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A staged reconstruction technique utilizing bioprosthetic mesh reinforcement in the repair of giant omphalocele

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ABSTRACT

Reconstruction of complex anterior abdominal wall defects, such as giant omphaloceles, remains a reconstructive challenge for plastic and pediatric surgeons. Though several repair techniques have been described in the literature, no standardized method has been explicitly developed to treat pediatric patients. The utilization of intraabdominal tissue expanders to augment the abdominal domain has been reported as a potential repair technique. Despite its documented application, substantial controversy remains regarding tissue expander implementation due to its associated complications. We describe a staged reconstruction technique with acellular dermal matrix-assisted musculofascial reconstruction followed by delayed skin closure. Utilization of this bioprosthetic mesh in the reconstruction of anterior abdominal wall defects is well-described in the adult population. We applied the principle to a preschool-aged child with a giant omphalocele. This technique provides a medium to bolster the musculofascia, limit the formation of visceral adhesions, decrease the need for numerous procedures, and reduce the risk of infection or pulmonary compromise. This report denotes that a bioprosthetic mesh reinforcement technique may be utilized for functional reconstruction of large, complex abdominal wall malformations in the pediatric population.

1. Introduction

Omphaloceles are congenital abdominal wall malformations characterized by the presence of herniated abdominal viscera enclosed within a peritoneal membrane. These defects are further defined as small, giant, or ruptured [1]. Giant omphaloceles are described as tissue defects greater than 6 cm containing considerable amounts of the liver [2–4]. Unlike the treatment of small abdominal wall defects, repair of giant omphaloceles remains a reconstructive challenge for plastic and pediatric surgeons given the absence of standardized repair techniques and limited intraabdominal volume to achieve primary closure.

Bioprosthetic mesh reinforcement utilizes an acellular dermal matrix to approximate the musculofascial edges of a defect that are otherwise unable to be primarily closed in a tension-free method within the midline of the abdomen. The technique has previously been reported to show favorable outcomes in adults with large ventral hernias [5,6]. Tension-free closure is imperative in improving the morbidity and mortality of a patient given that primary closure following forced reduction increases intraabdominal pressure, putting the patient at risk for fascial necrosis, wound dehiscence, compartment syndrome, and repair failure [7–9]. We aimed to apply this principle in a pediatric patient presenting with a giant omphalocele. Here we describe a staged repair with bioprosthetic mesh

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reinforcement to bridge facial closure, permitting natural intraabdominal volume expansion, followed by midline skin closure.

Our patient was a full-term male born with a giant omphalocele through which the liver, gallbladder, portions of the stomach, pancreas, and multiple loops of large and small bowel were herniated. Due to the size of the sac, limited abdominal wall domain, and narrow stalk, primary closure during infancy was not possible. Thus, the patient was treated nonoperatively with silver sulfadiazine and xeroform to allow epithelization and skin overgrowth of the sac. At four years of age, the patient was deemed to be a suitable size and health status for a staged reconstruction (Fig. 1). We performed a staged reconstruction with bilateral component separation, acellular dermal matrix-assisted musculofascial closure, and delayed midline closure with medial mobilization using lateral relaxing incisions and skin grafting of the donor sites.

2. Technique

A low midline incision was made in the hypogastric region up to the inferior margin of the omphalocele sac. Following dissection of the midline fascia and peritoneum, adhesiolysis was performed to permit unrestricted movement of the viscera and abdominal wall. Once completed, the defect measured 25 cm in width.

The anterior rectus fascia was separated from the overlying subcutaneous tissue bilaterally. The external oblique aponeurosis was incised 1 cm lateral to the right rectus abdominis muscle cranially and caudally, releasing the external oblique fascia from the anterior rectus sheath. As a result, the right rectus abdominis muscle could be mobilized medially. An identical technique was then completed on the left side, allowing for additional medial mobilization, leaving a midline defect measuring 10 cm in width.

