on the eighth day while complete wound closure was achieved after 57 days.*

Conclusions: *In conclusion, the combined use of biological mesh and negative pressure wound therapy is feasible in the management of complicated abdominal defects.*

Keywords: complex abdominal wall, biological mesh, negative pressure wound therapy.

INTRODUCTION

Although the term "complex abdominal wall defect'' has not been universally defined, the Italian Consensus Conference has laid the groundwork for an accepted definition on elective and emergency medicine as well as for guidelines regarding management techniques and indications (1). Every year, the number of abdominal wall reconstructions performed in Europe and USA is equal to 400,000/year and 300,000/year, respectively, leading to a total cost of US $ 3.2 billion. Taking into consideration the above, together with the total cost of recurrences, abdominal wall reconstruction procedures emerges as a considerable economic burden (2). Numerous causes can lead to abdominal fascia

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defects, including congenital disorders, age, abdominal wall tumors, necrotizing infections, previous abdominal surgeries, but also trauma and trauma-associated infections (3, 4). Among the techniques proposed so far, biological meshes constitute an innovative solution feasible for contaminated and infected environments such as traumatic defects (5). In addition, the application of NPWT is based on the principles of granulation tissue formation and prevention of infection and represents a valuable tool for large abdominal wall defects (4).

We report a combined use of NPWT over a porcine-derived acellular dermal sheet (PermacolTM) to manage wound dehiscence in an emergency setting. The following case report refers to a 20-year-old trauma patient and is presented in accordance to Surgical CAse REport (SCARE) guidelines (6). The patient and his relatives were thoroughly informed and written informed consent was obtained for publication of the present case report and accompanying images. Copies of written consent are available for review by the Editor-in-Chief of this journal. The present study highlights the possible application of the combined use of NPWT and biological meshes in cases of emergency complex abdominal wall reconstruction. ❑

CASE PRESENTATION

We report a case of a 20-year-old Caucasian male who was initially admitted to the Surgical Emergency Department of a regional general hospital due to a motorcycle accident with a high-injury associated mechanism. From his medical history, only severe obesity and hypothyroidism are referred. The patient complained of acute abdominal pain and pain of the left lower extremity. Clinical examination revealed an ecchymosis of the left flank as well as distension and diffuse tenderness in all quadrants of the abdomen, with muscle guarding or rebound tenderness and hypoechoic tympanic sounds on percussion. Computer tomography (CT) was performed, revealing a Grade IV splenic injury, with significant intraparenchymal and abdominal hematoma. From the radiological examination, a malleolar fracture of the fibula of the left extremity was found. The patient underwent exploratory laparotomy through a midline incision with extension to Chevron incision and splenectomy. In addition, closure of a mesenteric defect noticed intraoperatively with polyglactin 3-0 sutures was decided. The malleolar fracture was treated with open reduction and internal fixation.

Postoperatively, the patient was admitted to ICU, where fecal content was noticed on the fifth postoperative day. The patient underwent urgent abdominal CT which revealed generalized feculent peritonitis due to sigmoid colon perforation as a result of ischemia; therefore, transport to a tertiary hospital was decided. Initial resuscitation with intravenous fluids and broad-spectrum antibiotics was encountered and the patient was led to the operating room for a second exploratory laparotomy. Feculent peritonitis was diagnosed due to sigmoid perforation and peritoneal lavage followed by an emergency Hartmann's procedure was performed. Open abdomen negative pressure therapy with a vacuum-assisted wound closure system with a pressure of -125 mm Hg was chosen, since primary closure of the abdomen was not feasible due not only to intense intestinal edema and risk of abdominal compartment syndrome but also to intense bacterial contamination of the peritoneal cavity demanding peritoneal lavage. In this way, our surgical team had the opportunity for a second look and re-examination of the abdominal cavity as well as avoidance of abdominal compartment syndrome due to profound intestinal edema two days later.

