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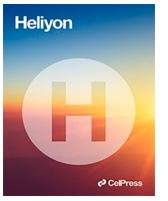

Case report

Pedicled myocutaneous flap transplantation for a large chest wall defect with infection in a 72-year-old female

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ABSTRACT

Background: In the realm of thoracic surgery, addressing chest wall defects accompanied by infections remains a formidable task. Despite the availability of a spectrum of surgical options, attaining clinical resolution is particularly challenging in intricate cases involving extensive chest wall defects in elderly patients. Thorough debridement followed by the utilization of autologous tissue for repair and reconstruction has emerged as a prevalent approach in current clinical practice.

Case presentation: Herein, we present a 72-year-old female patient with a large chest wall defect and infection. She has experienced left breast cancer surgery, multi cycle radiotherapy and chemotherapy. Nine months ago, there was yellow purulent fluid in the left chest wall. She had undergone debridement in other hospital, and the treatment effect was poor. At our hospital, Chest computed tomography (CT) imaging revealed a soft tissue anomaly on the left side of the chest wall, along with partial rib bone deterioration. Considering the patient's clinical presentation and radiological findings, a tentative diagnosis of an infected chest wall defect and chronic osteomyelitis was established. Consequently, daily dressing changes were deemed necessary for the patient's infected chest wound. Surgery for chest wall repair and reconstruction was scheduled once the wound area exhibited cleanliness with emerging granulation tissue. Preoperatively, a myocutaneous flap of an appropriate size was meticulously planned. During the surgical procedure, initial debridement of the infected chest wall area was conducted, followed by the strategic placement of a harvested pedicled latissimus dorsi myocutaneous flap to rectify the defect. Postoperative care involved stringent anti-infective measures, anti-spasmodic treatment, and preventive anticoagulation, accompanied by vigilant monitoring of the myocutaneous flap's viability and the healing progress of the defect site.

Conclusions: Utilizing the pedicled latissimus dorsi myocutaneous flap for repairing extensive defects in the chest wall presents a viable and efficient strategy. This technique preserves cardiopulmonary functionality and maintains the thoracic contour. The outcomes observed in the short to medium term postoperatively have been consistently gratifying.

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1. Introduction

Chest wall defects are commonly seen after treatment interventions such as tumors, infections, radiation injuries, and direct damage from traumatic factors [1–3]. Independent of the etiology behind chest wall defects, particularly those of a significant extent, a lack of appropriate repair and reconstruction can lead to a range of physiological and pathological alterations. These may include softening of the chest wall, disruption in normal respiratory mechanics, and mediastinal flutter [4,5]. The selection of methods, techniques, and materials for reconstruction surgery is the main factor affecting the effectiveness of chest wall repair and reconstruction.

There is no fixed surgical method for repairing large chest wall defects, and the specific method should be flexibly mastered based on the patient's overall condition, defect site, size, and surrounding available tissue conditions. Typically, thoracic reconstruction utilizes various soft tissue materials, such as latissimus dorsi muscle flap or myocutaneous flap, pectoralis major muscle flap or myocutaneous flap, rectus abdominis muscle flap or myocutaneous flap, free vastus lateralis myocutaneous flap and greater omentum flap [6–8]. In clinical settings, the preference for autologous tissue in repairing chest wall defects stems from its readily available nature, lack of immune rejection, and consistently dependable outcomes.

