Breast Cryoablation in Patients with Bone Metastatic Breast Cancer

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ABSTRACT

Purpose: To assess retrospectively the safety and feasibility of palliative breast cryoablation to treat primary breast tumors in patients with stage IV breast cancer.

Materials and Methods: In 17 female patients (mean age ± SD, 59 y ± 13; range, 37–81 y) with 22 bone metastatic ductal invasive breast lesions (2.5 cm × 1.6 cm ± 1.4 × 1.1; range, 1.0 cm × 0.5 cm to 6.7 cm × 5.5 cm), 19 computed tomography (CT)–guided percutaneous cryoablation sessions were performed for treatment of primary breast tumors. All patients had radiologic evidence (contrast-enhanced CT or magnetic resonance imaging) of persistence or progression of the primary breast cancer despite systemic therapy. The radiologic outcome was evaluated with a mean follow-up period of 13 months (range, 3–31 mo). Treatment of skeletal metastases was unnecessary during the follow-up period.

Results: All of the cryoablation sessions were completed and well tolerated. Complete regression of the disease was achieved in 15 (88%) patients 2 months after the cryoablation. Two (12%) patients underwent a second cryoablation treatment because of a minimal persistence of viable tumor (residual disease). No relapse of primary tumors was observed on breast imaging during the follow-up period. One patient (6%) developed a new lesion localized to the contralateral breast.

Conclusions: These data suggest that palliative cryoablation of primary advanced breast cancer is a well-tolerated, feasible, and effective treatment option. Given the palliative effects of breast cryoablation demonstrated in this series, larger studies replicating these results are warranted.

ABBREVIATIONS

HU = Hounsfield unit, ROI = region of interest

Metastatic breast cancer at diagnosis represents approximately 6%–10% of all new breast cancers. The prognosis for this group of patients is generally unfavorable. The 5-year relative survival rate is only 23%, although the overall survival is improving with the risk of death decreasing by 1%–2% each year (1,2). Metastatic breast cancer is considered an incurable disease, and the main treatment goal is palliation, with the aim of maintaining or improving the quality of life and possibly improving survival. Palliative treatment options currently available to these patients include external-beam radiotherapy, chemotherapy and combined modalities, endocrine therapies, and biologic agents (1–3). Traditionally, the local treatment of stage IV breast cancer, through either surgery or radiotherapy, has been reserved for palliation of advanced local disease to prevent local complications (4,5). Population and institutional database reviews suggest that a significant percentage of women (approximately 40%–60%) receive surgery for their primary breast tumor as a component of therapy for stage IV disease (6–8).

The biologic rationale for removing the primary breast tumor in cases of proven disease dissemination is debatable, but several observational studies have exhibited a higher survival rate among patients with stage IV breast cancer in whom the primary tumor is completely excised at the time of diagnosis (9–12). Ablative techniques, such as radiofrequency ablation,

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percutaneous cryoablation, interstitial laser ablation, and high-intensity focused ultrasound ablation, are being explored in the hope to avoid the need for surgery (13,14). Among these local ablative therapies, percutaneous cryoablation is a minimally invasive technique that has been proven to be a safe and effective technique for the treatment of local malignant disease in various organs (15–18). The aim of this retrospective review of our hospital's database was to assess the technical safety, feasibility, and efficacy of computed tomography (CT)–guided percutaneous cryoablation to treat primary breast tumors in patients with metastatic breast cancer in the bone.

MATERIALS AND METHODS

The indications, risks, and benefits of the cryoablation procedure were discussed with all the patients, and informed consent to perform this treatment was obtained. There were 17 female patients (mean age ± SD, 59 y ± 13; range, 37–81 y) with 22 bone metastatic ductal invasive breast lesions (2.5 cm × 1.6 cm ± 1.4 × 1.1 cm; range, 1.0 cm × 0.5 cm to 6.7 cm × 5.5 cm) who underwent 19 CT-guided percutaneous cryoablation sessions for the treatment of their primary breast tumors. All patients received the following systemic therapies: endocrine therapies in combination with bisphosphonates (n = 8; 47%), chemotherapy (n = 4; 24%), and anti–human epidermal growth receptor 2 therapy (n = 5; 29%). The characteristics of the patient population and tumor lesions are summarized in **Table 1**.

