Clinical Case Report

Medicine®

OPEN

Free vastus lateralis musculocutaneous flap transfer for radiation-induced chest wall fistula combined with osteomyelitis

Two case report

Xia Hong, RN[a], Zhongliang He, MD[a,*], Lifeng Shen, MD[b], Xueming He, MD[a]

Abstract

Rationale: Chronic chest wall fistula is a refractory and agonizing disease that results from multiple predisposing etiologies, including radiation-induced damage. Successful management remains challenging when this condition is combined with osteomyelitis, and a limited number of reports have been published in the literature concerning this management.

Patient concerns: Two Chronic chest wall fistula patients were selected to undergo surgery in our hospital because they could not be cured by conventional therapy for several years. One is a 74-year-old female who has received a right radical mastectomy and had radiation therapy 23 years ago; the other is a 59-year-old male who underwent a excision of thyroid cancer and had chemoradiation therapy 20 years earlier.

Diagnosis: Both patients were diagnosed with radiation-induced chest wall fistula combined with osteomyelitis.

Interventions: After total resection of the diseased chest walls, both patients underwent free vastus lateralis musculocutaneous flap transfers, in which the vessels were microvascularly anastomosed to the transverse carotid artery and vein via a subcutaneous tunnel or a direct incision. Histologic evaluations of the specimens demonstrated inflammation and osteomyelitis.

Outcomes: The patients recovered very well and currently have no recurrence of chest wall fistulae during the postoperative follow-up.

Lessons: It is crucial to not only completely resect chest wall fistulae and the surrounding diseased tissues but also reconstruct the chest wall. Thus, the use of the free vastus lateralis musculocutaneous flap transfer method for radiation-induced chest wall fistulae, combined with osteomyelitis, is a useful option for treatment and is also a feasible and efficient surgical procedure with promising results.

Abbreviations: CT = computed tomography, MRI = magnetic resonance imaging, POD = postoperative day, VSD = vacuum sealing drainage dressing.

Keywords: free flap, osteomyelitis, radiation-induced chest wall fistula, vastus lateralis muscle

1. Introduction

Chronic chest wall fistulae may be caused by many factors that arise in a trauma setting, including infections, neoplasms, radiation-induced tissue damage or a history of thoracic surgery. A radiation-induced chest wall fistula is a refractory and agonizing disease, and the successful management of this disease remains challenging when combined with osteomyelitis because it is very difficult to cure this disorder via conservative and conventional therapies.[1,2] There is an obvious need to not only completely resect the fistula and the surrounding diseased lesions but also reconstruct the chest wall; therefore, many patients commonly require more sophisticated, reconstructive soft-tissue and skin coverage after the complete resection of the diseased chest wall.[3,4] In this report, we describe 2 cases of successful operations involving total resections of radiation-induced chest wall fistulae combined with osteomyelitis and reconstructions of the chest walls solely via free vastus lateralis musculocutaneous flap transfers.

Editor: N/A.

XH and XMH contributed equally to the work.

This study was approved by the Institutional Review Board of Tongde Hospital of Zhejiang Province.

Written consent was obtained from both patients for the publication of their cases.

The authors have no conflicts of interest to disclose.

[a] Department of Cardiothoracic Surgery, Tongde Hospital of Zhejiang Province, [b] Department of Traumatology and Orthopedic Surgery, Tongde Hospital of Zhejiang Province, Hangzhou, Zhejiang, China.

[*] Correspondence: Zhongliang He, Tongde Hospital of Zhejiang Province, Hangzhou310012, Zhejiang, China (e-mail: doctorhzl@163.com).

Medicine (2019) 98:22(e15859)

Received: 13 December 2018 / Received in final form: 17 April 2019 / Accepted: 9 May 2019

http://dx.doi.org/10.1097/MD.0000000000015859

2. Case presentation

This report of 2 cases was approved by the Institutional Review Board of the Tongde Hospital of Zhejiang Province. Written consent was obtained from both patients for the publication of their cases.