Our patient's postoperative course was rough and long, with numerous reoperations. After two reoperations involving peritoneal lavage and intrabdominal negative pressure wound closure system two and four days after the initial surgical procedure, intrabdominal edema receded and reconstruction of the abdominal fascial defect was performed in an inlay manner, using a porcine-derived acellular dermal sheet (Figure 1) (PermacolTM, Covidien, Mansfield MA, USA, 15×20 cm), based on both the large size of the defect and history of intrabdominal contamination and feculent peritonitis. In addition, abdominal fascia as well as rectus abdominis muscles seemed weakened macroscopically and limited debridement of fascial edges was decided. The biologic mesh was overlapped and fixed to the abdominal fascia using nonabsorbable polypropylene 3-0 sutures. Skin closure was also attempted during the same procedure, with no evidence of tension intraoperatively. Four days after the last

operation and after the patient had been transported from the ICU to the surgical department, wound dehiscence was noted on two spots, leaving underlying Permacol mesh exposed. During this period, our patient remained febrile with associated leucocytosis and increased CRP levels. Apart from other previously investigated causes of fever, swab cultures revealed the presence of Acinetobacter and Proteus, and the patient was administered directed intravenous antibiotic therapy. However, a CT revealed no residual intra-abdominal fluid collections. Primary closure was performed, with nonabsorbable sutures under local anaesthesia (Figure 2), but this technique was unsuccessful due to increased wound tension. Taking into consideration all the above-mentioned issues, NPWT use was decided. After removal of sutures partially attached to the trauma, two regions of wound dehiscence with dimensions of 5 cm x 7 cm and 4 cm x 3 cm were encountered (Figure 3). After local wound disinfection with povidone-iodine and Prontosan® Wound Irrigation Solution, two discrete pieces of V.A.C.® Granulofoam Silver™ connected with a sponge bridge were applied, combined with NPWT. Polyvinyl alcohol (PVA) whitefoam dressing was applied between Permacol and Granulofoam Silver sponge (Figure 4). For the first two weeks, changes to the set of white foam and sponges were performed every four days and the negative pressure was set at -75 mm Hg. Infection was successfully controlled and after 12 days of systemic and local therapies, the patient was afebrile, with remission of leucocytosis and negative wound swab cultures. Eighteen days after NPWT application, development of granulation tissue has been noticed over the biological mesh and an increase of negative pressure to -100 mm Hg was decided (Figure 5). Autologous skin grafting was proposed to cover the skin defect, but the patient and his family refused an additional surgical procedure. The patient was discharged to a rehabilitation centre, with wound dimensions of the cutaneous defect 2 cm x 3 cm and 2 cm x 1,5 cm. The patient's follow-up continued on an outpatient basis, with visits every five days. Cutaneous defect dimensions progressively decreased and granulation tissue formed, covering the total surface of the mesh. Using a Y connector, a second NPWT system was used for a grade IV pressure ulcer of the sacrococcygeal region of the patient. We decided to remove the NPWT system after a total

FIGURE 1. Application of biological mesh in an inlay manner to recreate the abdominal wall

FIGURE 2. Non-absorbable sutures as an initial approach to wound dehiscence. Recurrence of dehiscence is evident

FIGURE 1. Two regions of wound dehiscence after failure of primary close, with exposure of biological mesh

FIGURE 4. Negative pressure wound therapy applied over the biological mesh

FIGURE 5. Granulation formation after 18 days of negative pressure wound therapy

FIGURE 6. Abdominal dehiscence after 57 days of negative pressure wound therapy

FIGURE 7. Final aspect of the abdomen

therapeutic period of 40 days. The minimum level of negative pressure was set at -75 mm Hg, while the maximum negative pressure level was set at -100 mm Hg. Following NPWT, the wound bed was treated with daily changes with Zinc-oxide based hydrophilic paste and alginate and hydrofiber dressings. Total closure of abdominal dehiscence was achieved 57 days after our first surgical procedure (Figure 6). No signs of recurrence or inflammation and necrosis were noticed up to the third month of postoperative follow-up (Figure 7). ❑