2. Case presentation

A 72-year-old female patient presented with ulceration and pus on her left chest wall 9 months ago. The wound was inflamed and painful, with visible redness and swelling. Microbial culture analysis revealed the presence of *Pseudomonas aeruginosa*, the drug susceptibility test revealed that this strain was more sensitive to certain cephalosporin antibiotics, such as Cefoperazone Sodium and Sulbactam Sodium antibiotics. Upon reviewing the patient's medical history, it was discovered that she underwent a left mastectomy in 2001 as a result of a diagnosis of left breast cancer. Following the surgery, she underwent regular radiotherapy and chemotherapy several times. Additionally, the patient has been diagnosed with diabetes for over a decade and is currently managing her condition through regular subcutaneous injections of long-acting insulin (Asparagus insulin injection 8u QD6; Asparagus insulin injection 6u QD11; Asparagus insulin injection 6u QD17; Insulin glargine injection 20u QD22). Her blood sugar levels are well controlled at present. The individual sought advanced treatment at our institution following persistent failure of a chest wall wound to heal, compounded by a substantial defect, an ulcer, and a fistula, all of which resulted from debridement procedures performed at a different medical facility. Chest CT scan showed partial soft tissue defect and fistula formation in the left chest wall, which did not communicate with the thoracic cavity, and partial bone destruction in the 3rd to 6th ribs. After the patient was admitted to the hospital, gauze dressings containing sensitive antibiotic solutions were used to change the infected wound every day. Additionally, the patient received nutritional support, correction of hypoproteinemia, and strict control of blood sugar. Prior to surgery, thoracic enhanced CT, three-dimensional reconstruction of the sternum CT, and subclavian artery computed tomography angiography (CTA) were performed to comprehensively evaluate the size, shape, and adjacent structures of the chest wall defect, as well as to identify any abnormal lesions in the thoracodorsal artery.

General anesthesia was administered for the surgical procedure, utilizing a double-lumen endotracheal tube to facilitate single lung ventilation, specifically on the unaffected side. The incision direction and suitable flap were designed according to the preoperative chest CT and the size of the chest wall defect **[Fig. 1(A–C)]**. After removal of necrotic bone (Starting at the level of the 3rd defective rib on the left side, the necrotic rib stumps on the 3rd, 4th, 5th, and 6th ribs were sequentially resected. This was done in a proximal to distal and top to bottom manner until the rib stumps were fresh. The length of the removed necrotic rib was approximately 0.5–1.0 cm), thickened pleura, and granulation tissue during the operation, a large amount of povidone iodine, hydrogen peroxide, and normal saline were repeatedly washed alternately after fresh wound appeared. The size of the chest wall defect was measured to be about 10 cm × 8 cm. Due to pleural fibrosis and thickening, the patient did not experience significant abnormal breathing phenomena. Therefore, we did not further restore the ribcage framework. The patient was repositioned into a 90° lateral orientation. The operative

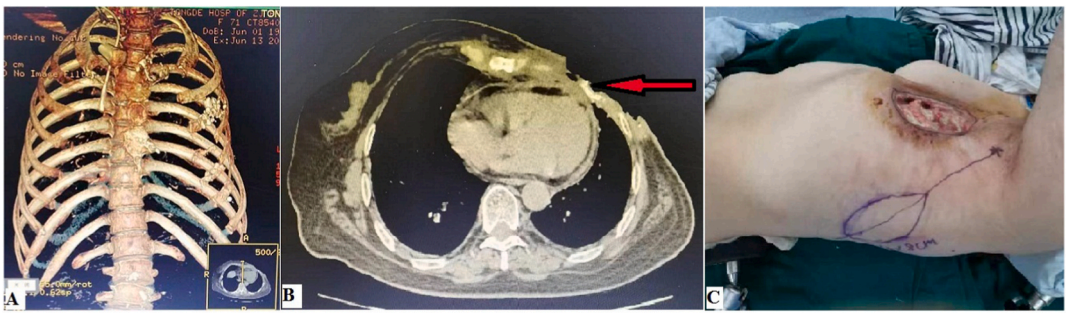

Fig. 1. Preoperative clinical data.
A.The preoperative rib CT three-dimensional reconstruction of the patient showed partial bone destruction in the 3rd to 6th ribs of the left chest wall.
B.The patient's preoperative chest CT showed partial soft tissue defect in the left chest wall and partial bone destruction in the ribs. (Red arrow)
C.An appropriate pedicled latissimus dorsi myocutaneous flap was designed according to the size of the patient's chest wall defect before operation.

