Excellent Long-term Breast Preservation Rate After Accelerated Partial Breast Irradiation Using a Balloon Device

Justin M. Mann,[1] Adrian D. Osian,[1] Andrew Brandmaier,[1] Weisi Yan,[1] Kap-jae Sung,[2] Beth Siegel,[2] Simon Fink,[2] Barry Kaplan,[3] Malvin Fulman,[3] Guojiao Wu,[4] Paul Christos,[4] Dattatreyudu Nori,[1] Akkamma Ravi[1]

Abstract

Balloon-based accelerated partial breast irradiation provides an effective and simple technique for administering adjuvant radiotherapy in the breast conservation setting. An increasing body of evidence has demonstrated local control rates and long-term breast preservation rates comparable with whole breast radiotherapy. Despite claims of inferior local control with balloon-based accelerated partial breast irradiation from a previously published population-based cohort study, our institutional experience further corroborates a low salvage mastectomy rate and excellent cosmesis in well-selected patients.

Background: Accelerated partial breast irradiation (APBI) using a balloon device has been well tolerated. A recent retrospective population-based study showed an increase in the rate of subsequent mastectomy for patients who undergo APBI compared with whole breast radiation therapy. Our aim was to analyze the long-term results of patients treated with APBI at our institution to determine the salvage mastectomy and locoregional recurrence rates and cosmesis outcomes. **Materials and Methods:** After institutional review board approval, we conducted a retrospective review of 111 patients treated from June 2003 to October 2014 at our institution for early-stage breast cancer using a balloon device. After lumpectomy and nodal staging, the patients underwent APBI with high-dose rate iridium-192 brachytherapy. A computed tomography-based 3-dimensional plan was created, and a dose of 34 Gy in 10 fractions was given twice daily, 6 hours apart, over 5 days. Follow-up examinations were performed 2 to 3 times annually by either a surgeon and/or a radiation oncologist. Annual mammograms were obtained. The patients included postmenopausal women with node-negative early-stage invasive ductal carcinoma with a tumor size < 3 cm ($n = 93$) or ductal carcinoma in situ ($n = 18$). Cosmesis was evaluated using the Harvard criteria, as excellent, good, fair, or poor. **Results:** At a median follow-up period of 66 months (range, 1-139 months) after completing treatment, with a minimum of 5 years of follow-up data for 62 patients (55.9%), the incidence of ipsilateral breast tumor recurrence (IBTR) was 2.7% ($n = 3$) and the incidence of ipsilateral axilla nodal recurrence was 1.8% ($n = 2$). The ipsilateral breast preservation rate was 97.3%. The salvage mastectomy rate was 2.7% ($n = 3$), and the 5-year salvage mastectomy-free rate was 98.7% (95% confidence interval, 91.0%-99.8%). No distant failure developed, and no breast cancer-related deaths occurred. The 5-year overall survival rate was 91.7% (95% confidence interval, 83.2%-96.0%), and the 10-year breast cancer-specific survival rate was 100%. Of the 3 cases of IBTR, 2 were estrogen receptor negative ($P = .076$). The mean interval to IBTR was 78.7 $\pm$ 27.5 months from treatment completion. A significant association was noted between African-American ethnicity and IBTR ($P = .0398$). Excellent to good cosmesis was observed in 98.1% of the patients. The maximum skin dose (mean value) for patients with excellent, good, and fair cosmesis was 302.2 Gy, 315.4 Gy, and 372.5 Gy (88.9%, 92.7%, and 109.5% of the prescription dose), respectively. The maximum skin dose was < 340 Gy (100% of the prescribed dose) in 69.9% of patients with excellent to good cosmesis. **Conclusion:** The long-term follow-up data

[1]Department of Radiation Oncology
[2]Department of Surgery
[3]Division of Hematology/Medical Oncology
[4]Division of Biostatistics and Epidemiology, Department of Healthcare Policy and Research, New York-Presbyterian Hospital/Queens, Weill Cornell Medical College, New York, NY

Submitted: Oct 30, 2015; Revised: Dec 14, 2015; Accepted: Feb 3, 2016; Epub: Feb 11, 2016

Address for correspondence: Justin M. Mann, MD, Department of Radiation Oncology, New York-Presbyterian Hospital/Queens, Weill Cornell Medical College, 56-45 Main Street, Flushing, NY 11355
E-mail contact: Jum9094@nyp.org

http://dx.doi.org/10.1016/j.clbc.2016.02.010

of patients receiving APBI with a balloon device showed a low salvage mastectomy rate with durable long-term breast preservation. Excellent local control with good cosmesis was noted in these postmenopausal patients treated with APBI.