2.1. Patient 1

A 74-year-old woman was referred to our hospital with a year-long history of a discharging right chest wall fistula. She

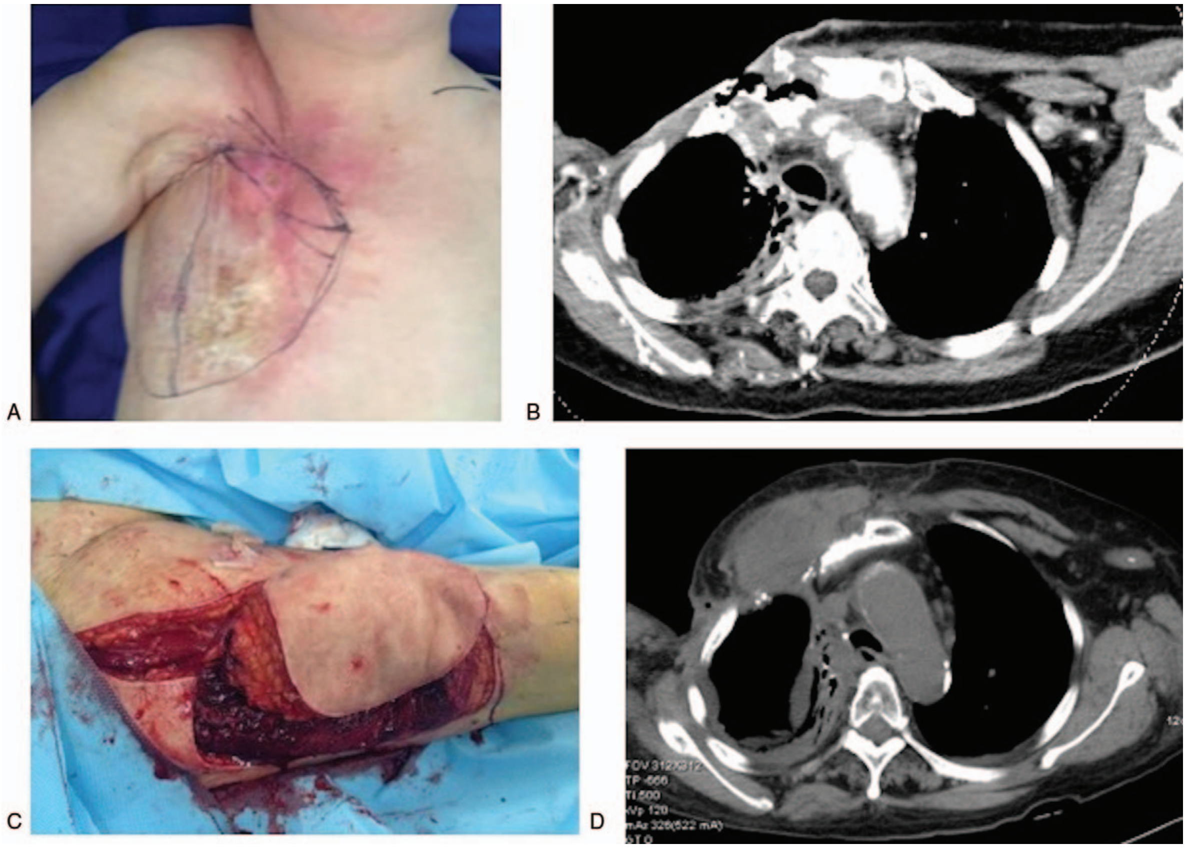

Figure 1. Patient 1. A: A preoperative image revealed a 1.0 cm×1.0 cm well-circumscribed, open fistula that was surrounded by an approximate 11 cm×10 cm area of scarred skin. B: A preoperative chest CT scan showed a chest wall fistula and osteomyelitis involving the entire right clavicle, the right aspect of the sternum, and the anterior first and second ribs in the right upper thorax. C: During the operation, a 15 cm×11 cm free vastus lateralis musculocutaneous flap, which was harvested from the patient's right thigh, was transferred to the chest wall defect. D: A postoperative chest MRI scan showed an adequate reconstruction of the chest wall defect at 3 months after the operation.

