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Technical Aspects of the Procurement, Bench-table Procedure, and Transplantation of a Nonvascularized Rectus Fascia

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INTRODUCTION

Closure of the abdominal wall after liver, intestinal, or multivisceral transplantation remains a challenging and frequently occurring problem, leading to increased morbidity and mortality. The main reason for this is the extensive history of abdominal surgical procedures with consequent enterocutaneous fistulas and wound infections in these patients. Moreover, posttransplant graft edema due to ischemia-reperfusion injury and edema of the recipient further challenges abdominal wall closure.

Over the years, different techniques have been developed like use of tissue expanders, component separation techniques, mesh implantation (synthetic or biological), or transplantation of a full-thickness vascularized abdominal wall. However, these techniques have limited indications, are often complex to perform, and have variable results. The option to use a nonvascularized rectus fascia (NVRF) in which the rectus abdominis muscle itself is removed was first described by Gondolesi et al in 2009.[1] A recent multicentric survey of our group revealed that it has already been used in almost 100 cases worldwide with an excellent short- and long-term outcome (few complications, low incidence of herniation, and no fascia-related rejections or deaths).[2,3] Here, we present a step-by-step surgical approach regarding the procurement, bench-table procedure, and transplantation of a nonvascularized donor rectus fascia.

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Received for publication December 19, 2023; accepted March 18, 2024.

Presented at 18th Congress of the Intestinal Rehabilitation and Transplantation Association (https://cirta2023.org), June 30–July 3, 2023, Chicago, Illinois.

Plast Reconstr Surg Glob Open 2024; 12:e5798; doi: 10.1097/GOX.0000000000005798; Published online 15 May 2024.

CLINICAL CASE

A 31-year-old male patient (height: 175 cm; weight: 55 kg; blood group: O positive) was referred to the Leuven Intestinal Failure and Transplant center with a history of congenital biliary atresia and a Kasai procedure. After a previous, failed liver transplantation due to a frozen abdomen with iatrogenic bowel perforation in another center, he was considered for multivisceral transplantation (stomach, duodenum, pancreas, liver, and small bowel). After 2 months on the waiting list, the patient received a multivisceral graft from a 53-year-old woman donor (length: 170 cm; weight: 70 kg; blood group: O positive). The procedure was uneventful, and primary closure of the abdomen could be achieved. Nine days later, a first re-operation was performed for the drainage of an intraabdominal hematoma and small bowel volvulus. Twenty days posttransplant, a second re-operation was performed due to suspicion of bowel ischemia after kinking of the superior mesentery artery. A successful iliac-ileocolic bypass was performed. However, the abdominal wall could not be closed, resulting in a remaining defect of 24–7 cm. Because this re-operation was anticipated, a non-ABO-matched third-party NVRF graft from a 33-year-old donor (length 180 cm; weight 75 kg; blood group A positive) was procured 4 days earlier and used to bridge the abdominal wall. Afterward, a vacuum-assisted device was applied on top of the NVRF.

SURGICAL PROCEDURE

Donor Assessment

According to Belgian legislation, family consent to organ and tissue donation is mandatory. Exclusion criteria

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for NVRF donation are center-specific and include age older than 60 years, a history of major abdominal surgical procedures, and the presence of abdominal wall herniation.

Donor Procedure

The NVRF donor is installed in dorsal decubitus on the operating table. The chest and abdominal wall are shaved, disinfected with chlorhexidine gluconate 4% (Betasept), and surgically draped. A classic midline sternolaparotomy is performed. The abdominal skin and subcutaneous tissues are then mobilized as laterally as possible until the lateral abdominal wall muscles are reached. Gradually the entire anterior fascia of the abdominal wall is exposed. Careful dissection is required to avoid damage to the fascia. Next, a subcostal incision is made starting from the lower cartilaginous arch of the thorax and extended to the lateral edge of the rectus abdominis muscle, entering the peritoneum. Subsequently, a longitudinal incision is made downward through the lateral abdominal muscles (ie, external oblique, internal oblique, and transversus abdominis) following the lateral edge of the rectus sheath. Ultimately, the inferior epigastric vessels are clamped and ligated, and the fascia is completely excised and transferred to a side table. The estimated time needed for this procedure is about 30 minutes. Hereafter, standard organ (heart, lungs, liver, and kidneys) and tissue procurement is performed.

Bench-table Procedure

The fascia block consisting of both the anterior and posterior rectus sheath and the rectus muscle itself is rinsed with cold saline buffer solution. The lateral flap edges (the aponeurosis of the external oblique, internal oblique, and transversus abdominis) are removed, thereby opening the junction between the anterior and posterior fascia. Using scissors and blunt dissection, the rectus muscle is carefully removed from the anterior and posterior sheath, creating a nonvascularized rectus sheath. This is performed on both sides toward the linea alba. After complete removal of the rectus muscle, small lesions and perforating arteries are sutured with 2-0 polypropylene (Prolene). Thereby, the anterior and posterior sheath of the fascia are sutured together, which prevents the formation of large seroma between the sheaths. Thereafter, the graft is rinsed with cold saline buffer solution and prepared for storage. The total duration of the bench-table procedure is estimated at 20 minutes.

