Radiotherapy and Oncology 110 (2014) 477–481

Contents lists available at ScienceDirect

Radiotherapy and Oncology

journal homepage: www.thegreenjournal.com

Breast cancer radiotherapy

Whole breast radiotherapy in the lateral decubitus position: A dosimetric and clinical solution to decrease the doses to the organs at risk (OAR) ☆

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ARTICLE INFO

Article history:
Received 25 June 2013
Received in revised form 27 September 2013
Accepted 19 October 2013
Available online 13 December 2013

Keywords:
Radiotherapy
Breast cancer
Lateral decubitus position
Dosimetry

ABSTRACT

Purpose: To evaluate whole breast 3D-conformal radiotherapy (RT) delivered in the lateral decubitus position (isocentric lateral decubitus [ILD]) and to report the acute toxicity of a series of consecutive patients treated with ILD.

Materials and methods: From January to December 2010, 56 consecutive patients with large breasts and early-stage breast cancer treated by breast conserving surgery underwent 3D-conformal whole breast RT in the lateral decubitus position. A dose of 50 Gy in 25 fractions via two opposed isocentric beams was prescribed to whole breast, with or without a 16 Gy photon tumor bed boost. Dosimetry of all patients was reviewed, and the acute toxicity of treatment, evaluated weekly using the NCI CTC v3.0 scale, was analyzed.

Results: Median age was 57 years (range: 33–71). 85% of patients had a breast circumference of at least 95 cm and 80% had at least a C cup size. Average breast volume was 991 cm^3 (range: 225–2791 cm^3). Median dose to the breast was 50 Gy, while median dose to the tumor bed was 16 Gy. Grade 1, 2 and 3 dermatitis developed in 37.5%, 58.9% and 1.8% of patients, respectively. From a dosimetric point of view, doses to the ipsilateral lung were extremely low: average V_{1Gy}, V_{2Gy} and V_{5Gy} were 26.6%, 9.3% and 0.7%, respectively. Average mean lung dose was 0.96 Gy. For the 26 patients with left-sided tumors, heart doses were also extremely low: average V_{1Gy}, V_{2Gy} and V_{5Gy} were 58.8%, 14.2% and 0.7%, respectively. Average mean heart dose was 1.35 Gy.

Conclusion: Whole breast radiotherapy in the lateral decubitus position for patients with large breasts and early-stage breast cancer provides an excellent dosimetric profile, with low doses to the heart and ipsilateral lung. It is also very well tolerated, with a good acute toxicity profile.

Breast conserving surgery followed by whole breast radiotherapy (RT) is the standard of care in early-stage breast cancer [1,2]. However, treatment-related morbidity affects most patients treated for early-stage breast cancer. Toxicity can affect the breast, either acutely, in the form of dermatitis, or long-term, with increased fibrosis and skin changes [3]. Other long-term side effects include secondary malignancies [4], cardiac morbidity and mortality [4], and pneumonitis and lung fibrosis [5].

While good local control can be obtained by breast conserving therapy, consisting of segmental mastectomy and whole breast RT, long-term toxicity is still considered problematic in this disease with excellent survival rates. The use of newer techniques for breast radiotherapy was motivated by the desire to improve dose distributions and to reduce treatment-related morbidity. This includes 3D-CRT, with the possibility of better protecting the heart and ipsilateral lung; IMRT, which has improved dose homogeneity and been shown to reduce acute side effects of RT [6]; helical tomotherapy, which has been shown to improve dosimetry of loco-regional RT [7]. Other delivery techniques, such as brachytherapy, have been studied with the aim of reducing toxicity [8]. Finally, alternate patient positioning has also been explored as a means to improve dose homogeneity and to decrease exposure of organs-at risk (OARs): treatment in the prone or in the lateral decubitus positions (isocentric lateral decubitus [ILD]) [9–13].

Treatment in the prone position has been extensively studied and reported. Treatment in the lateral decubitus position was first described and shown to be feasible in 1989 [9]. Since then, it has been adapted and adopted for whole breast radiotherapy of patients with large and ptotic breasts at our institution [10,11]. We have previously shown that this technique provides adequate local

☆ A part of this work was presented as poster at ASTRO, October 2–6, 2011, in Miami, USA.

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0167-8140/$ - see front matter © 2013 Elsevier Ireland Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.radonc.2013.10.038