DISCUSSION

The combined research of both general and plastic surgeons in the field of complex abdominal wall reconstruction has led to the emergence of numerous techniques, when primary repair fails or is contraindicated. These techniques involve the use of tissue expanders and locoregional flaps, or distant flaps for skin defects, while facia defects can be managed with prosthetic meshes, synthetic or biological, free flap reconstruction of the fascia, combination of meshes and component separation technique, or combined application of flaps and meshes. There are also reports for vascularized composite abdominal wall allotransplantation. In addition,

temporary abdomen closure or use of Negative-Pressure Wound Therapy Devices represents a feasible option, especially for contaminated and complicated cases (7). Synthetic meshes constitute a cost-effective solution for complex abdominal defects, but one should take into consideration their vulnerability to graft rejection, biofilm development as well as inability to form granulation tissue if left exposed (4). Biologic meshes can be of human, bovine, and porcine origin. They have numerous advantages. Thus, biologic meshes present sufficient revascularization and incorporation properties into the host site due to the preservation of extracellular matrix, with adequate structural and soft-tissue support. In addition, the ability to retain their properties and tolerate a contaminated environment, causing at the same time fewer adhesions to visceral organs, promotes their application in patients with trauma or multiple abdominal surgeries (8). Last but not least, biological meshes are a safe alternative for patients undergoing chemoradiation or immunosuppressive therapy (9).

PermacolTM is an acellular cross-linked porcine-derived collagen matrix implant. Available sizes vary up to 28 9 40 cm^2, while its cost raises up to $18.97 *per* cm^2. After being decellularized, PermacolTM is sterilized by gamma radiation. The first application of Permacol was reported in 1984, so the literature contains only a few small case series (9). Among the advantages offered by Permacol one should mention the reduced rate of infection, erosion of adjacent structures, rejection, adhesion, and fistula formation, leading to an extended use of biological meshes in cases of complicated abdominal wound defects nowadays (10). In their prospective non-randomized study, Limura *et al* described the experience of their institution regarding the use of a porcine implant (PermacolTM) in the field of complex abdominal wall reconstructions, including 56 complex abdominal wall reconstructions, with intraperitoneal (underlay) placement of the graft in 89% of patients. Recurrence rate amounted to 26% of patients and the postoperative complication rate was 45%, while 86% of patients were satisfied with the surgical outcomes. Authors concluded that biological implants may lead to reduced morbidity and better surgical results regarding complex abdominal wall reconstruction procedures when used in complicated cases (9). Based on the aforementioned data, our surgical team preferred the application of a porcine biologic mesh to prevent septic complications or adhesions to intraabdominal organs. Moreover, our patient's clinical conditions, including malnutrition, hypoalbuminemia, and multiple positive blood and wound cultures rendered reconstruction with the use of myocutaneous regional or distant flaps not feasible, due to the fear of donor and recipient site infection and flap necrosis. In cases of difficult abdominal wall reconstruction, the combination of negative pressure wound therapy with absorbable meshes leads to granulation into the mesh during its integration. In addition, the combination of biological meshes with NPWT reduces the possibility of enteroatmospheric fistula formation, as Nagashima *et al* highlight in a series of trauma patients (11). ❑

CONCLUSIONS

The combination of NPWT and absorbable mesh reconstruction of rectus abdominis muscle fascia is a feasible strategy for complex abdominal wall cases, leading to a reduced rate of enteroatmospheric fistula formation, early granulation, and reduced morbidity through shorter hospitalization period. The aforementioned strategy presents promising outcomes, with reduced hospitalization time and limited complications reported so far. ❑

Conflicts of interest: none declared.

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Informed consent: All authors certificate that they have the written consent of the identifiable person in order to present the cases in this scientific paper.

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