strategy involved using a pedicled latissimus dorsi myocutaneous flap, as per the pre-surgical design, to address the wound defect. During the procedure, incisions followed the anatomical contours of the latissimus dorsi, allowing for the careful dissection and exposure of both proximal and distal segments while safeguarding the thoracodorsal artery and vein. This process yielded a latissimus dorsi myocutaneous flap, incorporating an adequate length of the thoracodorsal neurovascular bundle, measuring approximately 20 cm × 10 cm, with a preserved skin paddle of roughly 10 cm × 8 cm. Throughout the flap's extraction, meticulous attention was paid to preserving its vascular supply and avoiding undue torsion of its vascular pedicle. The freely movable pedicled myocutaneous flap was transferred to the chest wall defect wound through the subcutaneous tunnel, then sutured and fixed with the soft tissue around the wound, and the myocutaneous flap was closely combined with the bottom of the chest wall wound to eliminate the dead space, and finally the negative pressure drainage tubes (A drainage tube is externally connected to a negative pressure ball device, with a diameter of 5mm) were placed for drainage **[Fig. 2(A,B)]**. We squeezed the negative pressure ball to create a certain amount of pressure, ensuring active drainage.

Postoperative treatment such as anti-infection (Cefoperazone Sodium and Sulbactam Sodium Injection), anti-spasticity (Raceanisodamine Hydrochloride Injection), and preventive anticoagulation (Enoxaparin Sodium Injection) should be given. Considering the patient's severe surgical trauma, we utilized the visual analogue scale (VAS) pain scoring standard to assess postoperative pain. The patient reported a satisfactory pain tolerance (5 points). The postoperative treatment plan involved administering Ketorolac Tromethamine Injection in combination with Tramadol sustained-release tablets to manage incision pain. Additionally, Estazolam tablets were prescribed to alleviate anxiety, while actively soothing the patient's emotions. The patient's upper limb on the involved side was stabilized in a functional position. The transplanted myocutaneous flap received thermal care to enhance healing, with careful attention to minimize pressure on the surgical site, thus ensuring uninterrupted blood circulation. One week after surgery, when the drainage flow rate was less than 10mL/day and the color of the drainage fluid was clear, we sequentially removed the drainage tubes at the flap donor site. Postoperative recovery was favorable, leading to the patient's discharge without any detection of malignant cells in routine pathological assessments. During a 7-month follow-up, chest CT re-evaluations indicated complete resolution of the chest wall defect, absence of any infection recurrence, healthy growth of the myocutaneous flap, and the thorax's contour largely maintained as before **[Fig. 3(A–C)]**. **An informed consent was obtained prior to this case report.**

3. Discussion and conclusion

Large defect of the chest wall from various causes often require tissue volume replacement, which remains a difficult and cumbersome task for surgeons. Due to long-term chronic infection, complex chest wall defect often present a pathological blind tube at the residual end of the wound, with the wall filled with necrotic bone and granulation tissue [9]. The causes of chest wall defect are mostly caused by local tissue necrosis caused by infection, traumatic injury or radiotherapy and chemotherapy after malignant tumor surgery. Initially, fibrous and thickened chronic sinus tissue is formed, and infection spreads due to residual necrotic tissue. The main goals of chest wall defect repair include protecting the potential chest structure and maintaining normal respiratory function while achieving aesthetic results [10,11]. Therefore, how to design a surgical method to achieve a primary cure is crucial.

The sequelae caused by radiation injury to the chest wall have been well documented in the available literature, especially in the context of breast cancer, where chronic ulceration of the skin and extensive dilation of capillaries have been described [12]. Reviewing the medical history of this patient, it is not known whether the formation of chest wall sinus is directly related to radiotherapy, as the course of the disease is long. In the process of diagnosis and treatment, how to plan a reasonable repair and reconstruction effect before surgery without changing the shape of the thorax is the key to solving huge chest wall defect. Patient factors and complications must also be considered when selecting reconstruction methods. The patient planned to harvest a large area of myocutaneous flap, thus increasing the risk of myocutaneous flap ischemia and poor postoperative wound healing. In addition, she is older and has a history of diabetes, so it is necessary to minimize the operation time and limit the total anesthesia time. During the operation, in order to make the myocutaneous flap reach the soft tissue defect area, the vascular pedicle and muscle pedicle need to be rotated, which may increase

