RESULTS OF THE USAGE OF BIOLOGICAL MESH IN THE REPAIR OF COMPLEX ABDOMINAL WALL DEFECTS IN PATIENTS POST TRANSPLANTATION AND GENERAL SURGERY. THE FEASIBILITY OF USING MRI IN FOLLOW UP.

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RUNNING TITLE The use of biological mesh in the repair of complex defects.

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ABSTRACT

Immunosuppressive therapy, inflammation, and surgical site or general infection make the use of traditional methods for abdominal wall closure ineffective and preclude the application of synthetic mesh. In such difficult cases, the utilization of the biological material, such as PermacolTM, a porcine acellular dermal collagen implant, may be a solution. The purpose of this study was to analyse the use of biological mesh in patients in whom the closure of abdominal wall defect with other methods was not possible and to compare outcomes in patients after transplantation and general surgery. The study group consisted of 14 patients, including 6 patients after transplantation. The evaluation of wound healing was based on a clinical examination and in selected patients on magnetic resonance imaging (MRI) that is an excellent examination however it should not be considered as an examination of choice in such cases. Only 3 uneventful outcomes were observed. Biological meshes may be used in patients in whom other ways of treatment had failed; still a prolonged time of wound healing should be expected. It seems, that it is safe to use PermacolTM in post transplantational patients. Implanting PermacolTM and negative pressure wound therapy can be combined.
BACKGROUND

Complications connected with wound healing with tissue loss are very difficult to treat. Immunosuppressive therapy, inflammation, and surgical site or general infection make the use of traditional methods for abdominal wall closure ineffective and preclude the application of synthetic mesh. There is a conviction that the use of synthetic materials in patients with surgical site infection is not recommended due to a high risk of their contamination and as follows, healing failure. On the other hand, it is believed that the appliance of biological material in such cases is appropriate. One of the most commonly used biological meshes is PermacolTM – porcine acellular dermal collagen implant. These materials are not used as the treatment of the first choice; there are not any randomized trials that may indicate the best treatment option. In our centre not only patients with general surgery problems are treated, but also there is a huge group of patients post transplantation procedures in which the risk of infection is significantly higher because of the immunosuppressive therapy. In our research, we are focused on the results of the treatment with the use of biological material in patients in whom standard technique of abdominal wall closure had failed. Two different types of biological materials are used in our centre: porcine acellular dermal matrix (PADM) and bovine pericardium. The fact that the magnetic resonance imaging was performed one-year post PADM implantation distinguishes our research. Moreover, there are no studies that would describe complications post biological mesh implementation.

MATERIALS AND METHODS

The purpose of the study was to analyse the usage of biological mesh for an abdominal wall closure and healing in patients after transplantation or general surgery at whom we were unable to use other method for abdominal wall closure. 14 cases were taken to analysis: 5 patients after kidney, simultaneous pancreas and kidney or pancreas transplantation that suffered from wound dehiscence due to infection connected with the lack of fascia or other abdominal wall tissue defect. The rest of the analysed group constituted of 9 patients that required PermacolTM implantation due to either fascia loss with infection or synthetic mesh infection. All of the surgeries were performed at Department of General and Transplantation Surgery, Medical University of Warsaw, Warsaw, Poland, between January 2013 and September 2015. Retrospectively, we analysed data as follows: age, sex, the main reason for the usage of the biological implant, comorbidities, procedural details (the size of the implant, technique of the procedure, the type of the implant), type of bacteria (if infected). Follow-up period ranged from 6 to 32 months.

Magnetic resonance imaging (MRI) was performed after 6 to 32 months post implantation of the mesh. All of the patients had had T2 weighted scans in transverse and sagittal plane, fat-saturated T2 weighted images in sagittal plane and Dixon sequence in transverse plane done.

We collected the data regarding the time of hospitalization and ambulatory treatment. As an ambulatory treatment we implied the period until there was no leakage from the wound and we were able to remove the sutures.

Average age of the patients was 47 (SD = 13.9 years, median = 47). There were 9 male patients (64.3%), including 3 after transplantation, and 5 women (3 post transplantation).

As long as post-transplantational patients are concerned: in 4 out of 5 patients multiresistant bacteria had infected surgical site (the most common were Enterobacter faecalis and Acinetobacter baumanii) that were treated according to the antibiogram. Continuous negative pressure wound therapy (NPWT), with negative continuous pressure equaling 120 mmHg, prior mesh implantation was used in 3 cases.

Data regarding patient surgical history prior PADM implantation was analysed in details and described in the table 1.

We stated that in the second group of patients (after abdominal surgeries), all of the patients had had surgical site infection (the most common pathogen was Staphylococcus aureus), however only one of them required NPWT prior PermacolTM implantation. The most frequent reason for PermacolTM implantation was fascia defect (after multiple laparotomies) and synthetic mesh infection after hernioplasty that required removal of the mesh (3 and 4 patients, respectively). There was only one case of use of PermacolTM in the recurrent abdominal hernia without accompanying infection.

