Medical Dosimetry ■■ (2017) ■■–■■

Medical Dosimetry

journal homepage: www.meddos.org

Clinical Radiation Oncology Contribution:

Multi-isocenter hybrid electron and rapid arc photon treatment for reirradiation of extensive recurrent inflammatory breast cancer

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ARTICLE INFO

Article history:
Received 30 March 2017
Received in revised form 7 June 2017
Accepted 10 July 2017

Keywords:
Hybrid electron
Rapid arc
IMRT
Reirradiation
Inflammatory

ABSTRACT

Delivering an adequate and homogenous dose to a large volume of recurrent cutaneous disease can be challenging even with modern techniques. Here, the authors describe a 3-isocenter hybrid electron and rapid arc photon radiation treatment plan to provide optimal tumor coverage to an extensive recurrence of inflammatory breast carcinoma. This approach allowed for homogeneous treatment of a large volume while effectively modulating dose to previously irradiated tissue and minimizing dose to the underlying heart, lungs and brachial plexus.

Introduction

Inflammatory breast cancer (IBC) is a rare entity that confers a poor prognosis with a high locoregional recurrence rate.[1-3] Reirradiation of the chest wall for recurrent breast cancer can be performed safely with standard or hyperfractionated treatments.[4] Delivering an adequate and homogenous dose to a large volume of recurrent disease can be challenging even with modern techniques. Here, we describe a 3-isocenter hybrid electron and rapid arc photon radiation treatment plan to provide optimal tumor coverage to an extensive recurrence of IBC.

Case Report

Initial diagnosis and treatment

At age 50, the patient presented with progressive erythema and swelling of the left breast that was unresponsive to antibiotics. Ultrasound showed a left upper outer quadrant nodule, and biopsy revealed grade III, triple-negative, breast carcinoma, with clinical findings consistent with IBC. Positron emission tomography-computed tomography showed 5 hypermetabolic lymph nodes in the left axilla measuring up to 1.3 cm and no distant disease. The clinical stage was T4d, N1, M0. Treatment was initiated at an outside institution where she received neoadjuvant chemotherapy with 6 cycles of dose-dense doxorubicin and cyclophosphamide followed by 12 weekly cycles of paclitaxel. She then underwent bilateral mastectomy with left sentinel lymph node biopsy (4 nodes removed) and tissue expander placement.

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http://dx.doi.org/10.1016/j.meddos.2017.07.006

Pathology showed extensive dermal lymphovascular invasion by tumor without residual tumor in the breast or lymph nodes (ypT0N0).

The initial course of radiation commenced 6 weeks postoperatively. The chest wall and regional lymph nodes were treated to a cumulative dose of 5040 cGy in 28 fractions using 6-MV photon fields for the chest wall tangent and supraclavicular fields and an 18-MV photon boost for a posterior axillary field. Bolus of 1 cm was applied every other day. A boost of 1000 cGy in 5 fractions was delivered to the scar and drain sites using 12 and 16-MeV electron fields. The treatment was interrupted by 3 weeks after 18 treatments (3240 cGy) because of infection of the left breast expander requiring removal.

Within 1 month of completing radiotherapy, she developed contralateral erythema and skin breakdown over the medial right chest wall. A punch biopsy confirmed recurrent disease. Chemotherapy with carboplatin and paclitaxel was initiated, but thrombocytopenia resulted in multiple delays. The skin erythema spread to involve the left chest wall with further skin breakdown necessitating debridement and negative-pressure wound therapy. The disease subsequently spread ipsilaterally to the left midaxillary line, superiorly to 4 cm above the clavicular head, contralaterally to the right anterior axillary line and inferiorly into the right upper abdominal wall to 3 cm above the umbilicus (Fig. 1A and 2A).

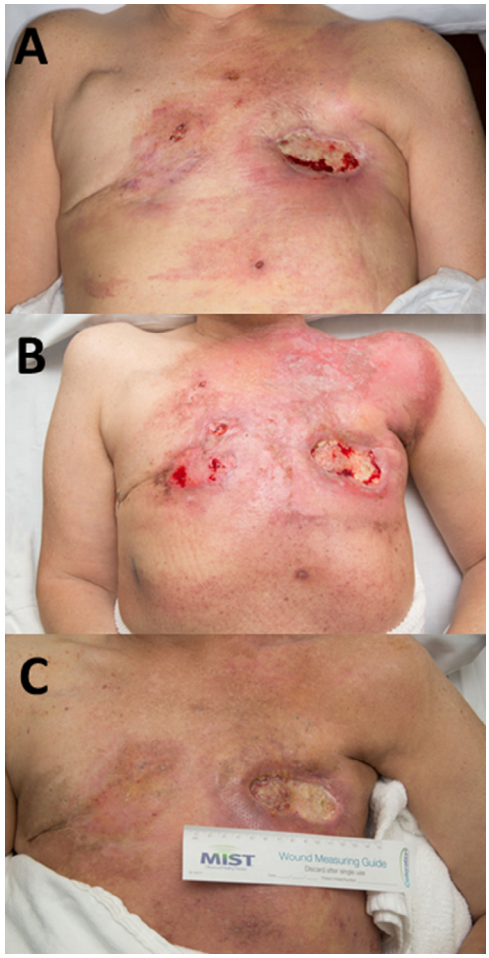

Fig. 1. Extensive recurrence of inflammatory breast carcinoma shown before initiation of reirradiation (A), after completion of treatment (B), and 1 month following completion of treatment (C).

Treatment of recurrence

A repeat course of radiotherapy was pursued for palliation of the wounds and to slow progression of disease after a restaging positron emission tomography-computed tomography showed no distant metastases. Concurrent capecitabine was planned but ultimately held for the duration of radiotherapy because of thrombocytopenia. For simulation, a wire was used to mark a region approximately 1.5-2.0 cm beyond clinically visible disease and the patient underwent CT scanning in an arms-up, head-first supine orientation. The clinical target volume extended to the wires and was expanded by 0.3 cm to create the planning target volume (PTV). The goal was to deliver 5000 cGy in 25 fractions to the large area of recurrent disease. Bolus of 1-cm thickness was used daily to ensure full dose to the skin. Because of the large span of the PTV and desire to modulate dose around the previously irradiated brachial plexus, 3D conformal and/or electron-based plans were not adequate. For the hybrid intensity-modulated radiation therapy (IMRT)-electron plan, a 15×15 cm 9-MeV electron field was used to encompass the area immediately anterior to the heart and lungs (Fig. 3A and B). To keep the junctions feathered and avoid a hard match with the arc fields, a 115-cm source-to-surface distance was used without a block. The isocenters for 6-MV photon arc fields were placed at the edge of the electron fields on each side and were aligned to the center of the PTV in the superior-inferior direction (Fig. 3C and D). Both isocenters were optimized on the same plan, using the electron plan as a base plan, which helped maintain normal tissue objectives and smooth junctions between photon and electron fields. After the plan was created, the isocenters were separated into their own plans and a plan summary (Fig. 4) was used for reporting purposes. All isocenters were imaged with kilovoltage imaging followed by cone-beam CT centered on the left side to match the PTV. A single setup was used from which shifts were made to each isocenter. Coverage of the PTV was excellent, with a D90% of 97% and D95% of 95% for the PTV5000. Comparing IMRT alone with the hybrid plan, the mean heart dose improved slightly from 657 to 632 cGy, total lung V20 decreased from 25% to 16%, total lung V5 decreased from 95% to 70% and maximal brachial plexus dose declined slightly from 1528 cGy to 1403 cGy. Following completion, a boost of 1000 cGy in 5 fractions was delivered to the upper abdominal extent of disease outside