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Multi-staged flap reconstruction for complex radiation thoracic ulcer



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ABSTRACT

INTRODUCTION: Chest wall reconstruction due to previous radiation therapy can be challenging and complex, requiring a multidisciplinary approach.

PRESENTATION OF CASE: The authors present the case of a 84-year-old woman with a right chest wall radionecrosis ulcer, that was submitted to an ablative surgery resulting in a full-thickness defect of 224 cm², firstly reconstructed with a pedicled omental flap. Due to partial flap necrosis, other debridements and chest wall multi-staged flap reconstruction were performed.

DISCUSSION: This case highlights that the reconstructive choice should be individualized and dependent on patient and local factors. The authors advise that surgical team should work closely and be well versed in chest wall reconstruction with a variety of pedicled flaps, when a complication occurs.

CONCLUSION: A multi-staged flap reconstruction could be a salvage procedure for the coverage of complex, great and complicated chest wall defects due to previous radiation therapy.

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1. Introduction

Chest wall reconstruction can be challenging and complex, requiring a multidisciplinary approach.^{1,2} The most common indications for chest wall reconstruction are repair of defects due to tumor resection, infection, radiation necrosis, congenital deformities and trauma. The main objectives are to restore chest wall integrity, adequate respiratory function, cover vital structures, obliterate dead space and regaining cosmesis.^{3,4} Although most defects could be repaired with local and regional flaps, more complex cases require increasingly sophisticated surgical techniques.^{2,5}

2. Presentation of case

The authors present the case of a 84-year-old woman, 39 kg of height, body mass index (BMI) of 18 kg/m² with history of hypertension (HTA) and right breast cancer, submitted to modified radical mastectomy, axillary dissection and adjuvant thoracic wall radiotherapy about 20 years before (cobalt therapy, 54 Gy, 27 sessions – 2 Gy/day). She was referred to the Plastic Surgery Department for thoracic wall reconstruction due to an anterior right radiation-induced ulcer, with partial exposure of the 3rd–5th ribs and pleura (Fig. 1A); no functional respiratory deficits were documented. Computed tomography (CT) confirmed partial

osteonecrosis of the 3rd–5th ribs and middle third of the sternum. Biopsy findings were negative for malignancy.

The surgical planning included debridement and reconstruction of the defect with a pedicled myocutaneous flap. An ablative surgery was performed, with collaboration of thoracic surgery, including debridement of devitalized soft tissue and partial anterior excision of the right 3rd, 4th and 5th ribs and costal cartilages, and partial sternectomy; no skeletal stabilization was needed. The resulting defect (14 cm × 16 cm; 224 cm²), presenting osseous and pleural exposure (with pachypleuritis due to previous radiation) (Fig. 1B) was reconstructed with a pedicled omental flap based on right gastroepiploic vessels and covered with expanded split-skin graft (Fig. 2A, B). The procedure went uneventfully. The patient did not require respiratory support after the operation. Definitive histopathological test was negative for malignancy and microbiological tests were also negative. At postoperative day 2, the flap started to show signs of congestion at the distal third, with progressive darkening of the distal portion (Fig. 2C). Due to partial flap necrosis, ten days after the first surgery, she underwent a second procedure of debridement and coverage with pedicled contralateral VRAM (vertical rectus abdominis myocutaneous) flap based on superior left epigastric vessels, including a skin island of 5.5 cm × 14 cm; one closed-suction drain was placed under the flap. During the first postoperative night, she had an episode of disorientation and psychomotor agitation, ripped the drain off, and a submuscular hematoma under the flap developed, with progressive signs of partial skin island necrosis (Fig. 3).

She was submitted to a third surgery of partial debridement and first time of reconstruction (delay) with pedicled fasciocutaneous