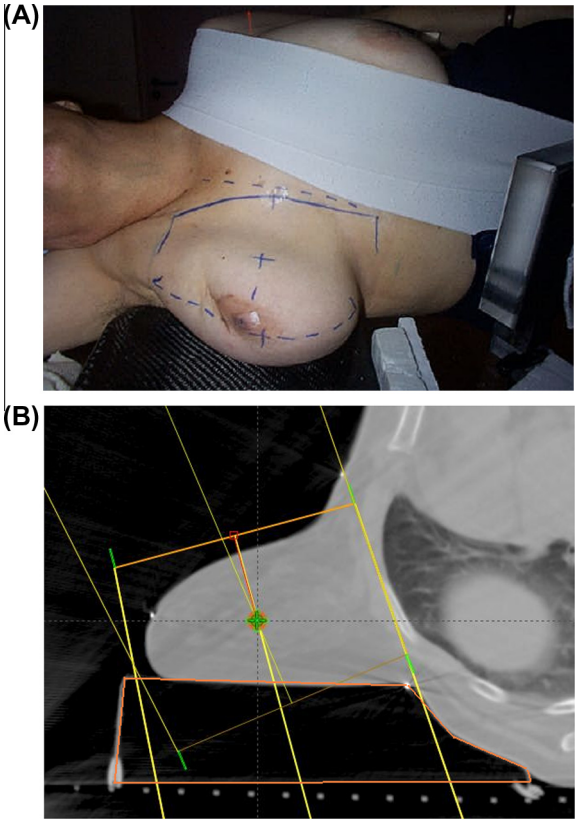

Fig. 1. (A) Patient position and immobilization device. (B) The breast lies on the flat part of the breast board. The edge of the angled side is marked by a metallic wire which is visible on CT scan and DRR (arrow).

control of breast cancer [12]. ILD, by changing breast shape, decreases separation and improves dose homogeneity in the target, possibly improving acute toxicity. Furthermore, in tumor bed boost, it decreases tumor bed depth, allowing for lower energy electrons to be used and decreasing skin entry dose [13]. As 3D-CRT has only been recently introduced in whole breast RT in the ILD position, with the advent of large-bore CT, there are little data about the 3D dosimetry of ILD, or the acute toxicity of treating patients in this position.

In the present study, we thus evaluate the dosimetry of whole breast 3D-CRT in the ILD with respect to dose to OARs, and evaluate tolerance and acute toxicity profiles of prospectively followed patients treated in our institution with this technique.

Methods and materials

Patient selection and evaluation

Consecutive patients with large, ptotic breasts, treated at the Institut Curie with whole breast radiation with or without a tumor bed boost after breast conserving surgery for early-stage breast cancer were selected for this study. A CT scan was performed after surgery for treatment planning. Patients were placed in the lateral decubitus position on a breast board, as described previously [11]. The patients' position is shown in Fig. 1A, as well as the immobilization disposal. The LD immobilization device consists of a dedicated patient board (Techset®) with a back rest. A large elastic fabric band serves to flatten and move the contralateral breast out of the radiation fields. The patient lies on the side of her treated breast. A thin carbon fiber breast rest of 6 or 7 cm height with angled sides is placed under the breast with its long edge along the lateral border of the breast (Fig. 1). Care is taken to flatten the breast on the breast rest, to open up the inferior and lateral mammary folds and to clear the breast from the angled edges of the rest. The medial field borders and alignment lasers are marked on the patient's skin.

Radio-opaque markers were also placed along the mid sternum, as well as 1–2 cm below the inferior, above the superior, and lateral to the lateral breast limits (Fig. 1B). Images were acquired on a large bore CT-scanner (Aquilion LB, Toshiba medical, Puteaux, France) from the mid-neck to the mid abdomen, using 3-mm slices. Using virtual simulation (Simago, Dosisoft, Cachan, France), two isocentric tangential beams – medial and lateral – with matching posterior borders were set-up. The CT data and the RT plan were transferred to a commercial treatment planning system (TPS) (Eclipse 3D, version 8.6, Varian Medical Systems Inc., Palo Alto, USA) for plan optimization. If necessary, a dynamic wedge of 15–20° was used on the tangential medial beam to homogenize the dose distribution (Fig. 2).

The tumor bed and organs at risk were delineated: heart was contoured from the level of the pulmonary trunk to the apex to include the pericardium but not the major vessels. Both lungs and the contralateral breast were delineated.

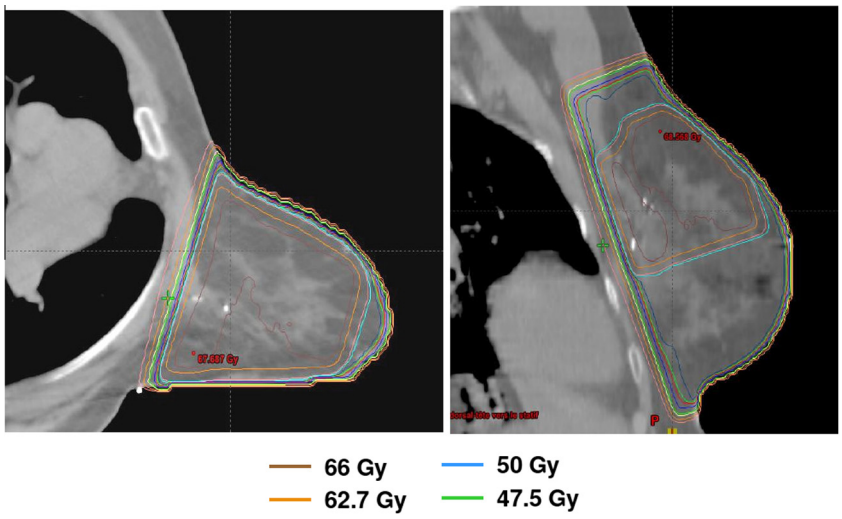

Fig. 2. Axial and sagittal CT scan images showing the dosimetry of whole breast radiotherapy and boost to the tumor bed delivered in lateral position. The colors of isodoses 95% and 100% are given.