underwent a right radical mastectomy and had received radiation therapy 23 years ago. She had not exhibited any specific symptoms until a chest wall fistula developed. A physical examination showed a 1.0 cm×1.0 cm well-circumscribed fistula, which was draining yellow pus, and an 11 cm×10 cm surrounding skin lesion, with contracture and scars in the right upper collapsed chest wall (Fig. 1A). The pathogen that was identified via culturing of the pus was *Staphylococcus aureus* and *Pseudomonas aeruginosa*. The chest computed tomography (CT) scan showed a chest wall fistula and osteomyelitis involving the entire right clavicle, the right aspect of the sternum, and the anterior first and second ribs in the right hemithorax (Fig. 1B). The abdominal CT scan, the bone scan, and liver sonography showed unremarkable results, and a fine needle aspiration of the sternum wound demonstrated negative signs of a malignancy. A combination of systemic antibiotic therapy, localized wound debridement, and daily dressing changes was applied before the operation. During the operation, and after the resection of the chest wall fistula and the surrounding scarred skin, the chest wall necrotic tissues, the affected entire right clavicle, the right aspect of the sternum, and the anterior first and second rib segments were resected to expose the normal chest wall tissue and the visceral pleura. Afterwards, a 15 cm×11 cm free vastus lateralis musculocutaneous flap was harvested from her right thigh and was transferred to fill the defect and to reconstruct the chest wall (Fig. 1C). The descending branches of the lateral circumflex femoral artery and the accompanying vein, which function as nutrient vessels, were subcutaneously tunneled to the left cervical region and were separately and microvascularly anastomosed end-to-end to the transverse carotid vessels via interrupted sutures with 9-prolene. After the completion of the microvascular anastomosis, the free flap was firmly stabilized inside of the defect with the surrounding tissue by using monofilament absorbable sutures, and a 9 cm×6 cm skin paddle was sutured with the surface skin. The donor site on the right thigh was covered with a split-thickness skin graft that was obtained from the right lower abdomen. Her postoperative course was uneventful (Fig. 3A), and she was discharged at postoperative day (POD) 45. The postoperative pathology of the resected chest wall tissues included chronic inflammation and osteomyelitis, while also demonstrating negative evidence for a malignancy. The chest magnetic resonance imaging (MRI) scan showed adequate reconstruction of the chest wall defect at 3 months after surgery (Fig. 1D). The patient remained healthy, and no recurrence of the fistula was evident during the 6 years of follow-up.

2.2. Patient 2

A 59-year-old male developed a discharging left chest wall fistula within 2 months, with the patient also having a history of

