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Multidisciplinary approach to treatment of radiation-induced chest wall sarcoma

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Abstract

Radiation-induced sarcoma (RIS) is a rare complication following therapeutic external irradiation for lung cancer patients. Patients with RIS may develop recurrence or metastasis of the previous disease and also at high risk for early chest wall complications following operation, which requires close follow-up and multidisciplinary approach. We present a challenging case of RIS with a multidisciplinary teamwork in the decision-making and successful management.

Keywords

Chest wall reconstruction; Radiation-induced sarcoma; Multidisciplinary

Introduction

Radiation-induced sarcoma (RIS) is a known rare complication in patients undergoing therapeutic external irradiation, with an estimated incidence of 0.03–0.08 % [1, 2]. There have been few cases reported of development of RIS of the chest wall referable to radiation

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for lung cancer [3]. RIS usually results from treatment of breast cancer or Hodgkin's disease [1, 2], with more rare occurrence following therapeutic external irradiation for lung cancer [3]. We present a case of chest wall RIS with challenges managed by a multidisciplinary approach.

Case report

The patient is a 53-year-old man with a history of non-small cell lung cancer (NSCLC) who underwent right upper lobectomy 5 years prior. Pathology at that time revealed a 1.5-cm squamous cell carcinoma with negative surgical margins, 1 of 7 hilar nodes, and a solitary 2R lymph node positive for disease (T1N2M0, Stage IIIA NSCLC). He received adjuvant radiation therapy (RT) and adjuvant chemotherapy. The RT was given anteroposterior for 4400 cGy over 29 days followed by left anterior oblique for 2600 cGy over 16 days, with all treatments completed as planned for a total of 70 Gy.

The patient began to experience right upper back pain approximately 4 years later. Computed tomography (CT) revealed a $6.8 \times 5.2 \times 3.8$ cm soft-tissue mass with rib destruction (Fig. 1a). CT-guided biopsy revealed a poorly differentiated sarcomatoid neoplasm favoring radiation-induced undifferentiated pleomorphic sarcoma.

After consideration in multidisciplinary sarcoma clinic, the decision was made to achieve local control of the RIS with neoadjuvant external beam radiation followed by surgical excision. Given the 5-year interval since the patient's prior external beam radiation for NSCLC, it was determined that the patient would tolerate this approach without injury to the spinal cord. The patient received 45 Gy in 25 fractions targeted to the mass and presented for surgical resection 6 weeks later.

An incision was made between the spine and the scapula overlying the location of the mass. The mass was most readily palpable at the posterior portion of the 5th rib. Resection of the involved portions of ribs 3–6 was then undertaken, achieving negative soft-tissue margins circumferentially. Reconstruction of the chest wall was not performed as the fibrotic lung underneath the chest wall resection was determined not be at risk for herniation whereas prosthetic material would represent a risk for infection.

Final pathologic analysis demonstrated a high-grade undifferentiated pleomorphic sarcoma, with all margins free of tumor. Mitotic rate was 22 per 10 high power fields with presence of 5 % necrosis in the specimen. The resected mass measured $4.5 \times 4.5 \times 1.7$ cm with an estimated 80 % treatment effect. Postoperatively the patient experienced poor wound healing and ultimately dehiscence of his surgical incision. This was managed in the outpatient setting for over a year with local wound debridements and gauze packing. During this time, surveillance imaging revealed the presence of multiple bilateral pulmonary nodules suspicious for metastatic disease. The patient was treated with 5 cycles of single-agent doxorubicin. Surveillance imaging revealed resolution of the bilateral lung nodules and no evidence of disease. As such, attention was turned to further management of the patient's chest wall defect (Fig. 1b).

The surgical wound dehiscence left the patient with a 10 cm × 4 cm × 11 cm wound of his right upper back. The wound consisted of a bed of thick granulation tissue and was surrounded by radiated skin and soft-tissue (Fig. 1c, d). In order to bring viable tissue into the radiated wound, a free flap was planned using the contralateral latissimus dorsi.

