

Osteoradionecrosis of the Chest Wall

Chatchai Pruksapong, MD, PhD,
FRCST*
Chairat Burusapat, FRCST*
Kantang Satayasootorn, MD†

Summary: We present the case of a 48-year-old woman with a chronic ulcer with bony erosion over the right chest wall who had undergone adjuvant chemoradiotherapy for right breast cancer 18 years previously. Preoperative computed tomography revealed a large soft tissue ulcerative lesion with bony destruction of the anterolateral aspect of the right fifth and sixth ribs. Biopsy showed no evidence of recurrent malignancy. En bloc resection including the necrotic ulcer and partial resection of the fourth to sixth ribs was performed, resulting in a chest wall defect that exposed the right diaphragm and the right, middle, and lower lobes of the lung. Synthetic mesh was used to reconstruct the rib defect and prevent paradoxical respiration. A pedicle transverse rectus abdominis musculocutaneous flap was used for soft tissue and skin reconstruction. (*Plast Reconstr Surg Glob Open* 2020;8:e2665; doi: [10.1097/GOX.0000000000002665](https://doi.org/10.1097/GOX.0000000000002665); Published online 25 February 2020.)

BACKGROUND

Radiotherapy to the chest wall is most commonly performed in the treatment of primary or recurrent breast cancer. It may cause both early and late radiation tissue injury, primarily by reactive oxygen species-mediated damage to differentiated soft tissue, soft tissue progenitors, and vascular endothelial cells. These changes lead to fibrosis, an abnormal response to tissue injury, and tissue death.¹ Additionally, cytokines and chemokines released after irradiation perpetuate a chronic inflammatory response that can cause persistent tissue injury. Interleukin-1, interleukin-6, transforming growth factor- β 1, and tumor necrosis factor- α are well-known proinflammatory cytokines involved in local and systemic inflammatory reactions² and contribute to chronic inflammation and tissue damage observed after radiotherapy.³⁻⁵ Several studies have demonstrated the importance of such molecules in the development and progression of radiation-induced complications,⁶ including lung fibrosis,⁷ intestinal damage,⁸ and brain injury.⁹

At the other end of the spectrum of radiation-induced soft tissue injury are severe osteoradionecrosis and radiation-induced sarcoma.¹⁰ Osteoradionecrosis develops primarily in the mandible and rarely in other regions such as

the chest wall.¹¹ Osteoradionecrosis presents as ulceration and sometimes as extensive soft tissue changes. When left untreated, full-thickness necrosis and superimposed infection can develop. Soft tissue biopsy is recommended to rule out recurrent breast cancer and Marjolin's ulcer, as these may change the treatment approach with regard to determining the goals of surgery and the necessity for preoperative therapies. Similarly, it is recommended that radiation-induced sarcomas be examined by core needle biopsy to exclude recurrent breast cancer.

CASE REPORT

We present the case of a 48-year-old woman who had undergone modified radical mastectomy and adjuvant chemoradiotherapy for cancer in the left breast 18 years previously. An infective ulcer was noted at the right anterior chest wall (Fig. 1). She had no significant preoperative pain that needed to be controlled. Preoperative computed tomography revealed a large soft tissue ulcerative lesion with bony destruction of the anterolateral aspect of the right fifth and sixth ribs. Punch biopsy of the adjacent skin showed no evidence of carcinoma. The cardiothoracic surgeon team was consulted for rib resection with tumor removal. En bloc resection was performed including necrotic ulcer and partial resection of the fourth to sixth ribs, resulting in a 15 × 20 cm chest wall defect that exposed the right diaphragm and the right middle and lower lobes of the lung. A synthetic mesh (polypropylene meshes [90- μ m fiber]; Ethicon, New Jersey) was used for the reconstruction of the rib defect and the prevention of paradoxical respiration (Fig. 2). The left contralateral pedicle transverse rectus abdominis musculocutaneous (TRAM) flap was used for soft tissue and skin reconstruction. Patient-controlled analgesia with morphine was used for postoperative pain

From the *Division of Plastic and Reconstructive Surgery, Department of Surgery, Phramongkutklo Hospital and College of Medicine, Bangkok, Thailand and †Department of Pathology, Phramongkutklo Hospital and College of Medicine, Bangkok, Thailand.

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Fig. 1. Clinical presentation: chronic ulcerative wound in the right chest wall.



Fig. 3. Gross specimen.