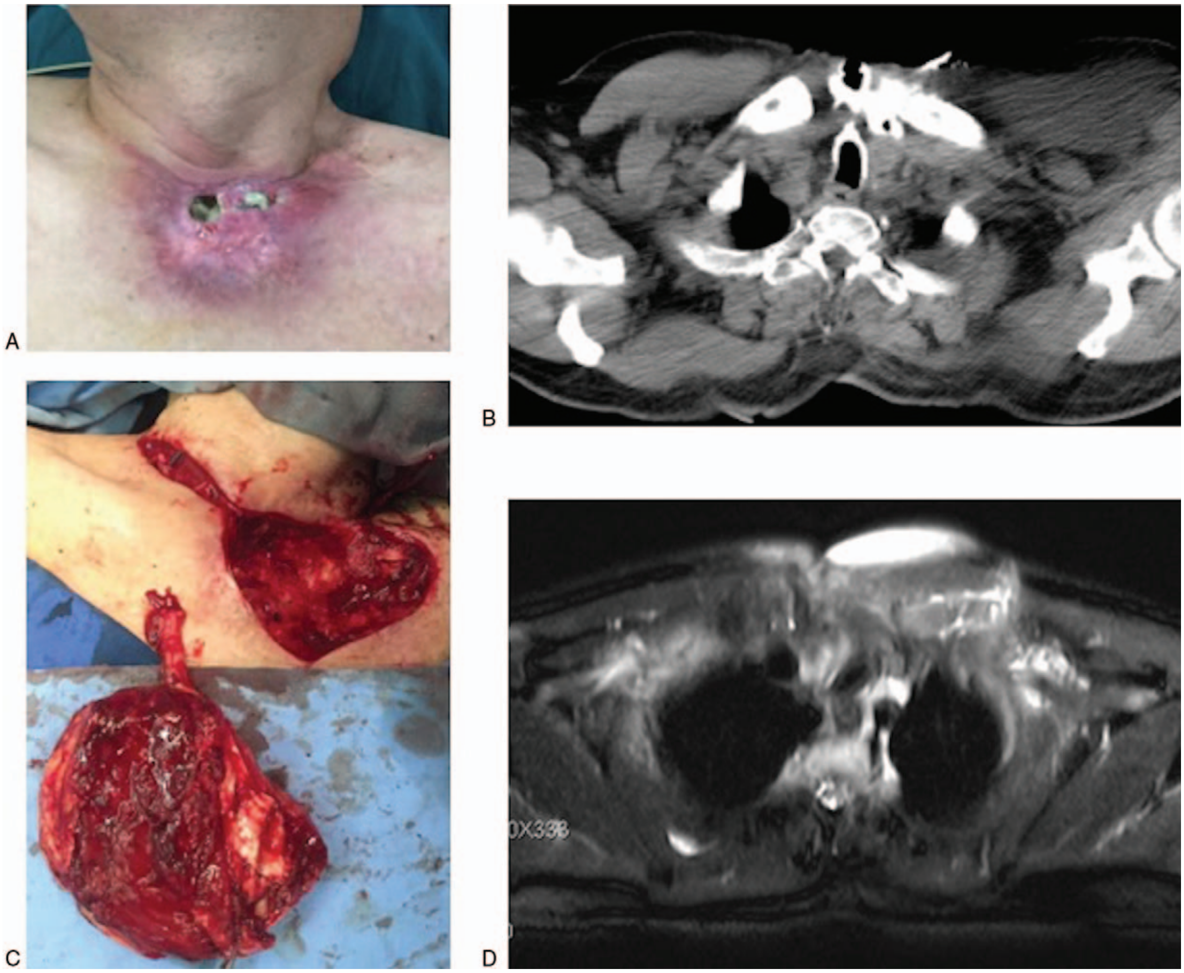

Figure 2. Patient 2. A: A preoperative image showed a 2.0 cm×2.0 cm irregular fistula that was surrounded by a 9 cm ×7 cm area of red and swollen skin lesions. B: A preoperative chest CT scan revealed a chest wall fistula and osteomyelitis involving the anterior left clavicle, the left aspect of the sternum, and the anterior first rib in the left upper thorax. C: During the operation, the descending branches of the lateral circumflex femoral vessels of the free vastus lateralis musculocutaneous flap were separately and microvascularly anastomosed end to end to the transverse carotid vessels. D: A postoperative chest MRI scan showed no recurrence of the chest wall fistula at one month after the operation.

excision of left thyroid cancer and having received chemoradiation therapy 20 years earlier. He had not exhibited any specific symptoms until the chest wall fistula developed. A physical examination showed a 2.0 cm×2.0 cm irregular fistula, which was draining yellow pus, and a 9 cm×7 cm area of red and swollen skin lesions in the left upper chest wall (Fig. 2A). The pathogen that was identified in the culture was *Clostridium difficile*. The CT scan revealed a chest wall fistula that was connected to the left upper lobe, as well as osteomyelitis involving the anterior of the clavicle, the left aspect of the sternum, and the anterior first rib in the left hemithorax (Fig. 2B). The cervical CT scan, the bone scan, and liver sonography revealed unremarkable results, and a biopsy of the chest tissue confirmed that the lesions did not indicate recurrent cancer. A combination of systemic antibiotic therapy, extensive wound debridement of the resection of the chest wall fistula and the diseased red skin, and vacuum sealing drainage dressing (VSD) therapy (Smith & Nephew, Inc., MI) were used before the last operation. After further debridement, the affected entire right clavicle, the left aspect of the sternum, and the anterior first and second rib segments were resected to expose the normal chest wall tissue and the parenchyma of the lung. Afterward, an 11 cm×9 cm free vastus lateralis musculocutaneous flap was harvested from the right thigh and was transferred to fill this defect and to reconstruct the chest wall. The vessels from the graft were directed to the right cervical region via a direct incision and were separately and microvascularly anastomosed end-to-end to the transverse carotid vessels (Fig. 2C). Subsequently, a 5 cm×4 cm skin paddle was sutured with the surface skin. The donor site was then primarily closed. The outcomes of the patient were uneventful, and the patient was discharged at POD 14 (Fig. 3B). The postoperative pathology of the specimen included chronic inflammation and osteomyelitis, and there were no findings of a malignancy. A chest MRI scan showed no recurrence of the chest wall fistula (Fig. 2D), and the patient remained healthy during the 3 years of follow-up.