Preservation

The NVRF is packed in a standard fashion with three sterile bags of which the inner one is filled with standard preservation solution [Institut Georges Lopez 1 (IGL-1)] and topical antibiotics (160 mg of gentamicin). Transport of the NVRF graft to the recipient hospital is performed using a classic container on ice (0°C). Upon arrival, the package is transferred and stored in a locked fridge adjacent to the operating theater at temperatures between 0°C and 4°C. In the presented case, the NVRF was stored for 104 hours and 30 minutes before transplantation. According to Farinelli et al, preservation of the NVRF graft of up to 21 days is possible, and even cryopreservation for longer periods of time is an option.[4]

Recipient Procedure

In the recipient, an exploratory laparotomy is performed due to suspicion of bowel ischemia following kinking of the superior mesenteric artery for which an iliac-ileocolic bypass is constructed. Closure of the abdominal wall is impossible with a resulting defect of 24–7 cm. The NVRF is unpacked and rinsed with povidone-iodine (Iso-Betadine) and physiologic serum. Next, the NVRF is tailor-sized to the defect of the abdominal wall. The goal was to create a "tension-free" closure. The NVRF is implanted and sutured to the recipient's abdominal fascia edges in an inlay fashion using continuous running 2-0 polypropylene (Prolene) sutures. We strive to follow the small bite suture technique, which takes about 30 minutes to perform. Afterward, the subcutaneous tissues are approximated, leaving four subcutaneous drains in place. Ultimately, the abdominal skin is closed with single 3-0 polyamide 6 (Ethilon) sutures. Centrally, a skin defect of 5–5 cm existed, which is covered with a vacuum-assisted device with intermittent suction of −75 mm Hg. (**See Video [online],** which displays the step-by-step surgical approach regarding the procurement, bench-table procedure, and transplantation of a nonvascularized rectus fascia.)

SURGICAL OUTCOMES

Because NVRF is essentially composed of acellular and avascular tissue, HLA and ABO blood group matching is assumed redundant. Six days after the NVRF transplantation, however, anti-A natural and immune antibodies were slightly increased, suggesting the presence of an immune reaction against the third-party NVRF. A detailed elaboration on immunological and integration aspects of the NVRF in this case is described elsewhere.[5] Additional advantages include the wide availability and lower cost compared with synthetic or biological mesh implantation. Furthermore, it is considered less prone to infections and less likely to form adhesions intraabdominally. The possibility for a reoperation using a classic midline incision and standard fascia closure afterward is another advantage, especially in delicate (transplant) cases. Therefore, in the setting of multivisceral transplantation, NVRF has emerged as the prevailing method for closure of abdominal wall defects. Whether it will replace biological mesh implantation in nontransplantation scenarios is not yet known and needs more preclinical research. Unfortunately, the patient died 12 days after the NVRF transplantation secondary to an acute rupture of a mycotic aneurysm at the level of the aortic tube. Despite this outcome, the donor NVRF graft looked macroscopically intact without loosening or herniation.

CONCLUSIONS

We present our surgical technique for closure of the abdominal wall after transplantation using an NVRF. This is an easy-to-learn, reproducible, and versatile technique to close complex (fascial) abdominal wall defects.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Gondolesi G, Selvaggi G, Tzakis A, et al. Use of the abdominal rectus fascia as a nonvascularized allograft for abdominal wall closure after liver, intestinal, and multivisceral transplantation. *Transplantation*. 2009;87:1884–1888.
2. Janssen Y, Van De Winkel N, Pirenne J, et al. Allotransplantation of donor rectus fascia for abdominal wall closure in transplant patients: a systematic review. *Transplant Rev (Orlando)*. 2021;35:e100634.
3. Van De Winkel N, Muylle E, Canovai E, et al. Long-term outcome after non-vascularized rectus fascia transplantation in solid organ transplantation: a global multi-center IRTA survey. *Transplantation*. 2023;107:e39.
4. Farinelli PA, Rubio JS, Padín JM, et al. Use of nonvascularized abdominal rectus fascia after liver, small bowel, and multiorgan transplantation: long-term follow-up of a single-center series. *Transplant Proc*. 2017;49:1810–1814.
5. Muylle E, Van De Winkel N, Hennion I, et al. Abdominal wall closure in intestinal and multivisceral transplantation: a state-of-the-art review of vascularized abdominal wall and nonvascularized rectus fascia transplantation. *Gastroenterol Clin N Am*. 2024 [E-pub ahead of print.]