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**Magnetic resonance imaging findings of radiation-induced breast angiosarcoma: A case report**

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**Abstract**

**BACKGROUND**

Breast conservation surgery (BCS) with adjuvant radiotherapy has become a gold standard in the treatment of early-stage breast cancer, significantly reducing the risk of tumor recurrence. However, this treatment is associated with adverse effects, including the rare but aggressive radiation-induced angiosarcoma (RIAS). Despite its rarity and nonspecific initial presentation, RIAS presents a challenging diagnosis, emphasizing the importance of imaging techniques for early detection and accurate diagnosis.

**CASE SUMMARY**

We present a case of a 48-year-old post-menopausal woman who developed skin ecchymosis on the right breast seven years after receiving BCS and adjuvant radiotherapy for breast cancer. Initial mammography and ultrasound were inconclusive, showing post-treatment changes but failing to identify the underlying angiosarcoma. Contrast-enhanced breast magnetic resonance imaging (MRI) revealed diffuse skin thickening and nodularity with distinctive enhancement kinetics, leading to the diagnosis of RIAS. This case highlights the crucial role of MRI in diagnosing and determining the extent of RIAS, facilitating timely and appropriate surgical intervention.

**CONCLUSION**

Breast MRI is crucial for detecting RIAS, especially when mammography and ultrasound are inconclusive.

## **INTRODUCTION**

Breast conservation surgery (BCS) with adjuvant radiotherapy is becoming the gold standard treatment for patients with early breast cancer (stage I and II) over the decades<sup>[1-3]</sup>. The use of radiotherapy reduces the chance of tumor recurrence and subsequent morbidity and mortality<sup>[4,5]</sup>. However, the adverse cutaneous effects of radiotherapy include early and late reactions, including erythema, hyperpigmentation, telangiectasia, chronic radiation dermatitis and radiation-induced fibrosis<sup>[6]</sup>. However, radiotherapy has been associated with development of secondary soft-tissue sarcomas, with angiosarcoma emerging as the most common subtype, so called radiation-induced angiosarcoma (RIAS)<sup>[7-9]</sup>. RIAS is a rare and aggressive complication of radiation therapy. In patients undergoing BCS and adjuvant radiotherapy, the estimated incidence of RIAS is 0.05%–0.3%<sup>[10]</sup>.

Mammography and ultrasound are reported to show mostly post-treatment changes, whereas contrast-enhanced breast magnetic resonance imaging (MRI) has been reported to be more sensitive in detecting skin enhancement of RIAS.

In this case report, we present the clinical course and MRI findings in a patient with RIAS presenting 7 years after treatment of breast cancer.

## **CASE PRESENTATION**

### ***Chief complaints***

A 48-year-old post-menopausal woman presented with skin ecchymosis on her right breast, which had developed several months earlier.

### ***History of present illness***

The patient noticed a non-painful skin ecchymosis around the previous surgical scar on her right breast, which had been enlarging over the past several months (Figure 1).

### ***History of past illness***

Seven years ago, the patient underwent BCS for breast cancer on the right breast, followed by adjuvant radiotherapy. The pathology of the tumor showed a 0.6 cm dimension, classified as ypT1bN0M0. Axillary lymph node dissection was performed with no tumor found in the lymph nodes. The patient received a total radiotherapy dose of 60 Gy over 30 fractions and was on Tamoxifen 20 mg daily for 5 years. Follow-up examinations showed no clinical evidence of recurrent tumor or upper-extremity lymphedema.

6

### ***Personal and family history***

The patient had no relevant personal or family history of breast cancer or other genetic disorders.

### ***Physical examination***

Physical examination revealed a non-painful skin ecchymosis around the surgical scar on the right breast.

### ***Laboratory examinations***

The patient had no specific laboratory examinations in relation to the diagnosis of the condition.

### ***Imaging examinations***

Mammography (Figure 2A) and ultrasound (Figure 2B) showed negative results for recurrent breast carcinoma but indicated post-operative changes such as skin thickening. Despite these findings, the clinician suspected the condition could be either a breast hematoma or recurrent breast carcinoma. For the problem solving, contrast-enhanced

breast MRI (Figure 3A-F) was performed and revealed diffuse skin thickening and nodularity, which showed hyperintensity on T2-weighted images and isointensity on T1-weighted images, with fast arterial enhancement on post-contrast dynamic series. The enhancement kinetics of cutaneous lesion shows rapid wash-in and wash-out (type 3 curve)<sup>[11]</sup>. No discrete intraparenchymal masses were present. Consequently, a diagnosis of radiation-induced angiosarcoma of breast or local tumor recurrence was made.