3. Discussion

A chronic chest wall fistula is a refractory and agonizing disease that results from multiple predisposing etiologies, with one of the causes being radiation-induced damage. The successful manage-

Figure 3. Postoperative image. A: Postoperative image of Patient 1. B: Postoperative image of Patient 2.

ment of this disease remains as a significant challenge, especially when it is combined with osteomyelitis because it is very difficult to cure this disorder via conservative and conventional therapies.[1,2] Radiation therapy may cause both early and late radiation tissue injuries, which are primarily caused as a result of reactive oxygen species-mediated damage to the differentiated soft tissue cells, the soft tissue progenitor cells, and the vascular endothelial cells. These changes can lead to fibrosis, which is an abnormal response to tissue injury, as well as tissue death. Tissue necrosis often progresses with time to develop into ulcerations or fistulae because of a combination of ongoing microvascular compromise, inflammation, and infection. The loss of the necrotic soft tissue and the ribs exposes the thoracic viscera, which results in empyema. Both soft tissue infection and empyema may result in septicemia. Patients typically present with a slowly worsening skin fistula and full thickness necrosis that involves the ribs and the sternum, which causes discomfort and a poor quality of life, which is a similar condition experienced by our patients.[2,5]

For the management of the fistula, the infection must be eliminated, all of the damaged tissue must be excised, and the chest wall must be stabilized during reconstruction. However, it is important to reduce the bacterial load of the soft tissue as much as possible. When an infection of the chest wall is present, a combination of systemic antibiotic therapy, localized or extensive wound debridement, and VSD therapy is often indicated before a definitive surgical resection.[1,2] After the administration of these therapies, several issues must be considered. First, a sufficient amount of tissue must be resected to dispose of all of the devitalized tissue, including all of the soft tissues, cartilage, and bone. This allows for the remaining healthy, viable margins to be used as secure anchors for tissues that are used in a reconstruction.[3,6] The resection of the underlying lung is occasionally necessary when it is adhered to the chest wall because of radiation-associated adhesions.[2] Second, for patients undergoing large chest wall defects or pulmonary collapses, the stabilization of the chest wall defect may be indicated to restore the rigid chest wall, in order to prevent a physiologic flail chest.[3,6] However, radiation leads to chest wall stiffness and fibrosis; therefore, muscle flaps alone often provide enough stabilization for large irradiated defects without causing flail segments, which is what was observed in our patients.[2] Finally, vascularized tissue must be provided to cover a thoracic defect with healthy soft-tissue that is pedicled or free of muscle coverage. Pedicled muscular and musculocutaneous flaps of the latissimus dorsi are commonly used because they may provide a source of reliable, vascularized tissue that enhances the eradication of the infection and that allows for the complete filling of the defect and for the reconstruction the chest wall;[3,6,7] however, close attention should be directed to whether the vascular pedicle was included in the radiation field and, if so, whether the vessels are patent and what the quality of the soft tissue that is surrounding those vessels is. These considerations can affect the blood flow to the flap after reconstruction, even when the vessels are patent, via the kinking of the pedicle when it is rotated through the fibrotic tissue.[2] Therefore, a free musculocutaneous flap transfer is probably the last treatment option for radiation-induced damage of the chest wall.[8,9] We harvested a free vastus lateralis musculocutaneous flap from the thighs of the patients to completely reconstruct the chest wall defect. Compared with other free musculocutaneous flaps, such as rectus abdominis flaps and latissimus dorsi flaps, a vastus lateralis flap is easier, is safer to undergo elevation, can provide a large weight for reconstruction, and contains better nutrient vessels, while also minimizing the incidence of damage in the donor site.[9] The nutrient vessels were microvascularly anastomosed to the contralateral transverse carotid artery and vein as the recipient vessels, and the conducting of the anastomosis through a subcutaneous tunnel or a direct incision was easily accomplished and can obtain reasonable results.[11] The greater omentum was used, either alone or in combination, when a muscle flap could not be used.[10,11] However, the downsides of omental flaps are the need for a laparotomy (or a laparoscopic harvest), the risk of a symptomatic ventral hernia, and an inferior cosmetic result. In addition, the omentum may not provide sufficient coverage in very thin patients.[2] Biomaterials represent a valuable option in the management of patients with infected chest wall sites.[12]

