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CASE REPORT

The use of Surgisis® for abdominal wall reconstruction in the separation of omphalopagus conjoined twins

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Abstract Abdominal wall reconstruction in omphalopagus twins poses a difficult reconstructive challenge, as separation often results in a large abdominal wall defect. A number of options are available for closure, including tissue flaps, expanders and patches made of foreign material. Surgisis® is a new biodegradable small intestine scaffolding substrate that permits tissue in-growth and results in a permanent durable scar. We describe its use in abdominal wall reconstruction after separation of a set of conjoined twins. A set of omphalopagus conjoined twins shared liver and abdominal wall. After separation at 6 months of age, Twin A's abdomen could be closed primarily, but Twin B could not. A 4-ply Surgisis® mesh was used in the upper abdominal closure, and a skin flap was created, to completely cover the patch. Both twins survived the operation. A small portion of the skin flap over the Surgisis® broke down, healing by secondary intention. In follow up of over 18 months post procedure, there have been no wound infections and the abdominal wall is intact with no evidence of a hernia. Surgisis® can be successfully used for the reconstruction of complex abdominal wall defects in the pediatric patient, including reconstruction after separation of conjoined twins.

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Introduction

Conjoined twins are a relatively rare occurrence, with an incidence of 1 in 50,000–200,000 births [1]. They are classified into eight basic types, with each type posing its own reconstructive challenges [2]. Omphalopagus conjoined twins are amongst the most common and comprise 17% of conjoined twins. Omphalopagus twins do not exhibit cardiac union but generally are joined at the liver and may share portions of the gastrointestinal tract. The reconstructive challenge with this subset of conjoined twins lies not only with the division of shared abdominal organs but also with the closure of what is often a large abdominal wall defect.

The closure of the abdominal wall defect in omphalopagus conjoined twins has been addressed in a number of ways. Tissue expanders implanted either subcutaneously or within the peritoneal cavity have been described, however, these are prone to infection and often require significant time before expansion prior to the definitive operation [3, 4]. Other reconstructive methods include the use of syngenic cryopreserved tissue from a deceased twin [5] and use of the tripus limb in ischiopagus twins [6, 7]. Traditionally polypropylene meshes have been used to bridge fascial defects, however, these too are prone to infection and hernia formation particularly in the growing child [7].

Surgisis® (Cook Surgical, Bloomington Ind., USA) is a relatively new prosthetic mesh derived from porcine small intestinal mucosa. It consists of an extra-cellular matrix, which serves as a framework for the growth of new tissue by supporting early in-growth of vessels from surrounding

tissue and fostering cellular differentiation [8, 9]. It is particularly appealing in the field of pediatric general surgery as it acts as a scaffold allowing the incorporation of host tissues, and theoretically should grow with the child and decrease the hernia development. The use of Surgisis® has been described in the repair of diaphragmatic hernia, chest wall reconstruction, gastroschisis, omphalocele and ventral hernia [10–14].

We describe the first use of Surgisis® to aid in the abdominal wall reconstruction of omphalopagus conjoined twins.

Case report

Omphalopagus male twins were born by caesarian section to a 40-year-old mother in Africa. The twins were born with bilateral cleft lip and palate but no other abnormalities were noted. They were transferred to our institution at 4 months of age and underwent numerous studies to delineate their shared anatomy. Computed tomography revealed that the twins shared common liver parenchyma with shared portal venous and hepatic arterial systems. Upper gastrointestinal contrast studies noted separate gastrointestinal tracts and a hepatobiliary iminodiacetic acid scan demonstrated separate biliary tracts. Echocardiography revealed a mild degree of left ventricular hypertrophy in both twins but separate pericardial sacs. In preparation for separation the twins were placed on an intensive nutritional regimen to gain weight to be optimized for surgical separation. In addition, tissue expanders were placed subcutaneously in the conjoined chest-abdomen junction. These were inflated with saline on a weekly basis. Unfortunately, approximately 3 weeks after insertion, the twins developed cellulitis and bacteremia and the tissue expander was removed. The twins were brought to the operating room for definitive separation at 7 months of age. At surgery the skin incision was made along planes that would allow for future skin flap closure and extended upwards to the joined xiphisternum. Upon abdominal exploration the gastrointestinal and urinary tracts were separate and the liver was the only organ that was shared. The liver was divided using the Ligasure® (Valleylab, Boulder, Colorado, USA) and a vascular stapler was utilized to divide the large bridging hepatic vessel. This allowed for a quick and hemostatic separation. The cut surfaces of the livers were coagulated with the argon beam laser. The abdominal wall closure of Twin A was relatively simple as the incision had been planned to give this twin greater skin and fascial coverage and the fascia and skin were re-approximated with minimal tension. The reconstruction of the abdomen for Twin B was more complex. A large fascial defect remained from the separation and the edges of the fascia could not be brought together. A piece of 4-ply 7×20 cm Surgisis® mesh was utilized and sutured to the fascia with 3–0 polydioxanone (PDS) sutures (Fig. 1a). The mesh was then covered by a transposition skin flap (Fig. 1b). The patients recovered well from their separation and were discharged from the hospital on postoperative day 26. At follow up, over 18 months post-separation, there is no evidence of herniation and the incisions have healed well in both twins (Fig. 2).

