CASE REPORT

Unusual complications after MammoSite brachytherapy: out-of-field rib fracture and Mondor’s disease

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Abstract
Recent reports have documented in-field rib fractures as a rare complication of accelerated partial breast irradiation. Here, we report a case of an out-of-field rib fracture, with a maximum point dose of <50% of the prescribed dose, and Mondor’s disease in a 61-year-old woman after MammoSite brachytherapy. This is the first case in the literature in which rib fractures occurred out-of-field, without trauma or risk factors. It also highlights a rare clinical entity, Mondor’s disease, of which its recognition is important for radiation oncologists given its potential for tumor recurrence.

KEYWORDS
brachytherapy, breast neoplasms, radiation oncology

INTRODUCTION

Tumor recurrence after breast-conserving therapy with whole breast irradiation for early-stage breast cancer tends to occur at or near the lumpectomy bed. As a result, accelerated partial breast irradiation (APBI) has become an alternative to whole breast irradiation. Different delivery techniques have been developed for APBI, although balloon-based delivery (i.e. MammoSite) remains a popular option. With increasing advancements in these different APBI techniques, knowledge of late toxicities and optimum planning constraints also continues to evolve.2

Although there have been recommended skin constraints, the consensus on chest wall constraints remains unsettled. Recent reports have documented chest wall toxicity as a rare complication of APBI in the context of a high maximum point dose (D_{max}). In contrast, a D_{max} of less than or equal to the prescribed dose (PD) was found to be safe from the occurrence of rib fractures.6,7

Here, we reported the first case of an out-of-field rib fracture, with a D_{max} of <50% of the PD, and Mondor’s disease in a 61-year-old woman after MammoSite brachytherapy.

CASE PRESENTATION

A 61-year-old woman with a history of inactive sarcoidosis and hypothyroidism was diagnosed with a 6-mm, hormone-positive, grade 2 ductal carcinoma in situ. She declined endocrine therapy and opted to undergo lumpectomy as part of a phase II APBI trial.8 After lumpectomy, a single-lumen MammoSite device (Hologic, Bedford, MA, USA) was placed intraoperatively, and the balloon was inflated to 40 cc with saline. APBI was then administered at 34 Gy in 10 fractions, twice daily, >6 h apart, using a multiple dwell radiation plan.

Apart from grade 2 radiation dermatitis, she tolerated the treatment well. However, at 26 months post-APBI, she noted a popping sound while extending her arm, followed by left lateral wall crepitus and pain. Chest radiography confirmed fractures of the left anterior ribs 4–6. There was no history of osteopenia/osteoporosis or recent trauma, and laboratory work-up (complete blood count, myeloma screen, serum calcium, vitamin D, and thyroid-stimulating hormone) were unremarkable. Dosimetric evaluation (Eclipse, Palo Alto, CA, USA) confirmed that ribs 4 and 5 received substantial radiation doses, with a D_{max} > 150% of the PD (Table 1), whereas rib 6 was spared, receiving 47% of the PD.
TABLE 1  Dosimetric analysis of individually contoured ribs

| Rib number | $D_{\text{max}}$ (cGy), PD (%) | $D_{\text{1cc}}$ (cGy) | Rib-to-balloon distance |
|------------|-------------------------------|------------------------|------------------------|
| 3†         | 2090, 61%                     | 1334                   | –                      |
| 4          | 6415, 189%                    | 4306                   | 3.7 mm                 |
| 5          | 5824, 171%                    | 3214                   | –                      |
| 6          | 1593, 47%                     | 1279                   | –                      |

†Rib 3 was unaffected and included for comparison with rib 6. $D_{\text{1cc}}$, minimal dose received by the highest irradiated volume of 1cc; $D_{\text{max}}$, maximum point dose; PD, prescribed dose.

FIGURE 1  Axial computed tomography scan showing the close proximity of the MammoSite balloon to rib 4 (marked with *)

(Table 1). The balloon was nearest to rib 4 (Figure 1), with a balloon-to-rib measurement of 3.7 mm (Table 1).