Fig. 2. Synthetic mesh for chest wall reconstruction.



Fig. 4. One-year follow-up.

control for 4 days postoperatively before switching to oral analgesics such as non-steroidal anti-inflammatory drugs.

Gross examination showed that the specimen consisted of skin, subcutaneous tissue, and muscle attached to 3 segments of the ribs. The overlying skin showed large areas of radiation-induced changes with a large central ulcer. At the base of the ulcer, there was an exposed bony cortex of the ribs, which was covered by fibrinous exudate (Fig. 3).

Histopathologic examination revealed reactive squamous hyperplastic changes of the epidermis adjacent to the ulcer with extensive necrosis of the dermis and

subcutaneous fatty tissue and mild to moderate chronic inflammatory cell infiltrate. The base of the ulcer showed fibrin admixed with necrotic cellular debris and moderate infiltration of acute and chronic inflammatory cells. Sections of the ribs showed dense hyalinization and fibrosis with loss of marrow cells. The bony trabeculae were irregular and lacked osteocytes within the lacuna.

Both the donor and recipient sites healed well after reconstruction (Fig. 4). The patient had normal respiration and lung expansion. Spirometry was used to test lung

function 3 months postoperatively and showed normal findings. Supplementary oxygen was not required.

Our patient provided consent for use of the case and images for publication.

DISCUSSION

Breast cancer is the most common indication of chest wall irradiation. However, all tissues of the chest wall and mediastinum, including the skin, ribs, and pleurae, are subject to postradiation changes. Patients with osteoradionecrosis can present with diverse symptomatology, ranging from occult disease to deep ulcers and major bone destruction with soft tissue necrosis, months to years after radiotherapy.¹² Severe osteoradionecrosis of the ribs is extremely rare, with only few published case reports over the past 10 years.¹³ Our patient had severe soft tissue and bone necrosis that required rib resection.

Full-thickness chest wall resection with reconstruction is still one of the most challenging surgeries. The loss of effective chest wall rigidity can result in paradoxical respiration and lead to ineffective respiratory effort and respiratory embarrassment.

Osteoradionecrosis affects not only the bone but also the surrounding soft tissues. Due to the changes associated with previous radiotherapy, osteoradionecrosis should always be treated with radical debridement of the infected area, followed by flap reconstruction using the unaffected tissue. Then, the prognosis for the patient is good. In this case, the reconstruction goals were not only function and wound coverage but also esthetic breast reconstruction.

TRAM flap is the most widely used and reliable flap for postoncologic mastectomy reconstruction, which provides enough soft tissue for reconstruction.¹⁴ The latissimus dorsi flap with implant or deep inferior epigastric perforator flap may be good options as well especially in cases where superior epigastric vessels are unavailable. The risk of herniation or paradoxical breathing is particularly high if the defect location is the anterolateral chest wall and the resection of >3–4 ribs is required.¹⁵ In such cases, the patient can be prone to respiratory problems if stability is not adequate. SA surgical mesh was used to stabilize the rib defect and prevent paradoxical respiration.^{16,17}

Implant-based reconstruction, which is another alternative for breast reconstruction, would not have been suitable in this case because we used mesh as an alloplastic material. Using alloplastic materials in the long term could increase the chances for an infection. In this case, we used the TRAM flap rather than latissimus dorsi flap because it might be difficult to move the patient into the lateral decubitus position after chest wall reconstruction.

We followed the patient for 1 year postoperatively. The patient had good clinical outcomes: the lung function test showed normal findings and the skin flap had good contour.

The diagnosis of osteoradionecrosis would require a supportive clinical setting to test for radiologic changes in the bone, supported by histologic examination to confirm that the bone is devitalized, and to confirm that the tumor has not recurred. Therefore, the gross examination and microscopic findings of soft tissue and bone changes are consistent with osteonecrosis and reveal osteoradionecrosis.

CONCLUSIONS

Reconstruction of the chest wall defect (3 ribs and soft tissue) after en bloc excision for osteoradionecrosis using polypropylene meshes and contralateral pedicle TRAM flap provides a good long-term outcome with both functional and esthetic results. With the reconstruction that the patient underwent, the prognosis is promising.

Chatchai Pruksapong, MD, PhD, FRCST

Division of Plastic and Reconstructive Surgery

Department of Surgery

Phramongkutklao Hospital and College of Medicine

Bangkok, Thailand

E-mail: cpuksapong@hotmail.com

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