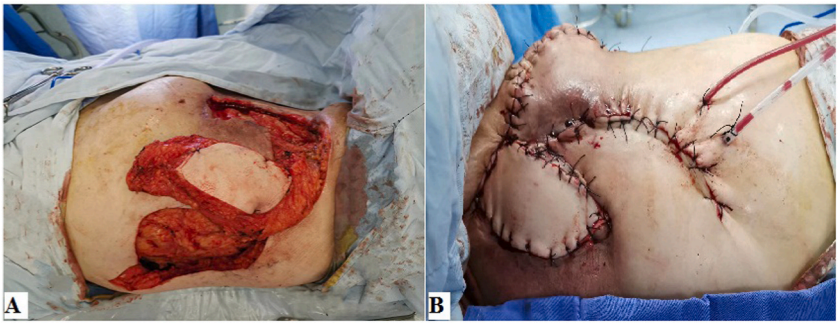

Fig. 2. Clinical information during operation.
A.A pedicled latissimus dorsi myocutaneous flap was harvested, and the skin paddle was retained.
B.The musculocutaneous flap was transferred to fill the defect in the chest wall, the incision was sutured and the subcutaneous drainage tubes were retained.

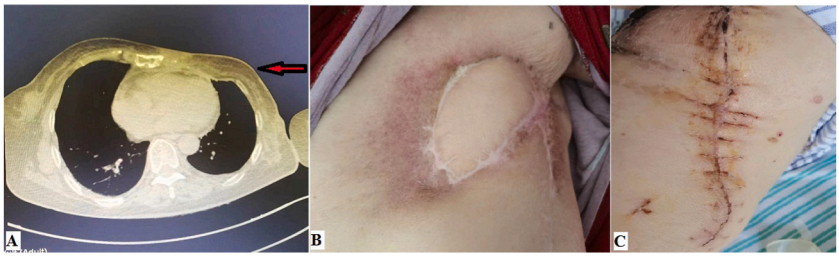

Fig. 3. Postoperative follow-up clinical data of the patient.
A. Chest CT showed that the chest wall defect disappeared and the pedicled myocutaneous flap survived. (Red arrow)
B. The pedicled latissimus dorsi myocutaneous flap survived, and the shape of the thorax remained basically unchanged.
C.The postoperative incision healed smoothly.

the risk of surrounding soft tissue compressing the vascular pedicle. When performing transposition, the fascia around the vascular pedicle and the soft tissue that may compress the vascular pedicle should be carefully removed as much as possible. Therefore, we need to evaluate the risk of myocutaneous flap necrosis in time after surgery. At the same time, the patient's upper limb on the affected side needs to maintain a functional position. If the range of motion is too large, the incision in the operation area will be dehiscated, increasing the risk of infection and bleeding.

For the reconstruction of the chest wall's soft tissue, the primary techniques employed are the fasciocutaneous and myocutaneous flaps. Each approach offers a substantial volume of tissue, ample length for coverage extending to the breast's upper quadrant, and optimal compatibility in terms of skin color and texture [13–15]. Tissue flap transplantation can avoid skin grafting due to large skin defect of chest wall, and can timely understand the activity and blood supply of myocutaneous flap after operation. Of course, in addition to soft tissue reconstruction, chest wall reconstruction also includes bone reconstruction carried out in recent years, such as biomaterials, artificial materials, and 3-D printing technology. A review of some literature shows that when extensive chest wall defects require restoration of chest mechanics and emphasis on support function, artificial biomaterials such as TiNi-based implants have also achieved good clinical results in the repair and reconstruction of chest wall defects [16,17]. However, there is no uniform standard for the clinical application of bone chest wall reconstruction. Generally speaking, extensive post-excisional thoracic defects with penetration into the free pleural cavity, especially along its anterior part, require a mandatory single-step reconstruction of the osteochondral frame. If a thickened parietal pleura and no flotation are noticed, a fasciocutaneous flap (pedicled latissimus dorsi myocutaneous flap) is considered a successfully chosen option. The latter is more straightforward and can significantly reduce intra-op trauma. However, the risks of recurrence and purulent complications seem to be threatening.