Discussion

The separation of conjoined twins often requires a complex reconstructive plan depending on which organs are shared. The abdominal wall reconstruction for omphalopagus twins has been addressed in many ways. Tissue expanders have traditionally been the technique of choice, however this often requires significant time and regular inflations in order to obtain adequate fascial and skin closure [4]. In addition, as in our case, tissue expanders are also prone to infection and may require removal, negating any potential benefit and delaying definitive closure.

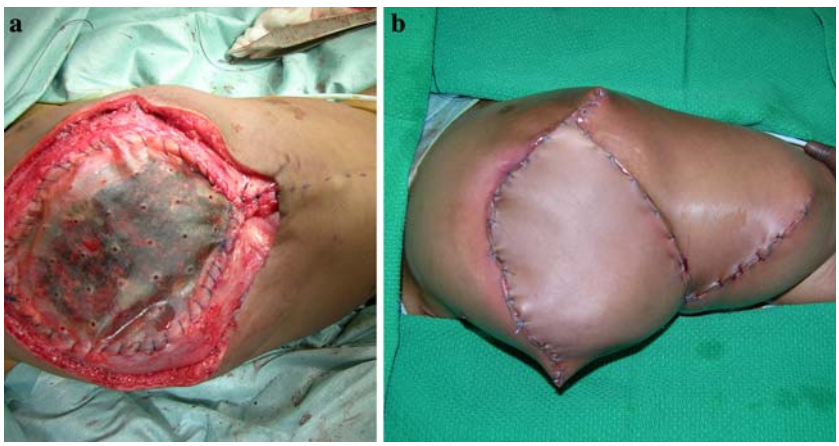

Fig. 1 **a** Insertion of Surgisis® to cover the large fascial defect remaining after separation. **b** Coverage of Surgisis® with a transposition skin flap

Fig. 2 Appearance of Twin B 1 year after the separation. There is no evidence of a ventral hernia

Small intestinal submucosa (SIS) is comprised of primarily type 1 collagen, growth factors, proteoglycans and glycosaminoglycans derived from porcine small intestine. Animal studies suggest that the extra cellular matrix framework rapidly degrades and is replaced by host tissue that is stronger than native tissue, at the completion of the remodeling process [15]. Experimental studies in animals have also shown that SIS is capable of supporting rapid tissue regeneration in large defects. At 12 weeks large fascial defects were filled with regenerated tissue, which resembled fascia and the mesh framework was completely replaced [16]. In the animal model of diaphragmatic hernias, it has been noted that 8-ply Surgisis® appears to more durable and persist for longer periods of time, potentially decreasing the recurrence rate [17].

The SIS mesh serves as a lattice for tissue in-growth and is also thought to be infection resistant. Several studies have reported good results with the use of Surgisis® mesh in the setting of bacterial contamination [18, 19]. Tissue in-growth and infection resistance is attributed partially to the neovascularization and growth factors found within SIS. SIS contains matrix molecules and peptides including vascular endothelial growth factor, a potent angiogenic factor [20] and transforming growth factor-β. These molecules are thought to be responsible for encouraging tissue growth and resistance to infection. A recent clinical report illustrating the use of Surgisis® for the management of complicated gastroschisis found that the that the two of three patients developed small umbilical hernias in follow-up [21].

The use of Surgisis® has numerous advantages for complex abdominal wall reconstruction such as during the separation of omphalopagus conjoined twins. It is easily available and ready to use at the time of closure with decreased infection risk compared other reconstructive methods. At 18 months our patient has no evidence of ventral hernia or weakness in the repair. SIS appears to be a favorable material for the reconstruction of complex abdominal defects, although long-term data, particularly focusing on hernia formation, still needs further study.

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