All of the surgeries that were performed had been elective surgeries. Antibiotic therapy was used in all of the patients: for patients with the sterile wound – ceftriaxone 1.0 g intravenous in a perisurgical period and patients with surgical site infection were treated according to the antibiogram.

According to operative notes 3 different techniques were used for PermacolTM implementation.

1. Sublay technique: PADM was placed intraperitoneal, under the fascia and sutured to the fascia. The fascia was closed above PADM.
2. Inlay technique: PADM was cut to fit the size of the fascia defect then sutured.
3. Onlay reinforcement of an autogenous suture repair. In all of the cases the PADM was sutured using non-absorbable sutures – Prolene 2-0. All of the wounds at the time of PADM implementation were primarily closed with the suturing of the skin (Figure 2).

RESULTS

Data regarding 14 patients (35.7% women, n = 5) who underwent surgery with the use of PADM were taken to analysis. Average age of the patients was 47 (SD = 13.9 years). Two patients died before the follow-up, their medical data was included in the analysis, however we were not able to perform MR imaging post surgery.

Mean hospitalization period after mesh implantation was 34.5 days and in groups: 31.83 days (transplantational patients) and 25.83 for patients without
immunosuppressive therapy. As the wound healing we referred the end of ambulatory treatment. In the group of patients without immunosuppressive therapy that time equalled – 90.87 days (7-210, median 91.5) and in the other group: 47.2 (from 8 to 110 days, median 44) (Figure 4). Average surface of implanted material was 253.33 cm².

Two patients revealed surgical site infection after PermacolTM implantation. One of them had had PermacolTM removed after one week because of its infection – biological mesh was tearing and fragile. PermacolTM was replaced with other biological mesh – Veritas. Further follow-up of that patient was impossible because of his death, not related to biological mesh implantation.

NPWT was applied over the biological mesh in case of the other patient, due to recurrence of surgical site infection. After the repair surgery, secondary wound dressing; the patient was discharged after 110 days. MRI after one year revealed that there was no hernia in the place of PermacolTM implantation, moreover the mesh was visible.

In case of the patient described in a Table 1 as patient M, MRI after 4 months post implantation showed that the remaining PermacolTM was intact (Figure 1). Thus far, there was no sign of hernia or abdominal wall dehiscence. However, the healing period was not complication free. In the lower extreme of the wound, 3 days after the first PermacolTM implantation massive leakage occurred and wound dehiscence in that area was observed. Exploration revealed that there was PermacolTM lysis and serous exudation. The patient wound-healing period was prolonged up to 3 weeks. Histopathological examination of damaged PermacolTM was performed: necrosis and infiltration of neutrocytes was described. It is important to mention that prior implantation of the graft wound was sterile (NPWT treatment and aggressive antibiotic therapy was used prior the repair surgery). The decision to implant another PermacolTM was made that turned out to be successful. The outcome of the patient with PermacolTM implantation because of muscle necrosis was uneventful. MRI after one-year revealed no abnormalities, abdominal wall continence was restored.

In case of patients after general surgery, the majority of the cases were connected with prolonged wound healing (up to 156 days). One patient required NPWT post biological mesh implantation.

None of the patient had hernia recurrence during the follow-up period.

Serum leakage from the wound (8 cases), wound dehiscence (5) that required secondary subcutaneous tissue and skin sewing, and surgical site infection (4 patients) were the most common complications post biological mesh implementation. There were no statistical differences between the groups as long as the complications are concerned (figure 3). In patients who suffered from leakage from the wound dressing were changed 2 times a day, patients with surgical site infection were treated according to antibiogram.

DISCUSSION

Multiple laparotomies may cause a large defect in the abdominal wall that enables the primary closure of the wound, not only because of fascia loss but also because of the accompanying infection. Primary autogenous suture repair, if it is possible, is connected with the least risk of infection, however the recurrence rate of hernia in such repair exceeds 60% or more. Furthermore, not infrequently, it is impossible to approximate abdominal wall by simple suture repair because of the high tension in wound edges. Traditionally, prior hernia repair, contaminated field should be purified, e.g. with deployment of NPWT. Nowadays, there is a new attitude towards that challenge – exploitation of the biological meshes. There are conflict reports regarding use of biologic mesh in the contaminated field but in general they are believed to be less susceptible to bacterial infection.

Biological meshes are supposed to cause milder inflammatory response in a comparison to synthetic meshes. Also, but not less importantly, biological materials have less affinity to infection or rejection [3]. Moreover, they are believed to have less potential for bowel adherence than synthetic meshes. However, all of those advantages are putative and not confirmed by any study with long-term follow-up.