Intraoperatively, a 35-cm saphenous vein graft was harvested and anastomosed to the ipsilateral external jugular vein and external carotid artery. The arteriovenous loop was then tunneled posteriorly into the defect in preparation for a microsurgical anastomosis. A myocutaneous latissimus dorsi free flap was harvested from the contralateral (left) back and anastomosed to the saphenous vein graft in the right chest (Fig. 2a, b). The bulk of the flap was used to fill the depth of the cavity, and the skin paddle was inset into the defect (Fig. 2c).

The recovery was complicated by a postoperative hematoma requiring a washout, and seroma requiring aspiration, but has gone on to heal completely (Fig. 2d).

The patient is presently alive and of excellent functional status without evidence of recurrent disease at 1 year.

Comment

Patients receiving RT for treatment of breast cancer, Hodgkin's disease, and lung cancer are at risk for developing RIS of the chest wall. A minimum dose of 10–16 Gy is postulated to be necessary to induce RIS [2]. The interval between radiation exposure and the development of the tumor is approximately 10–14 years [1, 3]. This demonstrates the need for a protracted period of survival after radiotherapy, which is not commonly possible for advanced stage lung cancer patients, explaining the published RIS cases being extremely rare [1].

The most common symptoms are pain and changes in the appearance and developing mass lesion in the previously irradiated area [2]. Imaging studies (including CT and/or magnetic resonance imaging) are mandatory to clarify the extension of the tumor and any infiltration of adjacent tissue and organs [3]. The diagnosis may be confirmed by needle biopsy as incisional biopsy has a potential of tumor dissemination [3]. RIS is known to have a very poor prognosis and radical resection with wide tumor-free margins remains the only proven treatment for a long survival and potential cure [1, 3]. The role for chemotherapy is not clear however radiotherapy is known to be additive to the outcomes [1, 3].

Recurrence or metastasis of the previous disease and the RIS may occur, which requires close follow-up and multidisciplinary management. Wound healing complications are common in this patient population. Strategies to minimize these complications, including hyperbaric oxygen therapy and/or the recruitment of non-irradiated tissues into the wound bed, should be strongly considered [4]. Their use in our patient could have potentially prevented our complication and should have been employed. Unfortunately, our wound dehiscence left our patient with a large lesion that required a complex surgical approach due to poor wound quality, radiation changes, and a lack of regional options. The size and depth of the wound limited options to large muscle flaps. Regional options sometimes employed in

these situations, such as an ipsilateral latissimus dorsi flap or a scapular flap, were not options due to prior operations. Radiation changes extended into the axilla towards the thoracodorsal artery, limiting its use in the reconstruction. A contralateral latissimus dorsi free flap with a skin paddle was chosen for its bulk and pedicle length [5]. However, the pedicle would not reach an anastomosis outside of the radiation field. A temporary arteriovenous loop was created in the neck with a saphenous vein graft and used to lengthen the pedicle of the latissimus flap [6, 7]. This allowed for a proper inset and ultimate healing of a chronically debilitating wound.

The present case represents an example of multidisciplinary teamwork (thoracic surgery, medical oncology, radiation oncology, plastic and reconstructive surgery) in the decision-making and management of a RIS. Long-term results with more patient outcomes will be additive.

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Fig. 1.

a Axial computed tomography image of sarcomatous lesion (*arrow*) of the posterior right chest wall mass with osseous destruction of the posterior fourth rib, and local metastasis to the posterior fifth rib. **b** Axial computed tomography image (*arrow*) and **c, d** preoperative photograph showing large posterior chest wall defect prior to chest wall reconstruction. Note the broad radiation changes to the surrounding skin

Fig. 2.

a Preoperative markings showing the edges of the latissimus and the proposed skin paddle. **b** Intraoperative picture of free latissimus flap filling defect, before *inset* and **c** after *inset*. **d** Eight weeks postoperatively, the flap is well-healed