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Original research

The combined application of human acellular dermal matrix and vacuum wound drainage on incarcerated abdominal wall hernias

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ABSTRACT

Purpose: Complex contaminated or infected abdominal wall defects present a particularly challenging problem to the surgeon. The aim of this study was to describe our experience with human acellular dermal matrix (ADM) in incarcerated abdominal wall herniorrhaphy.

Methods: We retrospectively reviewed data from 63 patients (51 males and 12 females) who underwent emergency surgery for acute incarcerated abdominal wall hernias with ADM repair, between June 2008 and October 2011 at Beijing Chaoyang Hospital, Capital Medical University.

Results: All hernias were repaired with an intraperitoneal underlay repair and received a high-vacuum wound drainage system after herniorrhaphy. 19 patients underwent reinforced repair with component separation. Over a median follow-up period of 32 (range 13–58) months, the recurrence rate was 4.8%. Two patients developed bulges, one developed a hematoma, one developed a seroma, and one had a superficial wound infection. No patients developed fistulae, intestinal obstruction, abdominal pain, or stiffness of the abdominal wall postoperatively.

Conclusion: Our study suggests that the use of ADM as a biological mesh combined with high-vacuum wound drainage system in complex abdominal wall reconstruction is acceptable without major side effects.

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Synthetic materials are widely used in tension-free repair surgery of abdominal wall hernias, significantly reducing the post-operative recurrence rate. In addition, materials such as polypropylene and expanded polytetrafluoroethylene (ePTFE) eliminate the need for donor sites and when fully incorporated, results in a strong and permanent repair. Implantation of a foreign body, however, is not without potential complications, including foreign body reaction, fistula formation, surgical site infections, bowel adhesions, and mesh extrusion [1].

Complex contaminated or infected abdominal wall defects present a particularly challenging problem to the surgeon [2,3]. It is well known that implantation of a synthetic mesh into a complex abdominal wall hernia and other abdominal wall defects, in the setting of contamination, has a very high complication rate, including mesh infection, fistula formation, and hernia recurrence [2,3]. The difficult complication of infected synthetic mesh often precludes its use in these cases. On the other hand, a staged repair is associated with a prolonged recovery and high morbidity.

Recently, bioprosthetic meshes such as human acellular dermal matrix (ADM) and porcine small intestinal submucosa have become available for use in complex abdominal wall reconstruction [4,5]. ADM is created by removing cellular materials from donated cadaver skin, leaving a matrix. This matrix consists of a basement membrane, collagen, elastin, hyaluronan, proteoglycans, fibronectin, and the native tissue's vascular channels. This bioprosthetic mesh is especially useful in contaminated or infected fields, because the mesh provides a biologic scaffold that allows for native cellular ingrowth, revascularization, and tissue remodeling [6].

We have applied ADM in treating anal fistulas [7], pelvic floor defects after cylindrical abdominoperineal resection [8], rectal defects [9], and complex abdominal wall hernias [10] since June of 2008. We aimed to describe our experience with the use of ADM in the repair of incarcerated abdominal wall hernias.

1. Materials and methods

Data from all patients treated for abdominal wall hernia are collected in a prospective database at Beijing Chaoyang Hospital, Capital Medical University. For the current study, we retrospectively reviewed data from 63 patients who underwent emergency surgery

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for an acute incarcerated abdominal wall hernia and repair with human ADM (Ruinuo; Qingyuanweiye Bio-Tissue Engineering, Ltd; Beijing, China), between June 2008 and October 2011. Patients with normal, irreducible abdominal wall hernias were excluded. According to the grading system for the management of incisional ventral hernias established by the Ventral Hernia Working Group (VHWG) [11], there were 50 patients with grade 3 and 13 patients with grade 4 ventral hernias in our study. This study was approved by the institutional review board of Beijing Chaoyang Hospital and all patients provided informed consent for use of their data in this study.

Incarcerated abdominal wall hernia repairs were performed by three experienced surgeons. Prophylactic second-generation cephalosporins were given 30 min before surgery. All procedures were performed under general anesthesia. While exploring the hernia sac and assessing its contents, the operative field was protected from contamination. The intestine was reduced, or necrotic intestine was resected. Anastomoses were performed using double layer 3/0 Vicryl interrupted suture. The human ADM mesh was placed under near maximal tension, in an intra-abdominal underlay position, and fixed in place using 0-prolene transfascial sutures to the abdominal wall. Sutures were placed at least 1 cm from the edge of the ADM mesh, to avoid tearing of the mesh. Irrigation of the operative field was performed with normal saline after ADM placement. The use of a component separation to facilitate primary closure of the fascia was performed in patients whose primary fascial closure could not be achieved. In these patients, ADM was also placed in an underlay fashion, using interrupted transfascial mattress sutures.

