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T-INVERTED SHAPED RECTUS ABDOMINIS MYOCUTANEOUS (TI-RAM) FLAP FOR CHEST WALL RECONSTRUCTION

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Summary

We present a case report of a 46-year-old man with a chest wall mass suspected for sarcoma who underwent wide surgical resection and reconstruction. The patient was treated with a large mass chest wall resection followed by a reconstruction using the myocutaneous rectus abdominis flap with a T-inverted shape skin paddle (Ti-RAM flap). This original flap design allowed us to cover a large chest wall defect due to a very extensive oncological resection while achieving an easier closure of the abdominal donor area.

Key words: chest wall, reconstruction, Ti-RAM flap, TRAM flap, rectus abdominis flap, pedicled flap, sarcoma

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INTRODUCTION

Management of chest wall defects is often required after extensive tumor resection and plastic surgeons should ensure appropriate evaluation of reconstructive options in order to minimize complications and improve aesthetic outcomes in one single stage [1,2]. Skin and soft tissue tumors of the thoracic region can sometimes infiltrate sternum and ribs causing difficult reconstructive planning due to the large full-thickness defects and the management of the mediastinal cavity [3]. The best surgical option depends on thoracic defect location, loco-regional tumor infiltration, etiology, surgeon expertise and patient history [4-6].
We present a case report of a 46-year-old man with a wide sternal mass suspected for sarcoma treated by extensive resection and reconstruction using a pedicled rectus abdominis myocutaneous flap with an original T-inverted shape of the skin paddle.

CASE REPORT

On February 2022, a 46-years-old male patient came to our institution for

management of a wide chest wall mass. He referred a small lump since May 2021, which gradually increased in size over time. During our physical examinations there was a palpable 15 cm hard-parenchymatous mass, fixed on the sternal bone. The man has a previous history of stroke in 2010, implanted PMK and mitral valve replacement with prosthesis in 2019. Radiologically a CTA scan showed a 14x13x7 cm mass which infiltrated the sternum, ribs and part of the upper left side of the rectus abdominis muscle (Fig. 1). A positron emission tomography (PET) with 18F-fluorodeoxy- glucose (FDG) highlighted a moderate increase of the metabolic data of the lesion.

Biopsy of the mass was performed pre-operatively, and histologic examination showed compatibility with a spindle-shaped cells mesenchyme neoplasm suggesting a possible diagnosis of chondrosarcoma.

A multidisciplinary surgical planning was scheduled with thoracic surgeons and pre-operative markings were performed the day prior to surgery. A 23x14 cm skin resection was drawn and the reconstruction was outlined using a pedicled TRAM flap with an innovative skin paddle shape, which we called T-inverted Rectus Abdominis Musculocutaneous (Ti-RAM) flap (Fig. 2). This original T-inverted design allowed us to enlarge the skin surface of the TRAM flap in order to cover such an extensive thoracic defect while facilitating the closure of the donor area at the same time. The amount of the vertical skin component was carefully designed based on the patient's skin laxity using the pinch test. Thoracic surgeons performed a radical en-bloc resection of the mass along with the lower third of the sternal bone and the adjacent 4th, 5th and 6th chondro-sternal junction. After the oncological resection, a deep full thickness defect remained, with anterior mediastinum and heart exposure (Video 1: video showing the deep loss of substance after oncological resection, along with pericardium and large vessels exposure). The bone defect was stabilized with placement of porcine dermal collagen (Permacol), and suction drain was placed deeply in the mediastinal cavity. Simultaneously, plastic surgeons team harvested the Ti-RAM flap in a standard fashion, identifying and preserving the superior epigastric vessels, which have been dissected proximally to allow a tension-free flap transposition. We detached the right rectus abdominis muscle from its costal arch insertion, leaving the posterior fascia intact and transposing the flap to the thoracic area. A prophylactic onlay prosthesis repair was performed to reconstruct the abdominal wall using a premilene mesh and the donor site was closed as an "anchor" abdominoplasty (Fig. 3). The flap showed immediately a good color and appropriate capillary refill. Elastic stockings and pneumatic pumps for the entire duration of the procedure were applied.

Post-operatively, the patient was transferred to the ICU and the next day to the surgical ward where he was allowed to walk by himself on second post-operative day. No post-operative major complications were observed and the patient was discharged home ten days after surgery. The histopathologic examination revealed an extra-abdominal desmoid tumor fibromatosis, completely excised with disease-free resection margins. This tumor represents a rare, locally aggressive soft tissue neoplasm, which is recognized as semimalignant with high tendency for local recurrence [7,8]. The 3-year and 5-year recurrence-free

Figure 1. Pre-operative transversal CT scan showing the huge mass in close contact with sternum and ribs.

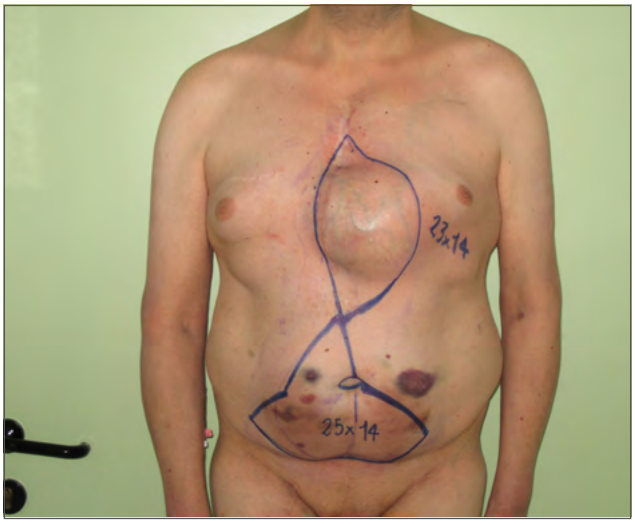

Figure 2. Pre-operative markings of the oncological excision (23x14 cm) and Ti-RAM flap.