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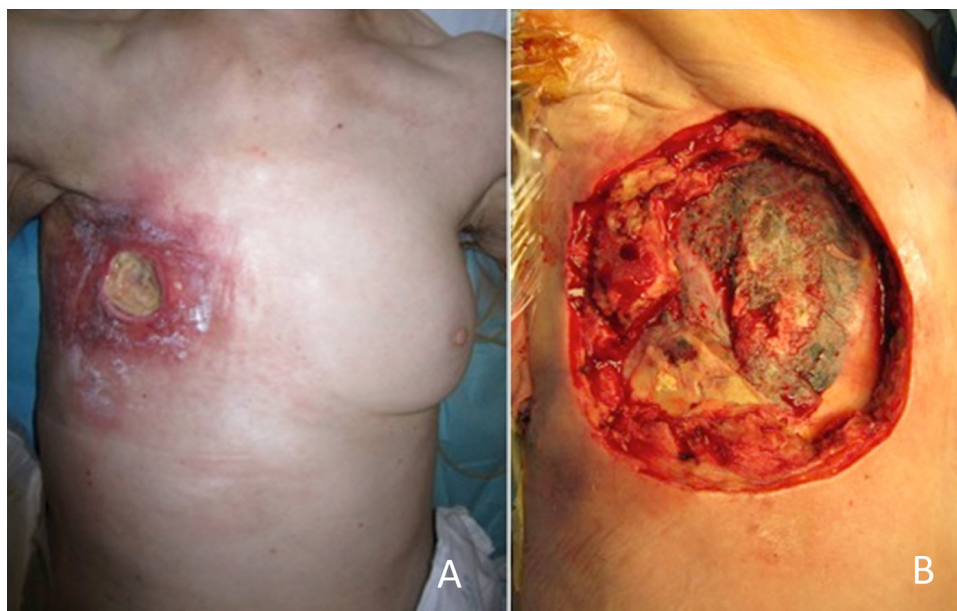


Fig. 1. (A) Chest wall radiation induced-ulcer. (B) Full-thickness defect (224 cm²) after ablative surgery.

deltopectoral flap (8 cm × 18 cm) based medially on mammary internal perforators (Fig. 4A) with no complications reported. After 3 weeks, she underwent a fourth procedure involving raising and inset of the delayed deltopectoral flap at the remaining thoracic defect. The donor area was grafted with expanded split-skin graft. No postoperative complications or functional limitations were described. She was discharged at day 45, completely healed, oriented to Plastic Surgery ambulatory.

After 5 months of follow-up, she presents adequate thoracic wall coverage (Fig. 4B) with no functional restriction, including respiratory function and mobility of the upper limb.

3. Discussion

Chest wall defects due to radiation therapy continue to represent a complicated treatment scenario for both thoracic and reconstructive surgeons.¹ Although radiation therapy has been highly refined and rendered much safer in the last years, it is still possible to see astonishing associated wounds.^{1,6} The first question is whether the lesion contains persistent or recurrent cancer. It is also important to determine whether any other local

problems such as mediastinal abscess may interfere with the reconstruction. Whether or not cancer is present, all nonviable tissue must be removed. Paramount treatment implies radical excisional surgery and full-thickness reconstruction, which can be roughly divided into an osseous thorax reconstruction and soft tissue reconstruction.^{1,3,7,8} Numerous factors can influence the decision regarding which defects require skeletal reconstruction.⁸ Despite no true consensus in the literature about the size and location of defects that absolutely require reestablishment of the continuity of the bony framework, actually, skeletal reconstruction is mostly achieved using alloplastic material for defects involving the resection of 3 or more adjacent ribs or a defect size of more than 5 cm in diameter, despite some authors advocate the use of osseous grafts. Achieving stable soft tissue coverage is also of equal importance, requiring great defects more complex reconstructions than little defects.^{2,4,8,9}

The patient presented had a large full-thickness defect of the anterior thoracic wall with exposure of important structures. Due to chronic pachypleuritis and no previous respiratory limitation, despite partial excision of three ribs and great defect dimension, we did not perform skeletal stabilization, with no risk of thoracic