In conclusion, it is crucial to not only completely resect the chest wall fistula and the surrounding diseased tissues but also reconstruct the chest wall. Therefore, a free vastus lateralis musculocutaneous flap transfer for a radiation-induced chest wall fistula combined with osteomyelitis is a useful option for treatment. Our results show that it is a feasible and efficient surgical procedure with promising results.

Author contributions

Investigation: Xia Hong, Xueming He.
Resources: Xia Hong, Xueming He.
Validation: Zhongliang He, Lifeng Shen.
Writing – original draft: Xia Hong.
Writing – review & editing: Zhongliang He, Lifeng Shen, Xueming He.

References

[1] Raz DJ, Clancy SL, Erhunmwunsee LJ. Surgical management of the radiated chest wall and its complications. Thorac Surg Clin 2017;27:171–9.
[2] Kim DY, Kim HY, Han YS, et al. Chest wall reconstruction with a lateral thoracic artery perforator propeller flap for a radiation ulcer on the anterior chest. J Plast Reconstr Aesthet Surg 2013;66:134–6.
[3] Mansour KA, Thourani VH, Losken A, et al. Chest wall resections and reconstruction: a 25-year experience. Ann Thorac Surg 2002;73:1720–6.
[4] Matros E, Disa JJ. Uncommon flaps for chest wall reconstruction. Semin Plast Surg 2011;25:55–9.
[5] Kim JH, Jenrow KA, Brown SL. Mechanisms of radiation-induced normal tissue toxicity and implications for future clinical trials. Radiat Oncol J 2014;32:103–15.
[6] Lu C, Feng Z, Ge D, et al. Pedicle muscle flap transposition for chronic empyema with persistent bronchopleural fistula: experience of a single clinical center in China. Surg Today 2016;46:1132–7.
[7] Netscher DT, Izaddoost S, Sandvall B. Complications, pitfalls, and outcomes after chest wall reconstruction. Semin Plast Surg 2011;25:86–97.
[8] Okuda M, Yokomise H, Muneuchi G, et al. Obliteration of empyema space by vascularized anterolateral thigh flaps. Ann Thorac Surg 2009;87:1615–6.
[9] He XW, He ZL, Shen L, et al. Free musculocutaneous flap transfer for refractory chronic empyema with chest wall sinus in a 43-year-old male with hemophilia A. J Thorac Dis 2018;10:E416–9.
[10] Horio H, Ohtsuka T, Kubota Y, et al. Large chest wall reconstruction using titanium micromesh and a pedicled latissimus dorsi musculocutaneous flap: report of a case. Surg Today 2005;35:73–5.
[11] Azoury SC, Grimm JC, Tuffaha SH, et al. Chest wall reconstruction: evolution over a decade and experience with a novel technique for complex defects. Ann Plast Surg 2016;76:231–7.
[12] Ong K, Ong CS, Chua YC, et al. The painless combination of anatomically contoured titanium plates and porcine dermal collagen patch for chest wall reconstruction. J Thorac Dis 2018;10:2890–7.