Once myocutaneous component separation was completed, a 2 mm thick acellular dermal matrix (*SurgiMend*, Integra LifeSciences, Plainsboro, N.J.) was placed to achieve musculofascial closure. The acellular dermal matrix was first secured to the rectus abdominis muscle with circumferential, interrupted 2–0 PDS (Ethicon, Raritan, N.J.) mattress sutures traversing the full breadth of the musculofascial layer. The remaining rectus abdominis muscle edge was further advanced towards the acellular dermal matrix with running 3-0 Monocryl (Ethicon, Raritan, N.J.) to evenly distribute the tension and provide reinforcement throughout the repair site (Fig. 2). A negative pressure vacuum-assisted closure device was then placed over the exposed acellular dermal matrix.

The second stage was completed on post-operative day fourteen, as the patient's abdominal swelling had subsided, and his intraabdominal cavity had naturally expanded to fit the reduced contents (Fig. 3). The subcutaneous flaps were raised, and a counter-incision was made on the flanks bilaterally to allow for further medial mobilization of the skin and subcutaneous tissue for midline closure. A split-thickness skin graft was used to provide coverage of the lateral counter-incisions bilaterally.

3. Outcome

The postoperative course was without any complications. The patient is now ten months postoperative with well-healed incisions, skin graft take, and no evidence of secondary herniation (Fig. 4). Minor distension of the anterior abdominal wall is expected from incomplete primary fascial closure.

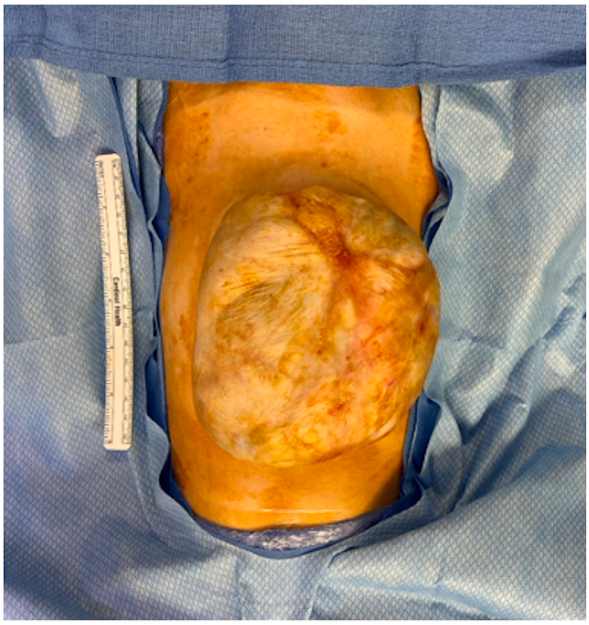

Fig. 1. Appearance of the epithelized giant omphalocele sac with protruded abdominal viscera.

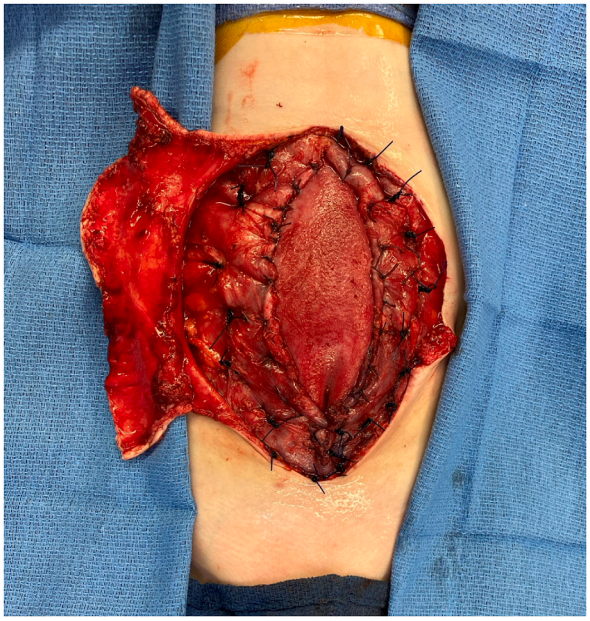

Fig. 2. Bioprosthetic mesh-assisted musculofascial closure.