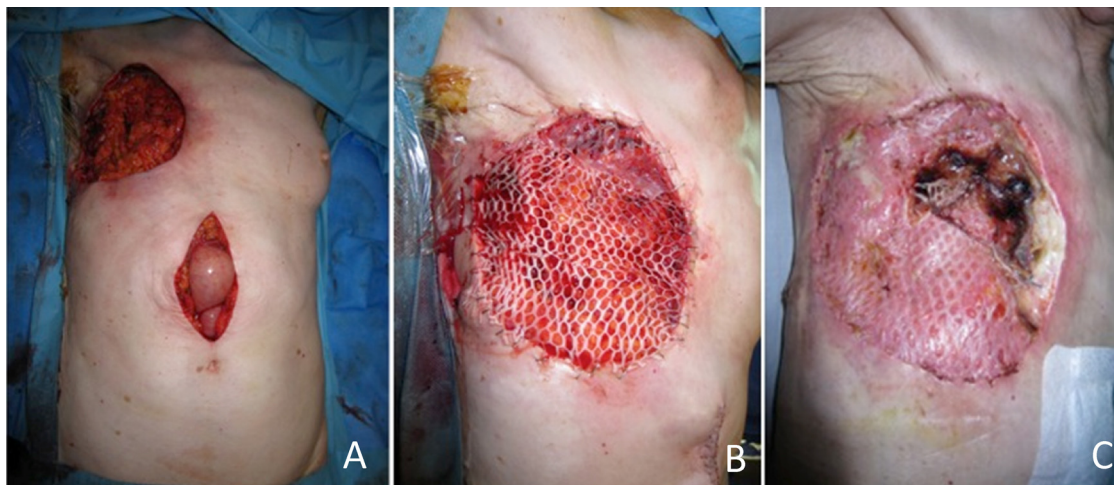


Fig. 2. (A and B) Reconstruction with pedicled omental flap. (C) Partial flap necrosis.



Fig. 3. Vertical rectus abdominis myocutaneous flap partial necrosis at postoperative day 3.

volet or respiratory function commitment described. The fact that no synthetic material was used may also have led to decreased risk of infection.

Considering the characteristics of the defect and patient conditions, the first reconstructive option was a regional myocutaneous flap, namely the latissimus dorsi flap, with consistent pedicle, that could achieve satisfactory pleural reconstruction, obliteration of dead space as well as resurfacing the defect, at least, partially. Due to intraoperative findings of fibrosis of the thoracodorsal vessels, the second option was the omental flap, to detriment of other regional muscular flaps. We have to notice that irradiation has not only effects on ulcer itself, but all the surrounding irradiated tissue

so, it is common to find poor healing and vascular pedicle damage, with risk of partial/total necrosis of the transposed muscles.⁶ The omental flap can provide tissue that may fit irregular shaped defects with large dimensions, which was the case. Due to its potential good microcirculation and phagocytic activity is particularly indicated in cases of reconstruction of damaged/compromised areas and may eliminate or limit the infection improving circulation of the receiving area, as in this type of injuries.^{4,6} The main drawback of the omental flap is its potential intra-abdominal morbidity with the laparotomy despite it can also be raised laparoscopically. It is also difficult to predict the flap size because of lack of direct correlation with the patient's morphologic characteristics.⁴ After partial omental flap necrosis, we had to take another reconstructive options and decided to perform a rectus abdominis flap, although complicated with partial necrosis, that was managed with a delayed deltopectoral flap, as a salvage procedure for reconstruction.

The patient here presented was an old female, with low BMI, HTA, that was submitted to higher doses of radiation therapy 20 years before. The radiation treatments made in that time were responsible for high collateral tissue damage, since the gamma rays were from cobalt-60 radioisotopes, in two tangential beams, with possible massive uncontrolled destruction of the surrounding tissues, including ribs, sternum and even lungs, and surrounding vasculature. These factors could have contributed to the sequential partial flap necrosis that was observed. Interestingly, Chun et al., in 2013, retrospectively analyzed 302 TRAM flap reconstructions, and found that previous chest wall irradiation did not result in increased rate of flap loss, infection, and fat necrosis; however, there was a trend toward higher revision rate in the previously irradiated TRAM group.¹⁰ In our case, the type of radiation applied, associated to other patient factors described above resulted in a different outcome.

Free microvascular reconstruction was not here considered as a primary option due to patient's poor conditions (including advanced age, low BMI associated with some inability to prolonged surgery/ICU stay, some periods of confusion and disorientation/poor compliance) and local/surgical conditions like lack of recipient vessels or need for complex temporary arteriovenous loops/interpositional grafts.^{2,4,5} Due to the described risks we looked at it as a final option.