In this particular case, the patient had undergone total left mastectomy due to breast malignant tumor. Subsequent multiple debridements led to the atrophy or necrosis of the adjacent pectoralis major muscle and its nearby tissues. Typically, for effectively repairing extensive chest wall defects, myocutaneous flaps situated anatomically nearby with a rich blood supply are preferred, including options like the transverse rectus abdominis myocutaneous (TRAM) flap or the latissimus dorsi myocutaneous flap [18]. Generally, autologous material is favored for chest wall soft tissue reconstruction owing to its compatibility, ease of procurement, and reliable results in reconstruction [19–22].

The latissimus dorsi flap is significantly utilized in repairing defects in the lateral and posterior areas of the chest wall near the neck, attributed to its abundant vascularization, consistent anatomical structure, voluminous tissue availability, high flexibility, and safety profile [23,24]. This pedicled flap can be adeptly tunneled subcutaneously to cover not only the entire ipsilateral chest and the midline but also the contralateral axillary regions, and it is even capable of extending to the abdominal, cervical, and upper arm areas [25,26]. Its advantages include a plentiful blood supply, effective resistance against infection, reduced duration of surgery, and feasibility for single-stage suturing. Generally, it does not need skin grafting (except in special cases). The proportion of complications is low, and the skin paddle is retained. Based on these advantages, it can not only be used for the reconstruction of large chest wall defect, but also meet the aesthetic needs of chest plastic surgery, especially for chest wall defects after breast cancer surgery [13,27,28]. Some patients may experience temporary dysfunction such as poor arm abduction and weakened arm strength after surgery, which can gradually recover after about one year of rehabilitation exercise [29–31]. Although there are also reports of free myocutaneous flaps for the treatment of empyema and huge chest wall defects, the risk of surgery is relatively high compared to pedicled tissue flaps due to the involvement of microsurgical techniques.

In summary, chest wall reconstruction is a complex process, and the choice of surgical techniques and materials is the key to the success of reconstruction. This patient was older and complicated with diabetes. In order to avoid the fatal consequences of the progression of chest wall infection, early surgical intervention was performed on the basis of actively improving the general condition. Although the patient's chest wall defect is huge, preoperative detailed surgical design is a key step, especially in the selection of flaps, including length, width, and range. The limitations of this study are that it is a single case report and presented as a retrospective analysis. Considering these constraints, the practical clinical applicability might be restricted in scenarios such as those involving patients with extensive chest wall defects or where the latissimus dorsi muscle is of inadequate volume or damaged prior to surgery. However, postoperative follow-ups indicate that the use of the pedicled latissimus dorsi myocutaneous flap for treating complex chest wall defects generally yields positive outcomes. The adaptability and ease of harvesting of the latissimus dorsi myocutaneous flap contribute to its effectiveness. As surgical techniques advance, the results of such reconstructions are expected to improve

progressively.

Ethics approval

The Institutional Ethics Committee does not require ethical approval as this is a case report.

Consent for publication

An informed consent was obtained prior to this case report. The patient's clinical data and images in the manuscript have been approved for publication.

Availability of data and materials

Data included in article/supp. Material/referenced in article. The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Author contribution statement

Kang Zhang: Project administration, Formal analysis, Data curation. **Lei Wang:** Writing – review & editing, Writing – original draft, Formal analysis. **Zhongliang He:** Project administration, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Not applicable.

Abbreviations

CT	Computed tomography
CTA	Computed tomography angiography
VAS	Visual analogue scale
TRAM	Transverse rectus abdominis myocutaneous

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