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Dynamic reconstruction of complex abdominal wall defects with the pedicled innervated vastus lateralis and anterolateral thigh PIVA flap

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Summary *Background and aim:* Reconstruction of large and chronically infected recurrent abdominal wall defects with exposed bowel in a scarred wound environment, when component release has been previously performed but failed, is a veritable challenge. We use a pedicled innervated vastus lateralis muscle with a fasciocutaneous anterolateral thigh flap (PIVA flap) to restore the continuity of the abdominal wall with vascularised tissues and create a dynamic component that improves the functional outcome.
Materials and methods: A one-stage PIVA flap was used in 15 patients with grade 4 transmural chronically infected defects. They had a mean of 4.53 previous laparotomies and important co-morbidities. We determined post-operative reconstructive abdominal wall strength using a validated quality-of-life (QoL) hernia-related questionnaire and modified it to quantify donor-site morbidity at the thigh. We measured the maximal force generated at 60°/s and the force velocity at 120°/s by isokinetic dynamometric analysis at 3 and 12 months. Electromyography (EMG) was performed 12 months after the reconstruction to analyse the contractile integrity of the vastus lateralis segment. A two-sided sign test was used to analyse data.
Results: All transmural chronic wounds healed without recurrence. Dynamometric strength increased significantly in the abdominal wall musculature ($p < 0.016$) and in the donor thigh ($p < 0.023$) between 3 months and 12 months after the intervention, which reflected in the EMG outcome and the high scores in the QoL measurements after 12 months.

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Conclusions: The PIVA flap revascularises the scarred milieu, adds a dynamic component to improve function and may reach up to the xiphoid process. Donor-site morbidity is limited.

Introduction

Most of full-thickness abdominal wall defects can be restored with a perforator-saving component release and an inlay or wide onlay synthetic or bioprosthetic mesh to provide structural support.[1–3] However, abdominal wall reconstruction after a previous component release and mesh grafting in a scarred and infected environment or after oncologic resection involving radiotherapy and the presence of a colostomy and urostomy is very challenging because further undermining leads to more tissue hypoxia and spreading of infection.[4–6] The Ventral Hernia Working Group developed a grading system for the assessment of risk for surgical site occurrences when using meshes. Wound infection plays a key role in the grading system: grade 3 is a potentially contaminated milieu due to previous wound infection, the presence of a stoma and violation of the gastrointestinal tract; grade 4 is an infected area with septic dehiscence and deep infection involving the muscle and/or the fascia.[4] Awad et al. estimated that >75% of all recurrence is due to infection and inadequate fixation of the mesh.[5] Luijendijck et al. reported a hernia recurrence rate of 80% among patients with post-operative infection versus 34% for those without infection.[6] The presence of individual co-morbidities, such as smoking, diabetes, chronic obstructive pulmonary disease (COPD), advanced age, obesity and chronic use of corticosteroids, increase the risk of post-operative infection as much as fourfold.[7] It was suggested that the biologic meshes might offer an advantage over synthetic meshes in a contaminated field.[8] Nevertheless, recent data show that the long-term durability of a single-staged approach to repairing contaminated abdominal wall defects with a biologic mesh was less favourable than initially thought,[9] as over 50% of patients had recurrent hernias within 3 years and an overall wound complication rate of 48%.[10] Further analysis with medium-term follow-up revealed a near-universal failure rate with biologic meshes when placed as a bridge.[11]

Therefore, chronically infected abdominal wall defects with exposed bowels in patients with important co-morbidity are also treated with negative-pressure wound therapy (NPWT).

Long-term use of NPWT may gradually close the abdominal wall defect over the bowels generating granulation tissue that can be skin grafted. There is a considerable risk of fistula formation if the vacuum-assisted closure (VAC) is in direct contact with the bowel. In addition, the generated granulation tissue does not result in a soft transmural reconstruction of the abdominal wall.[12]

Ideally, in such adverse milieu, vascularised tissues should be introduced that treat the infection after further debridement, induce healing in the chronic defect and restore the transmural tissue continuity.[12–14] A tensor fascia lata (TFL) flap used to be the workhorse to reconstruct abdominal wall defects but the reach, tissue bulk and vascularity of a pedicled TFL flap are poor and other strategies impose.[12]

Free musculocutaneous flaps revascularise and clean the wound environment and supply coverage.[15–17] An innervated dynamic muscular component can even be incorporated in the harvest.[18,19] Due to temporary denervation following neurovascular suturing, free innervated flaps require a long recovery time while further atrophy and weakening occur. Pedicled innervated locoregional flaps may avoid this delay, but conventionally they are not expected to reach the upper abdomen in Mathes zone IA.[13]

We report a series of 15 pedicled innervated vastus lateralis and anterolateral thigh (PIVA) flaps used to induce healing in chronically exposed severely scarred defects where previous component release was used to restore the transmural defect but failed. The PIVA flap restores the abdominal wall in a dynamic transmural fashion with innervated myofasciocutaneous tissues.

Materials and methods

This study was approved by the ethical committee/institutional review board of Leuven University Hospitals. Between 2007 and 2013, 15 patients were treated with a composite PIVA flap for recurrent complex midline abdominal wall defects in zone IA and IB[6] (Table 1). Four of five zone IA defects reached the xiphoid process. There was a mean of 4.53 (range 3–8) abdominal operations per patient prior to the reconstruction. All 15 patients had previous closure of the abdominal wall defect using component release. All had a colostomy and nine had a urostomy. In all 15 defects, omentum was missing or could no longer cover the bowel, which caused direct exposure (Table 1).

We used a Hernia-Related Quality-of-life Survey (HerQLes) questionnaire to evaluate quality of life (QofL) as it relates to abdominal wall function. This survey is validated to measure the qualitative outcome of hernia repair.[20] Patients circled their agreement in six grades ('strongly disagree' to 'strongly agree', score 1–6) preoperatively and after 12 months for 12 statements related to the impact of the abdominal wall on health, physical pain, strenuous activities, moderate activities (e.g., bending, bowling), walking and climbing stairs, daily activities (dressing, cooking, taking a shower), sexual activity, the accomplishment of work at home and overall well-being.[20]

As no validated surveys exist to measure donor-site morbidity at the thigh, we transposed these 12 statements for use at the thigh. Patients circled their agreement or disagreement on 12 statements in the context of loss of