It is generally recognized that PermacolTM may be implanted in the contaminated field however there are no level 1 evidence confirming that statement, [1] because it is impossible to perform a randomized controlled trial. Additionally, there are no guidelines regarding dealing with that kind of patients. Many authors advocate that biological meshes should be reserved for multicompllicated cases only. Whereas it is contradicted to implant synthetic meshes in the infected field, they remain the first choice in the hernia repair in the clean field. However, there is a question whether in the group of patients that have higher probability of the wound infection (for instance obese patients or on immunosuppressive treatment) [2] biological implant should be used, even in the clean field. It is crucial to identify clear guidelines for biological grafts implantation to justify use of that extremely expensive product. In our research we are comparing two groups of patients: patients after solid organ transplantation and patients without immunosuppressive regimen. We were not able to find any research that would compare or describe that specific cohort of patients. We are distinguishing 2 cohorts, however each patient should be treated and analysed individually. The use of PADM in post transplantational patients, despite the fact it is connected with higher percentage of complications, prolonged hospitalization time, is effective and safe. It is extremely important due to the fact that those patients have immune response deficiency, that is connected with higher risk of infection (caused by for instance steroids) and the use of synthetic mesh is more risky (due to its higher affinity toward infection).

Moreover, the recurrence rate of hernia ranges from 0 to 15% [4] but it should be emphasized that biological grafts are used in the situations that are burdened with high risk of complications. It is very difficult to assess whether the
complications described in our research are the effect of PADM implantation or general patient condition. One may notice that after implantation of biological graft in the contaminated field, it is not seldom that the wound needs further cleaning. We proved that it is not contradicted to combine PermacolTM implantation and NPWT, that is in agreement with Caviggioli et. al [5] and NPWT can be applied over the biological mesh safely. According to Harth and Rosen the main causes for failure in the use of bioprosthesis are acute mechanical failure or dehiscence from fascial fixation, mesh disintegration and poor mesh incorporation. In reference to our research we have noticed 2 cases of mesh disintegration with no obvious reason. Poor mesh incorporation may be connected with massive leakage from the wound. PermacolTM is far from ideal material, the use of it may be connected with some complications e.g. prolonged wound healing but in our opinion it may be a good solution for extremely difficult cases. The majority of the articles regarding the use of bioprosthesis responds to the recurrence rate, not to the general complications connected with mesh implementation itself. High percentage of complication is drawing attention, however after careful analysis, it turns out, that all of the complications are the minor ones, connected mostly with the prolonged time of wound healing, not threatening patient’s life or health and not affecting the final results of the treatment. Serum leakage from the wound that occurs in 7 patients seems to be connected with the use of biological material. It causes prolonged wound healing; however it does not require any special treatment. As long as leakage from the wound may be connected with excessive secretion that is induced by the mesh, we are not able to prove that mesh implantation may increase the rate of surgical site infection or wound dehiscence. The group of patients that were taken to analysis included complicated cases with high risk of surgical site infection. To sum up, in spite of the higher percentage of complications, taking into consideration the final effect, that kind of complications are fully acceptable. Our study confirmed the feasibility of using MRI in follow up of patients with the PermacolTM implant. MR images, due to their superb soft tissue contrast, are capable of demonstrating the biological mesh, its integrity with the recipient’s tissues, and complications such as fluid collections, hernia, and folding of the implant. In this respect, our observations are in agreement with previous reports [6-8]. However, those studies are different in that all of them dealt with patients after pelvic floor reconstruction. Considering the limitations of physical examination in perineal area, MRI proved useful in revealing occult herniations in those patients. To the contrary, the anterior abdominal wall is easily accessible for physical or ultrasound examination. After meticulous analysis of that images and taking into consideration operation summaries and complications it following, we were able to state that PermacolTM should be sutured under slight tension. If the material was pleated, there was serum collection in the pockets. Therefore, we believe that the high cost of MRI will limit its application only to selected patients after the repair of the anterior abdominal wall, for instance with obesity precluding an adequate physical examination.

CONCLUSION
Biological meshes may be used in patients at whom other ways of treatment had failed and they should be reserved for complicated cases. It is safe to use PermacolTM in post transplantational patients. Implanting PermacolTM and NPWT can be safety and successfully combined together. MRI is an excellent examination to visualise the occurrence and condition of PermacolTM, thanks to that we were able to improve our operation technique, however it should not be considered as an examination of choice. The way of treatment in such complicated cases should be considered individually. More trials, with bigger group of patients should be performed.

CITE THIS AS

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Fig. 4. Time of ambulatory treatment and hospitalization period in groups.

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<td>Restoration of gastrointestinal tract continuity</td>
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FIG. 1. AN EXAMPLE OF THE UNEVENTFUL OUTCOME POST MESH IMPLANTATION. GENERAL SURGERY PATIENT. AXIAL PLANE. ARROWS INDICATE PERMACOL™.

FIG. 2. OPERATION TECHNIQUE.

Operation technique

- onlay
- inlay
- no data
- sublay

FIG. 3. COMPLICATIONS POST PERMACOL™ IMPLANTATION.

Complications

- serum wound leakage
- wound dehiscence
- surgical site infection
- none

FIG. 4. TIME OF AMBULATORY TREATMENT AND HOSPITALIZATION PERIOD IN GROUPS.