### **FINAL DIAGNOSIS**

The final diagnosis was radiation-induced angiosarcoma of the breast, confirmed by excision biopsy findings.

### **TREATMENT**

Given the MRI findings indicative of diffuse involvement of the right breast with angiosarcoma and the natural course of the disease, the patient elected to undergo right simple mastectomy. The timeline of this case report was illustrated as Figure 4.

### **OUTCOME AND FOLLOW-UP**

The mastectomy procedure was successful, with a gross examination revealing an irregular firm tumor measuring 12.1 cm in the greatest dimension. All margins were tumor-free. There was no mention of distant metastases on subsequent positron emission tomography/computed tomography scans. No recurrence or metastases observed during follow-up.

### **DISCUSSION**

Angiosarcoma of the breast is a rare, highly aggressive malignant tumor of the vascular endothelium by the World Health Organization<sup>[12]</sup>. It accounts for 0.05% of all reported breast cancers, making them the rarest in that category<sup>[7,13,14]</sup>. It can be either primary or secondary. Primary angiosarcoma occurs in young women, with a median age of onset

of 40 years. Secondary angiosarcoma occurs in older women with a history of BCS and radiotherapy<sup>[15]</sup>, or chronic lymphedema, so called Stewart-Treves angiosarcomas<sup>[16]</sup>.

<sup>2</sup> The clinical differential diagnosis of angiosarcoma may include recurrent breast carcinoma, radiation-related morphea, and malignant melanoma. Results of mammography and ultrasound <sup>2</sup> are not diagnostic for angiosarcoma and are typically negative in early disease. Clinical suspicion is the key to making an early diagnosis. Diagnosis prior to surgery, either by core needle biopsy or fine needle aspiration, is difficult. Chen *et al*<sup>[17]</sup> reported that a false negative result of core needle biopsy can achieve 37%. In this situation, <sup>2</sup> a full-thickness incisional or excisional biopsy is required to ensure adequate sampling of the lesion.

Because the rarity and seeming harmless presentation, physicians and patients may frequently neglect initial symptoms and clinical findings with consequent diagnostic delay<sup>[18-20]</sup>. Chikarmane *et al*<sup>[21]</sup> reported that over half of the patients with RIAS have skin thickenings with post-radiation and lumpectomy changes on mammogram and ultrasound. Only one-quarter of RIAS were observed to involve intraparenchymal regions, presenting as irregular masses. Due to post-radiation alterations such as skin thickening, identifying predominantly cutaneous lesions on mammography and ultrasound may pose particular challenges..

<sup>1</sup> The important role of breast MRI plays in the diagnosis and determination of disease extent. Salminen *et al*<sup>[7]</sup> reported that the spectrum of RIAS imaging findings was broad, but the majority of patients (63%) <sup>3</sup> had enhancing skin thickening or discrete plaque-like enhancing in the skin. In our case, the cutaneous lesion demonstrated rapid arterial enhancement and washout on the dynamic series. Associated diffuse skin thickenings <sup>10</sup> were hyperintense on T2-weighted images and isointense on T1-weighted images. Sanders *et al*<sup>[22]</sup> hypothesized in his study <sup>1</sup> that the T2 hyperintense skin thickening with persistent enhancement could be related to post-radiation inflammatory changes, and foci with rapid early arterial enhancement and washout could represent tumor foci. Our case has the same findings on the breast MRI. In the patient with RIAS, contrast-enhanced

breast MRI study could have important diagnostic potential to evaluate the true extent of disease.

We present this case to emphasize that, due to the nonspecific findings on mammography or ultrasound, breast MRI offers superior morphological characterization and assessment of disease extent. This is crucial for surgical planning and avoiding diagnostic delays. If an enhancing cutaneous lesion is detected on contrast-enhanced breast MRI at a postoperative and irradiated site, clinicians should consider the possibility of cutaneous angiosarcoma.

### **CONCLUSION**

This case emphasizes the importance of considering radiation-induced angiosarcoma in patients presenting with skin changes post-radiotherapy for breast cancer. MRI plays a critical role in diagnosing and assessing the extent of the disease, especially when other imaging modalities are inconclusive. Early diagnosis and appropriate surgical intervention are crucial for managing this rare but aggressive complication.

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SIMILARITY INDEX

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