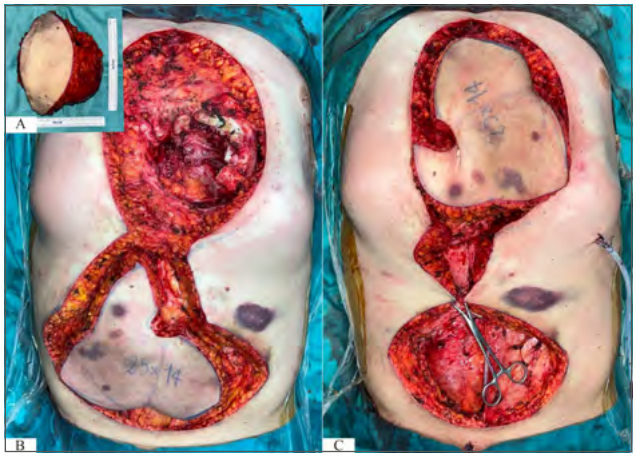

Figure 3. Immediately post-operative picture: Ti-RAM flap placed at the recipient site and donor site closed as an "anchor" abdominoplasty.

survival rates of this neoplasm were 82.5 and 78%, while the 5-year survival rate is greater than 98% [9,10]. The patient did not undergo adjuvant chemotherapy or radiotherapy. The Video 2 showing the excellent continence of the abdominal wall during the Valsalva maneuver and while coughing, at 2 months of follow-up, while the chest was completely healed and the patient resumed all of his normal activity (Fig. 4).

DISCUSSION

Management of chest wall reconstructions requires evaluating several factors such as defect size and location, patient comorbidities and general condition [11,12]. Different alternatives are suitable and different solutions should be adapted to the patient's profile [13-17]. Since in most cases skin grafts are not applicable for their inadequate coverage [18,19], pedicled flaps represent a useful surgical option [20]. In our case, we opted for the TRAM flap [21], trying however to enlarge the skin envelope as much as possible using a T-inverted design, in order to cover the extensive loss of substance. Partial drawbacks of this flap are potential herniations, that could be overcome with adequate mesh positioning at donor site [22].
In their elegant study, Galli et al. compared the outcomes of the TRAM and Latissimus Dorsi flap, concluding that the rectus abdominis flap showed a distinct advantage of superior thickness as compared to Latissimus Dorsi flap, minimized the risk of creating a 'flail' reconstructed chest wall [23]. The Latissimus Dorsi flap can be harvested in dorsal decubitus as well, lifting the scapula as in orthoplasty approach. However, it may be hard to harvest this flap while thoracic surgeons perform the resection.

Figure 4. Post-operative result 2 weeks after reconstructive procedure.

Furthermore, due to the position of the recipient site, it may not fully reach and completely cover the loss of substance [24-25]. Pectoralis major muscle flap represents a further pedicled flap alternative, indifferently used as an advancement or rotation flap based on the internal mammary artery perforators [26-29]. As reported by Bakri et al, although it is ideally suited to central chest defects, low sternal and xiphoid defects may be out of reach for the pectoralis flap [30]. Moreover, since the patient had a positive cardiological history, we excluded this flap for the possible future need of IMA by-pass procedure.
Free flaps like ALT or DIEP flap, provide a proper amount of well vascularized tissues and are usually considered a valid alternative [31]. As reported by Tukiainen E., the general conditions of the patient represent a relevant element during the flap selection process, since the advantages of free flaps reconstruction should outweigh the disadvantages like longer operative time and potential thrombotic problems [32,33]. Unfortunately, in our patient a microvascular procedure was not recommended, making this reconstructive option inappropriate. In our case, the Ti-RAM flap proved to be a reliable alternative for chest wall reconstruction and could be added to the reconstructive surgeon's armamentarium, as it allows the coverage of wide defects with a proper closure of the donor site, while avoiding the use of microsurgery.

CONCLUSIONS

The Ti-RAM flap showed to be an effective and easy procedure for chest wall reconstruction with no major complications at both recipient and donor sites. This flap represents a safe and fast forward flap procedure that accomplish a reliable tool for coverage of extensive soft tissue defects of the chest wall.

Conflict of interest statement

We, hereby certify, that to the best of our knowledge no financial support or benefits have been received by Author or any co-Author, by any member of our immediate family or any individual or entity with whom or with which we have a significant relationship from any commercial source which is related directly or indirectly to the scientific work which is reported on in the article. None of the Authors has a financial interest in any of the products, devices, or drugs mentioned in this manuscript.

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Author contributions

BL, GD, VC: A
AP, EG, LV: D
BL, GD, AP, EG, LV: DT
GD, AP: S
GD, AP: W
GN, VA: O (performed the oncological resection)

Abbreviations

A: conceived and designed the analysis
D: collected the data
DT: contributed data or analysis tool
S: performed the analysis
W: wrote the paper
O: other contribution (specify contribution in more detail)

Ethical consideration

The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.
Written informed consent was obtained from each participant/patient for study participation and data publication.

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