Clinical Breast Cancer, Vol. 16, No. 3, 217-22
Keywords: Ballon brachytherapy, Breast brachytherapy, Breast cancer, Contura, MammoSite, Radiotherapy, Whole breast radiation therapy

Introduction

Breast conservation therapy (BCT) consists of partial mastectomy followed by adjuvant whole breast irradiation (WBI) to eradicate any residual microscopic disease. BCT provides equivalent survival to mastectomy for early-stage breast cancer; however, interest in shorter treatment regimens, including hypofractionation and accelerated partial breast irradiation (APBI), has been increasing. Previously, a number of seminal randomized trials with $>$ 20 years of follow-up data have demonstrated equivalence in overall survival between mastectomy and BCT.[1,2] More recently, a number of institutional studies have begun to publish evidence supporting the equivalence of APBI versus WBI; however, the data remain limited and few randomized trials have been published.

Breast cancer is the most common cancer among women in the United States (excluding skin cancer), and approximately 1 in 8 women will develop invasive breast cancer during their lifetime. About 231,840 new cases of invasive breast cancer and 60,190 new cases of ductal carcinoma in situ (DCIS) were expected to be diagnosed in 2015.[3] Despite the large body of evidence supporting BCT, it is believed that only 35% to 80% of patients eligible for BCT receive it and $\leq$ 15% to 30% of patients who undergo breast conservation surgery never receive adjuvant radiotherapy as part of their treatment.[4] Conventional WBI requires approximately 6 weeks of daily radiation treatments, Monday through Friday, which can create logistical issues for patients of poor performance status or for patients who live far from a radiation facility. An accelerated radiation schedule would understandably increase the ease of access to BCT by decreasing the length of treatment.

The concept of treating the entire breast after breast conservation surgery has long been standard; however, the recurrence patterns of failure have revealed that most local failures occur in close proximity to the site of the original tumor. Recurrences in the same breast distant from the original tumor appear to occur at a similar rate as new primary cancers in the contralateral breast.[5] This has formed the rationale for APBI, which involves treating the area of the breast at the greatest risk of recurrence, allowing normal portions of tissue to be spared. This high-risk volume can be treated to a higher radiation dose within a shorter duration, typically twice daily (BID) for 5 days (10 fractions).

The first techniques of APBI involved high-dose-rate (HDR) multicatheter interstitial brachytherapy. Although this technique was initially proposed as a boost to the lumpectomy bed, multiple trials, including 1 from the Hungarian National Institute of Oncology with $>$ 5 years of follow-up, revealed a local failure rate of 4.7%, which was not significantly different from the WBI arm in the trial. Additionally, an increased number of patients with excellent to good cosmesis was seen in the HDR multicatheter implant arm.[6]

Technical complexity limited the widespread adaptation of multiple interstitial brachytherapy. However, the introduction and Food and Drug Administration approval of intracavitary balloon-based brachytherapy applicators, including the MammoSite (Hologic Inc., Marlbourough, MA) in 2002, increased the popularity of APBI because of the simpler, more reproducible technique for performing breast brachytherapy.[7] The long-term outcome data are limited; however, the American Society of Breast Surgeons MammoSite Registry trial enrolled 1440 patients from 2002 to 2004 and is the largest collection of patients treated using MammoSite. Treatment consisted of APBI using MammoSite, with long-term outcomes showing high rates of local control and excellent to good cosmesis.[8]

We present our single-institution experience with balloon-based APBI and analyze the long-term results to determine the salvage mastectomy rate, locoregional recurrence rate, and cosmesis outcomes.

Materials and Methods

After institutional review board approval, we retrospectively analyzed the outcomes of 111 patients with early-stage breast cancer treated with APBI using a balloon-based applicator at our institution from June 2003 to October 2014. Patient selection included those of postmenopausal status with either invasive ductal carcinoma or DCIS, tumors no larger than 3 cm, and no evidence of lymph node metastases. Patients underwent standard surgical lumpectomy and axillary staging with negative surgical margins. Next, adjuvant breast brachytherapy using the MammoSite single lumen or multilumen devices was performed. The MammoSite device was placed intraoperatively using an open cavity technique or postoperatively using a closed cavity technique.

Our institutional placement technique has been previously described.[9] After insertion, postplacement computed tomography scanning was performed to assess the conformality, balloon surface to skin distance, air gaps, and highest dose regions in the target area. The planning target volume for evaluation was defined as the breast tissue volume bounded by the uniform expansion of the balloon radius in all dimensions by 1 cm minus the balloon volume and limited to 5 mm from the skin surface, chest wall, and pectoralis muscles. Planning was performed using Eclipse BrachyVision planning software (Varian Medical Systems, Inc., Palo Alto, CA). Before each treatment, imaging was performed using fluoroscopy or radiography to inspect the balloon integrity. The total dose delivered was 34 Gy in 10 fractions, given BID $\geq$ 6 hours apart within 5 consecutive days, prescribed 1 cm from the balloon surface. The source for the HDR brachytherapy treatments was iridium-192.

Follow-up examinations were performed 2 to 3 times annually by either a surgeon and/or a radiation oncologist. Annual mammograms were also obtained. Cosmesis was graded using the Harvard