In general, the mesh was placed with at least 2–3 cm of an overlap between the mesh and fascia, allowing for distribution of pressure over a wider area (Pascal's principle). If the hernia defect was larger than the size of a single piece of ADM (10 cm × 8 cm), individual sheets were sewn together with permanent monofilament polypropylene sutures in an interrupted or running fashion.

All patients received a high-vacuum wound drainage system (Drainobag® 600 – B. Braun Melsungen AG, Germany) after completion of the hernia repair. The drain was placed superficial to the ADM mesh, and brought out through a separate stab wound. The skin and subcutaneous tissue were closed without compromising the blood supply. All drains were removed if the drainage was less than 10–15 ml on 2 consecutive days, or after a maximum of 14 days, regardless of drainage volume. Patients were encouraged to avoid activities that might increase intra-abdominal pressure (severe coughing, straining, etc.) for 3 months postoperatively.

Statistical analysis was performed with SPSS statistical software, version 15.0 (SPSS Inc., Chicago, IL). Unless otherwise indicated, group values were expressed as the median with interquartile range (IQR). Comparisons between groups were analyzed by the χ^2 test for categorical variables and the Wilcoxon rank-sum test for continuous variables. Variables with a *P*-value of less than .05 by univariate analysis were entered into a multivariable model (multiple logistic regression analysis) to identify variables predictive of bulge and recurrence.

2. Results

The current study includes 63 patients (51 males and 12 females) with incarcerated abdominal wall hernias who underwent ADM repair. The median age was 57 years and the median body mass index (BMI) was 29. Most defects were attributed to a previous midline laparotomy incision (71.4%). More than 50 percent of our patients had American Society of Anesthesiologists scores ≥ 3 and 12 patients were diabetics. The demographic characteristics of our patients are summarized in Table 1.

22 patients underwent repair with one sheet of 10 cm × 8 cm ADM mesh, 11 with two sheets of 10 cm × 8 cm ADM mesh, sewn together using continuous sutures (2/0 prolene suture material), 17 with three sheets, and 13 with four sheets for large abdominal wall defects. Lateral component separation was performed and the ADM was placed as a reinforcement graft in 19 of 63 patients.

The median follow-up period for patients was 43 (range 24–69) months. A CT was performed if the patient was considered to have recurrence or bulge; bulges were differentiated from recurrence by the absence of hernia sacs. Ten patients developed recurrences (15.9%), eight patients developed bulges (12.7%), and all refused further surgical intervention. Three patients developed seromas (4.8%) that resolved by percutaneous drainage. One patient had a superficial wound infection (1.6%) that was treated with local wound care and allowed to heal by secondary intention (Table 2). No patients developed fistulas, intestinal obstruction, or abdominal pain postoperatively. There were no deaths in our study.

We evaluated potentially significant patient factors and surgical techniques that contributed to our complication rate. Comparison of patients with bulge and recurrence vs. those without bulge and recurrence (Table 3) demonstrated the following variables to be associated with bulge and recurrence: high BMI ($P = 0.001$), large defect size ($P < 0.001$), numbers of biological meshes used ($P = 0.018$), and indication for ventral hernia ($P = 0.005$). Multivariate analysis (Table 4) demonstrated three factors to be significantly related to bulge and recurrence: BMI ($P = 0.008$), defect size ($P = 0.016$), and numbers of biological meshes used ($P = 0.027$). Other factors did not significantly affect recurrence rate.

3. Discussion

The use of prosthetic materials has been successful in uncomplicated anterior abdominal wall reconstruction [12]. Most prosthetic mesh implantations today are composed of permanent

Table 1

Characteristics and perioperative data of 63 patients with incarcerated abdominal wall hernia.

Characteristic	Perioperative data
Age (y), median (IQR)	57 (46–67)
Sex	
Male	51 (81%)
Female	12 (19%)
BMI (kg/m ²), median (IQR)	29 (26–33)
Current smoker	19 (30.2%)
Diabetes mellitus	12 (19.0%)
Classification of the hernia	
Grade 3	50 (79.4%)
Grade 4	13 (20.6%)
ASA score	
1	9 (14.3%)
2	22 (34.9%)
3	25 (39.7%)
4	7 (11.1%)
Duration of operation (min), median (IQR)	120 (110–150)
Length of hospital stay (d), median (IQR)	9 (8–10)
Defect size (cm ²), median (IQR)	96 (48–162)
Type of Incision	
Midline	34 (54.0%)
Paramedian	21 (33.3%)
Oblique	8 (12.7%)
Indication for ventral hernia repair	
Laparotomy	45 (71.4%)
Recurrence	18 (28.6%)
Bowel resection	
Small bowel resection	28 (44.4%)
Large bowel resection	5 (7.9%)

IQR, interquartile range; BMI, body mass index.

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