The decision to perform breast cryoablation was made by the interventional radiologist after consultation with the patients and referring physicians. The patients were selected based on the following criteria: (*a*) stage IV ductal invasive breast cancer, (*b*) primary tumor located at a distance of at least 10 mm from the skin (to avoid skin burn), (*c*) clinical and radiologic evidence of persistence or progression of primary breast cancer despite systemic therapy at least 3 weeks before the ablation session, and (*d*) life expectancy >2 months. The criteria for exclusion were (*a*) histologic types of breast cancer different from the ductal type (eg, lobular carcinoma, tubular carcinoma), (*b*) presence of distant metastasis different from the skeletal metastasis (eg, liver and brain), (*c*) platelet count $< 50 \times 10^3/\mu L$, and (*d*) unmanageable coagulation disorders.

The patients were seen at our department approximately 2 weeks (range, 10–20 d) before cryoablation. Staging of the patients included chest radiography, bone scintigraphy, whole-body CT, breast magnetic resonance (MR) imaging, histologic confirmation of ductal invasive breast cancer, electrocardiogram, complete blood counts, and coagulation study. Patients taking anticoagulants and antiplatelet medications were advised to stop these therapies 2 days and 1 week before the procedure, respectively. Nonenhanced and contrast-enhanced MR imaging of the breast was considered the preferred imaging modality to assess the tumor characteristics (eg, size, intensity), but in 3 (18%) of 17 patients, evaluation of the primary breast cancer was conducted by enhanced and nonenhanced CT cross-sectional imaging because of patient claustrophobia. Treatment of skeletal metastases was not considered necessary unless the patients had painful metastasis or metastasis at high risk of fracture.

Imaging Techniques

Breast MR imaging examinations were performed with the patients placed prone in a 1.5-tesla system (MAGNETOM Avanto; Siemens, Munich, Germany). A dedicated sensitivity-encoding breast coil was used for radiofrequency signal reception. Six dynamic acquisitions of T1-weighted three-dimensional fast low-angle shot sequences were performed. Between the first and the second acquisition, a pause of 20 seconds was used for the administration of 0.1 mL/kg gadobutrol (Gadovist; Schering AG, Berlin, Germany). Intensity/time enhancement curves were obtained by drawing a region of interest (ROI) around the areas of the lesions that showed the greatest degree of enhancement. Turbo inversion recovery magnitude sequences were acquired. Nonenhanced and enhanced CT images of the breast were acquired using a Somatom Sensation CT scanner (Siemens) with 3-mm collimation and 80–140 mA with the patient placed supine. Tumor measurements were obtained in three dimensions on the CT images, using

Table 1. Baseline Characteristics of Patient Population and Tumor Lesions

Characteristics	Data (n = 17 Patients)			
Age (mean ± SD)	59 y ± 13 (range, 37–81 y)			
Primitive tumor distribution	Unifocal lesions, 13 (76%)	Multifocal lesions, 3 (18%)		Multicentric lesions, 1 (6%)
Stage (TNM)	Stage IV (100%)			
T	T1c = 5 (29%)	T2 = 9 (53%)	T3 = 2 (12%)	T4 = 1 (6%)*
N	N0 = 16 (94%)	N1 = 1 (6%)†		
M	—	M1 = 17 (100%)‡		
Tumor size (mean ± SD)	2.5 cm × 1.6 cm ± 1.4 × 1.1 (range, 1.0 cm × 0.5 cm to 6.7 cm × 5.5 cm)			

*Right pectoralis major muscle infiltration.
†One ipsilateral axillary lymph node; maximum diameter = 2.0 cm.
‡M1: only skeletal metastases in all patients.