A radiation ulcer of the chest wall following breast cancer treatment presents a severe physiological and psychological problem, which can last several years with progressive tissue necrosis, superimposed infections, scarring, and even carcinogenesis. A radiation-induced ulcer of the chest wall with cardiac encroachment and dysfunction is rare, but nevertheless life threatening, as a result of the high risk of cardiac dysfunction, myocardium hemorrhage, traumatic cardiac injury, and even accidental heart damage. Surgical reconstruction of this defect presents a two-fold challenge: covering the defect while preserving cardiac function. Early reconstruction of such a chest wall defect, though challenging, is recommended as outlined in this report.

**Key points**
- A radiation induced ulcer of the chest wall with cardiac encroachment and dysfunction is rare, but nevertheless life threatening
- Early reconstruction of such a chest wall defect, though challenging, is recommended as outlined for this 36-year-old patient

**Case Report**
A 36-year-old woman with a non-healing ulcer on the left anterior chest wall was referred to the burn department of the authors' hospital. The patient noted occasional arrhythmia and fatigue in addition to frequent pain...
from the scar tissue surrounding the ulcer. Eleven years prior, a left-sided radical mastectomy was performed to treat breast cancer followed by local radiotherapy. Despite ongoing wound management, a progressive ulcer developed in the radiation field 1 year after the mastectomy, and an operation in another hospital was performed 3 years prior to presentation, but failed to close the defect.

The physical examination upon admission to the hospital revealed a deep radiation ulcer (5.0 cm × 6.5 cm) on the patient’s left anterior chest wall with exposure of the stumps of the third and forth ribs, the left edge of the sternum, and the anterior part of the heart with visible pulsations. The ulcer was filled with foul-smelling necrotic tissue. Several hemorrhagic spots were present on the exposed heart. Scar tissue around the ulcer and the encroached heart are shown in Figure 1. Laboratory tests showed an increased proportion of neutrophils of
75% and an elevated serum troponin T (4.2 ng/mL). Electrocardiogram (ECG) revealed an enhanced ST-T segment. Spiral computerized axial tomography (CT scan) revealed a mild left ventricular dilation and a moderate mitral regurgitation with decreased ejection fraction of 48%. Histopathology of the ulcer border indicated a chronic inflammatory response without carcinomatous transformation.

Intravenous antibiotics and local wound care were employed to control infection. Defect reconstruction was performed on day 12 after admission. Scar tissue and any areas of necrotic tissue were excised. For safety, only dissolved necrotic cardiac tissues were removed from the exposed heart by curette, with bulks of non-separated devitalized tissues remaining in situ. Intraoperatively, two small pieces of devitalized myocardium were torn apart from the original hemorrhagic spots, which led to spurts of blood. Cardiac patches successfully repaired the two tears and the bleeding was stopped (Figure 2). After debridement, the defect was extended to 7.0 cm × 9.0 cm. A superiorly based vertical rectus abdominis myocutaneous (RAM) island flap (8.0 cm × 10.0 cm) was then created on the right abdominal region and transferred to the defect (Figure 3). The inferior part of the anterior rectus sheath was reconstructed with a polypropylene surgical mesh and was closed in layers.

Postoperatively, the flap showed complete survival. Before discharge, CT examination showed that there was no obvious lacuna between the transferred flap and heart. The appearance at the original defect was satisfactory 1.5 years after surgical intervention. No instability of the abdominal wall was observed (Figure 4). Echocardiography examination indicated improved cardiac function that was nearly normal. The patient did not note symptoms of arrhythmia, fatigue, or breathlessness again.

**Discussion**

This is the first reported case of a chest wall defect with an extensively encroached heart and severely impaired cardiac function. While rectus abdominis myocutaneous flap has been used for mediastinitis and chest wall reconstruction, the case reported here had dual challenges. The first challenge is to determine surgical timing. Usually, reconstruction would not be performed early on when bulks of necrotic tissue or infection are present in the wound. To ensure a safe procedure, as well as a good healing after flap transfer, the optimal surgical timing in this case would likely be delayed until granulation tissue has formed in the damaged heart. However, granulation tissue growth in an irradiated bed can take a long time, and the patient in this case was sustaining myocardial damage and experiencing progressive cardiac dysfunction because of the irradiation necrosis and chronic infection. In this situation, an early surgical procedure provides more hope for success in stopping the cycle of myocardial injury and reducing the risk for life-threatening complications that may arise in such an extreme case.

Another challenge is how to perform efficient and safe debridement on a damaged heart. In principle, complete removal of all devitalized tissues is required for a deep radiation ulcer, but such a principle is limited in this case because of the significant risks for hemorrhage and heart damage during the procedure. In this case, debridement comprised removal of only dissolved necrotic tissues from the exposed heart, while bulks of non-separated devitalized tissues remained in situ. This minimalistic debridement approach, however, resulted in satisfactory healing and significantly improved cardiac function. This could be explained by the powerful capacities of the transferred RAM flap in infection resistance and biological resorption. Minimal debridement followed by muscle flap can be regarded as a safe, and more importantly, effective strategy that allows for early reconstruction of a complex chest wall defect in cases where other complications could develop if surgical intervention is delayed.

In this case, the right vertical RAM flap based on the right superior epigastric vessels was used considering the possibility for radiation necrosis of the left vessels. Prior to flap transfer, an occlusion test of the deep inferior epigastric vessels was further performed to confirm the patency of the superior epigastric vessels. Nevertheless, angiography of vessels should be recommended for the safe preoperative evaluation of the vertical RAM inflow vessels.

**KEYPOINTS**

- A progressive ulcer developed in the radiation field 1 year after the mastectomy
- Intravenous antibiotics and local wound care were employed to control infection
- Necrotic cardiac tissues have to be removed from the exposed heart with great care
- A superiorly based vertical rectus abdominis myocutaneous island flap was created on the right abdominal region to cover the heart and close the defect
It is also important to note that such a reconstruction should only be undertaken with a cardiac surgeon present. The close cooperation between a reconstructive and cardiothoracic surgeon in this case made it possible to limit the occurrence of the vital implications and repair the unexpected myocardial tears.

**Conclusion**

A complex chest wall defect with the heart extensively encroached due to radiation injury was treated with minimal debridement followed by vertical RAM island flap, which allowed for an early reconstruction and facilitated successful reversal of cardiac dysfunction, thus avoiding a life-threatening situation. This successful experience should prove helpful for the reconstructive surgeon in management of similar cases.

**KEYPOINTS**

- Minimal debridement followed by vertical RAM island flap allowed for early reconstruction and facilitated successful reversal of cardiac dysfunction

**References**