

Time Trends and Predictors of Heart Dose From Breast Radiotherapy in a Large Consortium of Community and Academic Practices

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Introduction

- Cardiac toxicity has been shown to be a major risk factor for patients receiving treatment to the left breast.
- Little is known about the range of heart doses delivered in routine practice in the United States today.
- *The goal of this study was to assess the current range of cardiac sparing in a large prospective observational cohort, and to determine how cardiac dose varies by practice setting, technique, and patient characteristics.*

Methods

- From 2012-2015, 4735 patients with breast cancer treated with lumpectomy cavity and whole breast radiotherapy at 20 sites participating in a state-wide consortium were entered into a registry, with web-based transmission of clinical and treatment details, including dose-volume histograms (DVHs) for the heart.
- Table 1 presents patient characteristics including conventional whole breast irradiation (CWBI) and accelerated whole breast irradiation (AWBI)
- Participating institutions were educated to contour heart according to a published atlas for consistency
- 2296 patient with left- and 1342 patients with right breast cancer had a heart DVH available for the analysis
- Mean heart dose was modeled for several variables (Table 2) including patient position, target, dose, and delivery technique

Results

Table 1. Patient Characteristics

Variable	# of Patients (%)
Laterality (left)	2664 (56.3%)
IMRT	1874 (39.6%)
Supine	4530 (95.7%)
Conventional fractionation	3055 (64.5%)
Boost	3948 (83.4%)
No nodal treatment	4219 (89.1%)
Nodal treatment (SCV or ICV excluding IMNs)	340 (7.2%)
Nodal treatment (IMNs regardless of SCV/ICV)	176 (3.7%)
Deep Inspiration Breath hold (DIBH)	641 (13.5%)
Academic Center	1980 (41.8%)

Figure 1. Observed mean dose to the heart for the consortium (line) and the institutions (dots, proportional to number of cases) by fraction size and laterality.

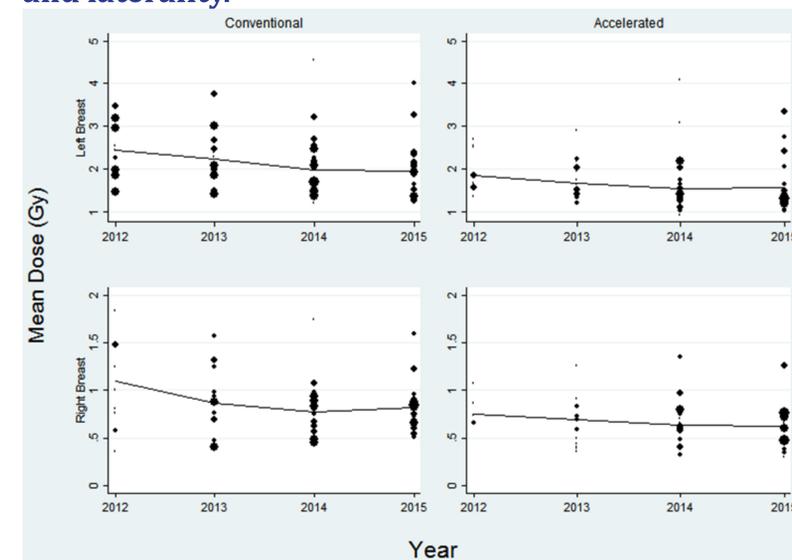


Table 2. Regression model for effect of clinical variables on heart dose (left breast treatment). All variables were statistically significant.

Variable	CWBI	p-value	AWBI	p-value
Baseline	1.32 Gy	<0.0001	1.14 Gy	0.0003
IMRT (Yes vs No)	15.1%	<0.0001	13.1%	0.0004
DIBH (Yes vs No)	-23.9%	<0.0001	-22.5%	<0.0001
Position (Prone vs Supine)	-34.8%	<0.0001	-20.8%	0.0008
Boost (Yes vs No)	19.6%	<0.0002	20.5%	<0.0001
Nodal treatment (SCV or ICV) vs None vs Axillary	13.8%	<0.0005		
Nodal treatment (IMNs +/- SCV/ICV)	41.5%	<0.0001		
Academic (Yes vs No)	13.6%	<0.0001	10.7%	0.0053
Year MROQC per 1 year prior to 2015	-6.6%	<0.0001	-6.9%	<0.0001
Breast volume (centered at 1000 cc) per +100cc	0.58%	<0.0138	0.3%	0.4184
Separation (cm) (centered at 22 cm)	1.0%	0.0180	1.7%	0.0126

Mean Heart Dose	Significant Variables (left breast treatment)
↑	Use of IMRT, boost, nodal treatment, increasing planned breast dose
↓	Use of DIBH, AWBI, prone position, and year treated

For patients treated to the right breast, overall cardiac mean dose was approximately 1 Gy. The most significant factors were nodal irradiation, boost treatment, position.

Conclusions

- Within a state-wide consortium, the mean cardiac doses received in over 2500 women treated to the left breast has decreased from 2.3 Gy to < 1.6 Gy regardless of practice setting.
- These results can serve as a guide to others regarding what sparing is achievable for patients regardless of nodal status and can guide technique choices to further reduce cardiac dose.