The patient’s recovery course was further complicated by sclerosing thrombophlebitis of the lateral thoracic vein (Figure 2), which was diagnosed as Mondor’s disease and managed conservatively to regression. She remained disease-free and was doing well at 6.5 years follow-up.

FIGURE 2  Superficial thrombophlebitis of the left lateral thoracic vein (Mondor’s disease)

3 | DISCUSSION

Chest wall toxicity, defined as rib fracture and/or chest wall pain, is a rare late complication of WBI (incidence 0.9%). As chest wall toxicity has been associated with dose rate and dose per fraction, APBI may increase the risk of occurrence among breast cancer patients.

Brashears et al. described the first known cases of spontaneous rib fractures after MammoSite brachytherapy, reporting an incidence of 2.8%.

Although guidelines for intracavitary brachytherapy per NSABP B-39/RTOG 04–13 do not include chest wall/rib constraints, a skin-to-balloon distance > 7 mm is usually preferred. With the emphasis on skin constraints, clinicians may also favor balloon-based brachytherapy in women with more posterior lesions, where the chest wall dose becomes more concerning.

Given the growing awareness of chest wall toxicity as a late complication of MammoSite brachytherapy, chest wall/rib parameters have been commonly reported, although the specific parameters and thresholds are not well-defined. For external beam radiation, rib constraints have traditionally been volumetric, using tolerance doses associated with a 5% risk within 5 years ($TD_{5/5}$) and a 50% risk within 5 years ($TD_{50/5}$). In this regard, a fracture is more likely to occur when the TD encompasses >33% of an individual rib. In the three patient cases reported by Brashears et al., the five fractures showed $V_{37}$ Gy and $V_{44}$ Gy ($TD_{5/5}$ and $TD_{50/5}$ adjusted for 10 fractions, respectively) at 13.5% and 3.3%, respectively, which were well below the 33% constraint. They also proposed that given the unique properties of brachytherapy, the maximum dose (D $D_{\text{max}}$) may be a more important parameter than volume irradiation. Thus, most studies have reported rib $D_{\text{max}}$ as a chest wall/rib parameter, with some measuring the balloon-to-rib distance as well. From these data, a $D_{\text{max}}$ of 120–125% of the PD has been proposed, wherein the preferred $D_{\text{max}}$ should be as low as 100%.

Thus, although it was unsurprising that ribs 4 and 5 were fractured in this case report, the finding of rib 6 was unexpected. The patient had no known risk factors, such as primary or secondary osteoporosis. Although sarcoidosis can involve bones in up to 13% of patients, it rarely affects the axial skeleton. Although hypo- and hyperthyroidism can increase fracture risk, the patient was euthyroid on synthroid. Given that her medical history was unremarkable, we speculated whether the rib 6 fracture was secondary to mechanical instability from the neighboring fractures.

In addition to the out-of-field rib fracture, the patient developed Mondor’s disease, a sclerosing superficial thrombophlebitis of the anterior chest wall (most commonly the lateral thoracic, superior epigastric, or thoracoepigastric vein). Although it is primarily idiopathic in etiology, the disease has been linked to inflammatory/hypercoagulable processes, including traumas, surgeries, infections, and local cancers.

Radiation-induced Mondor’s disease, in particular, has rarely been reported, with only one documented case to date. Furthermore, as Mondor’s disease has been associated with cancer, failure to spontaneously regress may warrant further work-up for breast cancer.
Thus, it is important for radiation oncologists to be aware of this condition. In this case report, the patient’s condition was likely secondary to breast surgery or radiation treatment.

4 | CONCLUSION

Although radiation-associated rib fractures have been reported, this is the first case in the literature wherein an out-of-field rib fracture occurred, without apparent risk factors or trauma. Mondor’s disease is an entity unknown to most radiation oncologists, although it can be associated with surgery, radiation, or breast cancer. Thus, radiation oncologists should recognize this condition.

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