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Factors influencing eligibility for breast boost using noninvasive image-guided breast brachytherapy

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ABSTRACT

PURPOSE: Noninvasive image-guided breast brachytherapy (NIBB) allows for accurate targeting of the tumor bed (TB) for breast boost by using breast immobilization and image guidance. However, not all patients are candidates for this technique.

METHODS: Consecutive patients treated for breast cancer were evaluated. Patients with very small breast size (cup ≤ A) for whom immobilization could not be achieved were treated with electrons. All others underwent simulation for NIBB boost. The rate of eligibility for NIBB, reasons for ineligibility, and related patient and anatomic factors were analyzed.

RESULTS: Of 52 patients evaluated, 6 patients were ineligible for NIBB because of small breast size. Of the remaining patients who underwent simulation for NIBB boost, 33 patients (72%) were treated with NIBB. Reasons for ineligibility were the absence of identifiable TB (n = 5), inability to position patient/breast to adequately target the TB (n = 4), posterior TB location (n = 3), and discomfort during compression (n = 1). The likelihood of being eligible for NIBB boost was dependent on breast size: ≤A (0%), B (50%), C (71%), D-DD (77%), and >DD (80%) (p = 0.002). The presence of surgical clips also predicted eligibility for NIBB: 79% clips vs. 45% without clips (p = 0.05). A posterior TB location was not associated with ineligibility (p = 0.2).

CONCLUSIONS: NIBB boost is feasible in most patients. Patients with larger breast size are more likely to be good candidates. Posterior TB location can be challenging for NIBB, but most patients are still candidates. Surgical clips are very helpful in defining the TB and greatly increase the likelihood of eligibility for NIBB.

Keywords: Noninvasive image-guided breast brachytherapy; NIBB; Accuboost; Breast boost; Breast cancer

Introduction

Breast boost, as part of adjuvant whole breast irradiation after breast conserving surgery, has been shown in Phase III randomized trials to decrease the rate of ipsilateral breast tumor recurrence (1, 2). Noninvasive image-guided breast brachytherapy (NIBB) is a novel method to precisely delivery breast boost by using breast immobilization and imaging for each treatment fraction. NIBB has been validated dosimetrically (3–5), and early clinical outcomes have shown favorable results with this technique (6–8). However, not all patients are ideal candidates for this approach. The aim of this study was to identify the rate of eligibility for NIBB and determine patient and anatomic factors that influence eligibility.

Methods

From April to November 2013, consecutive patients with early stage breast cancer treated with breast conserving therapy who were candidates for breast boost

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were analyzed. This study was conducted in accordance to and approved by our institutional review board. Patients with very small breast size (cup size A or smaller) for whom breast immobilization could not be achieved with compression did not undergo NIBB simulation. These patients were treated with *en face* electrons. All other patients underwent simulation for NIBB boost. Both NIBB simulation and boost treatment were performed on the AccuBoost System (Advanced Radiation Therapy, Inc., Billerica, MA). Simulation consisted of breast immobilization between compression plates on the AccuBoost System followed by kilovoltage imaging (Fig. 1). The tumor bed (TB) was localized using postsurgical changes and/or surgical clips placed at the time of surgery to delineate the lumpectomy cavity. Whole-breast CT simulation and preoperative imaging (mammography and/or MRI) were used to assist in TB identification. To be eligible for NIBB boost, the TB had to be identified by the treating physician and encompassed by an available applicator. Furthermore, patients had to achieve a separation of ≤10 cm with compression. For boost, the target volume consisted of the TB without need for additional planning target volume margin expansion. Patients who met eligibility criteria on simulation underwent NIBB boost in the immobilized position with breast compression using specialized applicators and a remote afterloaded iridium-192 high-dose-rate source. The NIBB technique has been previously described in detail (5, 9). Patients who were found to be ineligible for NIBB on simulation underwent boost treatment with either *en face* electrons or three-dimensional (3D) conformal photons. The rate of eligibility for NIBB and reasons for ineligibility were evaluated. Eligibility for NIBB boost was analyzed for association with patient and anatomic factors using the χ^2 and Student's t tests. A p-value of <0.05 was considered statistically significant.

Results

A total of 52 patients who were candidates for breast boost were evaluated. Six of these patients were ineligible for NIBB because of small breast size and thus, were treated with *en face* electrons. Of the remaining patients who underwent simulation for NIBB boost, 33 patients (72%) were treated with NIBB. The reasons for ineligibility were the absence of identifiable TB in 5 patients, inability to position the patient or patient's breast in such a way to adequately target the TB in 4 patients, a posteriorly located TB that abutted the chest wall in 3 patients, and discomfort during breast compression in 1 patient.

The likelihood of being eligible for NIBB boost based on breast size, breast quadrant, and the presence of surgical clips is shown in Table 1. The eligibility for NIBB was significantly associated with breast size ($p = 0.002$). Patients with breast cup size B, C, D-DD, and >DD were eligible at rates of 50%, 71%, 77%, and 80%, respectively. Patients with tumors located in the central breast or upper outer quadrant were more likely to be eligible for NIBB boost than those with tumor located elsewhere in the breast, although this did not reach statistical significance ($p = 0.07$). Surgical clips placed at the time of surgery to define the TB were helpful to identify the TB for targeting and significantly associated with eligibility for NIBB boost. Patients with no surgical clips were candidates for NIBB only 45% of the time, whereas those with clips were candidates

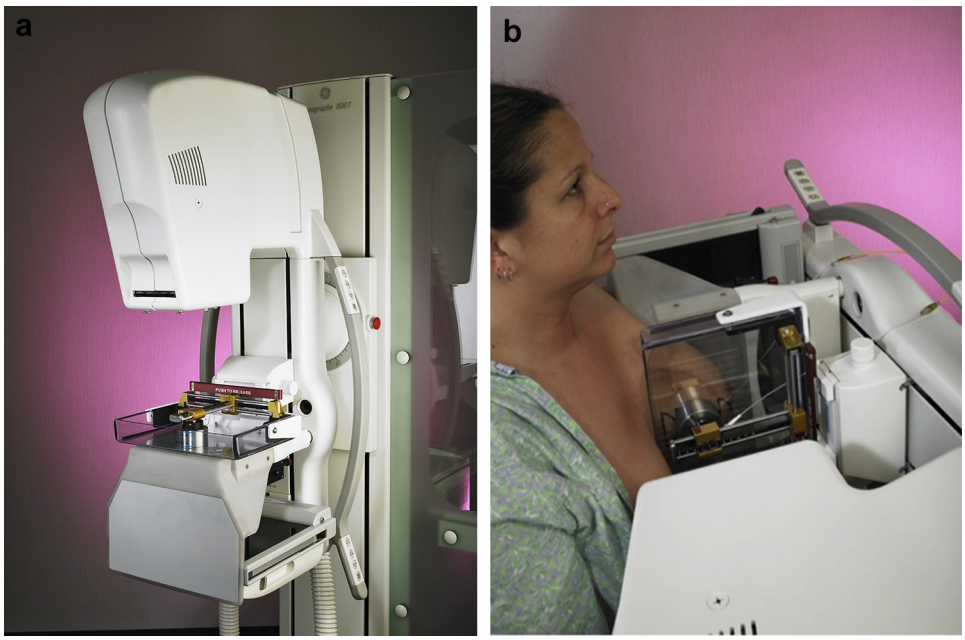

Fig. 1. (a) The AccuBoost System. (b) Noninvasive image-guided breast brachytherapy treatment using breast immobilization via gentle breast compression, image guidance, and specialized applicators for an iridium-192 high-dose-rate source.