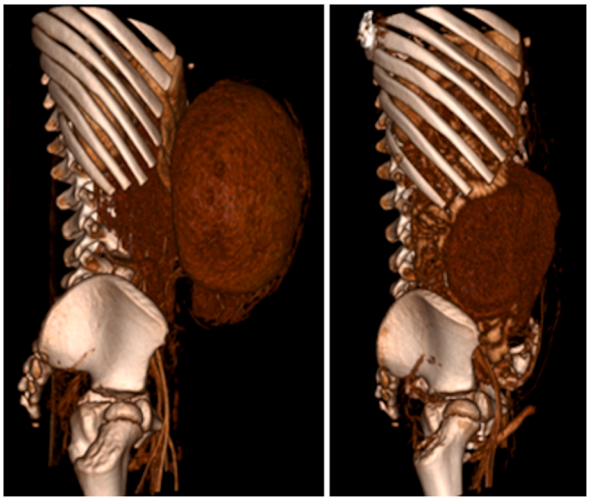

Fig. 3. Preoperative (left) and postoperative (right) computed tomographic imaging obtained immediately prior to the second stage of reconstruction. The abdominal domain has naturally expanded following reduction of the visceral contents.

4. Discussion

We present a unique case using a staged repair technique on a child presenting at preschool-age with a giant omphalocele. This technique circumvents the use of intraabdominal tissue expanders, permits tension-free musculofascial closure, and provides adequate time for abdominal edema and swelling to abate to facilitate skin approximation.

The implementation of bioprosthetic materials for abdominal wall closure was first described by Welch in 1951 [10]. In this procedure, homologous dermal-epithelial grafts were utilized as a scaffold to develop a layer of reinforcement for future grafting. Advancements in these bioprosthetic constituents provide surgeons the ability to reestablish fascial integrity, protect abdominal viscera, and restore abdominal wall functionality in defects that were formerly deemed inoperable [11,12]. The authors' preferred mesh to facilitate bridged closure is acellular dermal matrix. This bioprosthetic material provides a medium to bolster musculofascial closure without the complications of synthetic mesh [13–15].

The utilization of intraabdominal tissue expanders to recreate a functional abdominal wall domain has been described as a method for repair in prior literature [4,16–18]. The technique requires placement of multiple expanders under general anesthesia over several months to achieve appropriate expansion [17]. Patients are at an increased risk of pulmonary compromise, infection, skin necrosis,

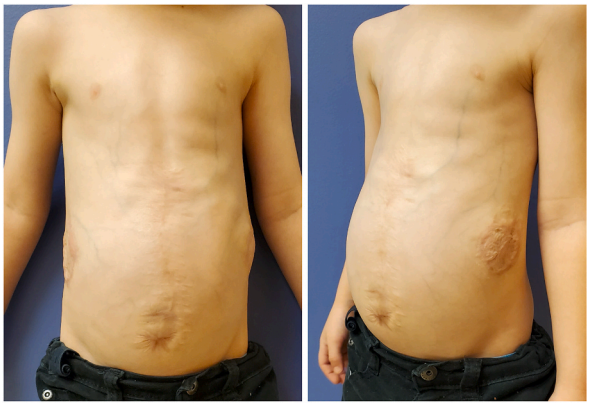

Fig. 4. Anterior (left) and lateral (right) views of the abdominal wall reconstruction ten months postoperatively.

urinary retention, adhesion formation, and scarring that ultimately limits tissue mobility at the time of closure [16–19]. Following expansion, several cases still necessitate bioprosthetic mesh to achieve complete musculofascial closure. We believe the use of tissue expanders is not necessary, as reduction of the abdominal contents itself acts as a mechanism to expand the intraabdominal cavity.

5. Conclusion

Bioprosthetic mesh-assisted musculofascial closure has been a successful method of reconstruction for adult patients with complex abdominal wall defects. In this report, we apply the same principles to repair the abdominal wall in a child presenting with a giant omphalocele. This surgical technique should be considered in the repair of large, complex abdominal wall malformations among the pediatric population.

Patient consent

Consent for publication was obtained for the use of information and images by the legal guardian of the patient.

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Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. Annahita Fotouhi reports financial support was provided by National Center for Advancing Translational Sciences of the National Institutes of Health. Kamlesh Patel reports a relationship with Stryker CMF that includes: consulting or advisory. This research was supported by award TL1 TR002344 from the National Center for Advancing Translational Sciences of the National Institutes of Health (ARF). The funders had no role in the design and conduct of the study; collection, management, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

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