

# Breast conservation in breast cancer patients with cardiac pacing devices

Mark Trombetta<sup>1, 3, 4</sup>, Yongbok Kim<sup>1, 3, 4</sup>, Thomas B. Julian<sup>2, 3, 4</sup>

1. Department of Radiation Oncology, Allegheny General Hospital, 320 East North Avenue, Pittsburgh, Pennsylvania, USA. 2. Department of Surgery, Allegheny General Hospital, Pittsburgh, Pennsylvania, USA. 3. Temple University School of Medicine, Pittsburgh Campus, Pittsburgh, Pennsylvania, USA. 4. Drexel University College of Medicine, Allegheny Campus, Pittsburgh, Pennsylvania, USA

**Correspondence:** Mark Trombetta. Address: Department of Radiation Oncology, Allegheny General Hospital, 320 East North Ave. Pittsburgh, PA 15212, USA. E-mail: mtrombet@wpahs.org

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## Keywords

Radiation, Pacemaker, Defibrillator, Accelerated partial breast radiotherapy, Breast, Lumpectomy

## Introduction

Patients that have implantable pacemakers and defibrillators who develop localized breast cancer have historically been considered better candidates for mastectomy than breast conservation therapy (BCT) due to the risk of device malfunction. Many of these patients are desirous of BCT but have been felt to be unsuitable due to the disruptive potential to the pacing device resulting from the primary radiation beam and electromagnetic fields that occur during delivery of megavoltage irradiation. The use of pacing devices is growing rapidly and more patients with early-stage breast cancers have implanted devices. Newer treatment techniques involving the use of accelerated partial breast radiotherapy (APBI)<sup>[1, 2]</sup> accompanied by recently published guidelines detailing suitability criteria for APBI<sup>[3]</sup> have changed the breast cancer paradigm. We present the Allegheny General Hospital experience in patients with early-stage breast cancer and implanted cardiac pacing devices who desired breast preservation.

## The need for a continued persistent focus on breast preservation

Breast conservation therapy in early-stage breast cancer has a long history with two major studies reporting equivalence in 20 + year experiences in safety, local control, cosmesis, overall survival, and patient preference<sup>[4, 5]</sup>. Researchers have reported improvement in self-esteem and body self-image when the breast is preserved using breast conservation techniques<sup>[7, 8, 9]</sup>. With the current trends devolving away from mastectomy, we believe the presence of cardiac pacing devices should have little impact the choice of breast preservation, provided that safety and quality criteria can be accommodated. In 2004, Solan et al, outlined safety criteria standards for patients with cardiac pacing devices who require radiotherapy<sup>[10]</sup>. However, the current generation of cardiac pacing devices are less radiotolerant, with most manufacturers defaulting to a 200 cGy maximal limit or an ALARA (as low as reasonably achievable) dose recommendation. The complexity of these devices, including the institution of complementary metal-oxide semiconductor (CMOS) technology, may make them at least 10-fold less tolerant to radiotherapy than just 15-20 years ago. While these statements suggest an argument toward lesser use of radiotherapy, we argue for continued focus on breast preserving therapy when possible. Allegheny General Hospital radiation oncologists and breast surgeons have successfully treated a number of patients with

a pacemaker either ipsilateral or contralateral to their breast cancer. Only a single incident of a non-life threatening pacemaker reset to default has occurred and this was easily corrected by the manufacturer's representative. Treatment has been delivered using both whole breast radiotherapy (WBRT) (3 patients), and APBI with both high dose rate brachytherapy (HDR) and three-dimensional conformal radiotherapy (3D-CRT) (13 patients). The WBRT and APBI patients were treated in accordance with the National Surgical Breast and Bowel Project (NSABP) protocol B-39/Radiation Therapy Oncology Group (RTOG) 0413 guidelines<sup>[11]</sup>; although the WBRT patients required a shortening of the superior border of the tangent fields by 1.5-2.0 cm to protect the device. Despite lowering the superior border, two of three WBRT patients met the protocol planning volumes for APBI. As APBI is an evolving standard of care with two studies demonstrating 10 + year equivalence data in local control compared to WBRT<sup>[1, 2]</sup>, we were comfortable with the border reduction since these patients were highly desirous of BCT. The single patient who did not fit the protocol required only a 0.5 cm reduction at the superior border of the treatment bed. Because the relatively large planning margins required are due in large part to respiratory motion (2.5 cm total), and chest wall motion in this region is physiologically limited, we felt this acceptable despite the usual motion concerns as the superior aspect of the thoracic cavity (and therefore the breast) demonstrates the least variation which may require less planning target volume margin.

We employ an in-house pacemaker protocol, that includes a graphic instructive chart (Table 1), which is based on the Solan recommendations<sup>[10]</sup> and have established minimal distance guidelines (target volume to device) based on ex-vivo computerized simulation for both external radiotherapy and HDR. The device manufacturer is contacted to obtain the device specific radiation tolerances and virtual pre-plans are performed to estimate the maximal dose to the device. Once the patient has been approved for treatment following verification of safe dose limit predictions, the device is monitored during two consecutive treatments by thermoluminescent or electronic dosimetry. All patients met the maximal dose standards both virtually and real-time and the tumor bed coverage averaged 98%.

**Table 1.** Minimum Recommended Pacemaker Interventions

	<b>Cardiologist Consult before XRT</b>	<b>EKG Monitor</b>	<b>Vital Signs Pre and Post XRT</b>	<b>Dosimeter measurement first two fractions</b>
Dependant High Risk	Yes	first 3 tx's or daily per MD	daily	Yes
Dependant Low Risk	Yes	first 3 tx's	first 3 tx's	Yes
Non-Dependant High Risk	Yes	No	first 3 tx's	Yes
Non-Dependant Low Risk	Yes	No	first 3 tx's	Yes

\* AICD = Automatic Implantable Cardiac Defibrillator

High risk = pacer constant use necessary for life or AICD

**Dependant High Risk:** Dependant Pacemaker or AICD that is receiving  $\geq 2\text{Gy}$  and/ or  $\leq 10\text{cm}$  from field edge.

**Dependant Low Risk:** Dependant Pacemaker or AICD that is receiving  $< 2\text{Gy}$  and  $> 10\text{cm}$  from field edge.

**Non-Dependant High Risk:** Non-Dependant Pacemaker or AICD that is receiving  $\geq 2\text{Gy}$  and/ or  $\leq 10\text{cm}$  from field edge.

**Non-Dependant Low Risk:** Non-Dependant Pacemaker or AICD that is receiving  $< 2\text{Gy}$  and  $> 10\text{cm}$  from field edge.

## Conclusions

BCT is feasible in patients who prefer BCT when presenting with early stage breast cancers and who also have implanted cardiac devices in the contralateral or ipsilateral breast as long as both the limits of cardiac device tolerance and target volume coverage can be achieved. Breast conservation should be considered for these patients who meet appropriate APBI criteria.

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