In similar situations of previous severe chest wall irradiation, a correct and exhaustive preoperative assessment should be performed, which can include CT-angiography evaluation or even

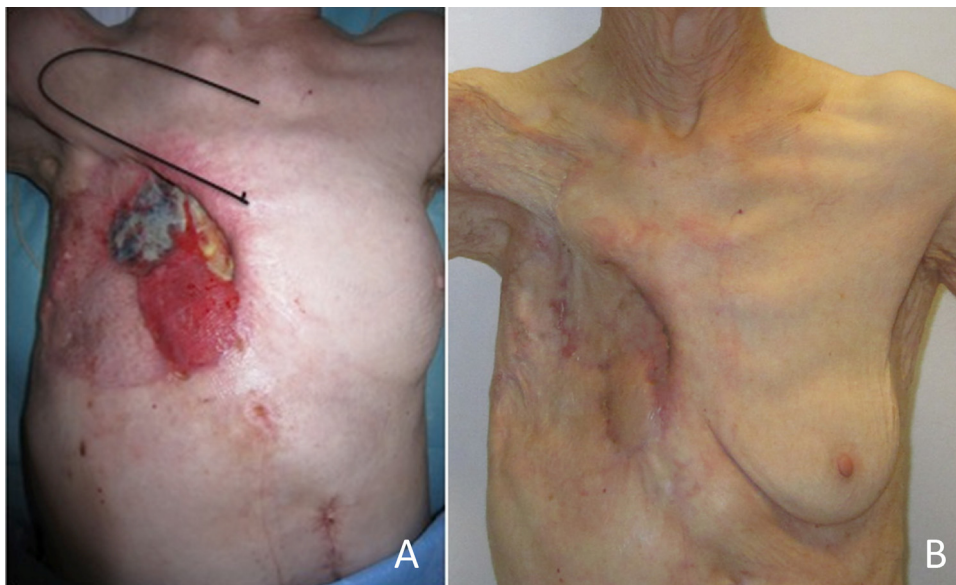


Fig. 4. (A) Schematic design of delayed deltopectoral flap for covering the remaining defect. (B) Complete chest wall coverage after 5 months.

doppler sonography, in order to evaluate the status of the surrounding vasculature – potential vascular pedicles, for decision making on the reconstructive option. Also, in these cases, the venous (or even arterial) supercharging of the flaps could be a consideration on the treatment planning in order to avoid flap loss/increase the likelihood of a successful reconstruction.¹¹

This case highlights that, despite some good orientation guidelines and algorithms already published, reconstructive choice should be individualized and dependent on patient and local factors such as size of the defect, location on the chest wall, arc of rotation of the flap, and availability of recipient vessels. The authors advise that surgical team should work closely and be well versed in chest wall reconstruction with a variety of pedicled flaps (delayed or even combined/multi-staged reconstruction) and techniques, when a complication occurs.

4. Conclusion

Multi-staged flap reconstruction may have to be used as a salvage procedure for the coverage of complex, great and complicated chest wall defects due to previous radiation therapy.

Conflict of interest

The authors have nothing to disclose or any conflict of interest.

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Ethical approval

The guardian of the patient gave informed consent for this publication. There was no need for approval by an Ethical Committee given the type of the article. Written informed consent was obtained from the guardian of the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Rita Valença-Filipe contributed to study design, manuscript writing, decision for publication, case orientation and editing of the final manuscript. Ricardo Horta contributed to manuscript writing, data analysis, and editing of the final manuscript. Joana Costa contributed to data collection and treatment of the patient. Jorge Carvalho contributed to data collection. Apolino Martins contributed to patient orientation and follow-up, data analysis and interpretation. Álvaro Silva contributed to data analysis and final manuscript.

Key learning points

- Chest wall reconstruction due to previous radiation therapy can be challenging and complex, requiring a multidisciplinary approach. Radiation thoracic ulcers still occur.
- A 84-year-old woman with a chest wall ulcer was submitted to an ablative surgery (full-thickness defect of 224 cm²), firstly reconstructed with a pedicled omental flap and due to sequential complications, submitted to a multi-staged complex flap reconstruction, with good coverage.
- Reconstructive choice should be individualized and dependent on patient and local factors.
- The team should be well versed in chest wall reconstruction with a variety of flaps when a complication occurs and when microsurgery cannot be considered.
- Multi-staged flap reconstruction may have to be used as a salvage procedure for the coverage of complex, great and complicated chest wall defects due to previous radiation therapy.

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