ACUTE TOXICITY OUTCOMES AND DOSIMETRIC IMPLICATIONS FROM INCIDENTAL IRRADIATION OF ADJACENT TISSUES IN TANGENT FIELD HYPOFRACTIONATED BREAST RADIOTHERAPY

Sara Alcorn, MD, MPH[1], Todd McNutt, PhD[1], Fariba Asrari, MD[1], Victoria Croog, MD[1], Susan Stinson, MD[1], Bethlehem Floreza, BS, CMD[1], Arcelia Weaver, CMD[1], Jean Wright, MD[1]

[1]Department of Radiation Oncology and Molecular Radiation Sciences, Johns Hopkins School of Medicine, Baltimore, MD, USA

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Purpose/Objectives

- In whole breast irradiation (WBI), current protocols often specify dosimetric constraints for the contoured breast alone.
- However, adjacent normal tissues outside of the breast may also receive substantial in excess of the prescription within standard tangent fields.
- To better characterize the impact of incidental irradiation of these tissues-in-beam (TIB), we analyzed dosimetric parameters of TIB and associated acute toxicity during hypofractionated whole breast irradiation (HF-WBI).

Materials/Methods

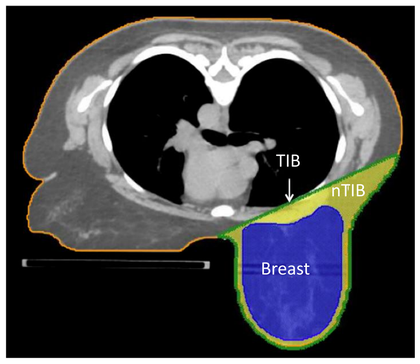
- Tangent field WBI plans for 137 patients treated to 40.5 Gy/15 fractions from 4/2016 to 1/2018 were evaluated.
- Plans were contoured to include the following volumes of interest:

Figure 1: Structure description

Tissues-in-beam (TIB)
Volume encompassing all breast and non-breast tissues within the 30% isodose line

Breast
Breast tissue visible on CT as per RTOG, excluding tissue within 5mm of skin surface

Non-breast TIB (nTIB)
Volume remaining after subtracting breast structure from TIB structure



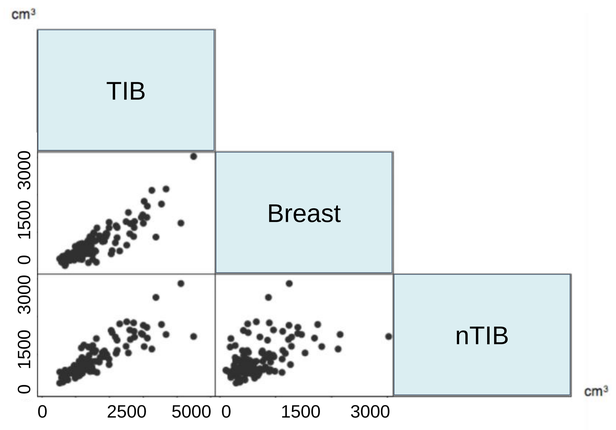
- Volumes of the TIB, breast, and nTIB receiving 100%-107% of the prescription dose (V100-V107) were calculated in cm^3.
- 12 acute toxicities were prospectively collected weekly during WBI including radiation dermatitis, pruritus, fatigue, and hyperpigmentation as per CTCAE v.4; Karfosky Performance Status; pain per intensity scale (0-10); and presence of burning, twinging, tenderness, rash, and dry and most desquamation.
  - Toxicity grade changes of ≥1 unit during WBI were calculated.
- Relationships between volumetric and dosimetric parameters were assessed using Spearman's rank-order correlation.
- Multivariable logistic regressions evaluated TIB V100, V105, and V107 (in cm^3) as predictors of acute toxicity outcomes.

Results

Table 1: Select patient and treatment characteristics by treatment position

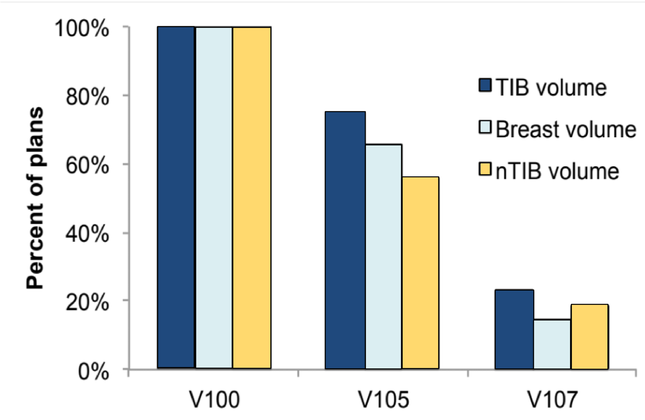
	Overall, n=137	Prone, n=73	Supine, n=64	p-value
Side treated—% right	58%	49%	67%	**0.035**
Surgical bed boost—% yes	78%	79%	77%	0.715
Volumes—mean (SD) in cm^3				
TIB volume	1558.6 (788.9)	1637.1(816.7)	1465.9 (751.0)	0.147
Breast volume	696.8 (453.1)	866.8 (496.4)	498.5 (294.2)	**<0.001**
nTIB volume	879.8 (455.8)	792.3 (380.3)	980.5 (514.5)	**0.027**

Figure 2: Matrix displaying correlations* between TIB, breast, and nTIB volumes in cm^3



*Significant correlations were found between TIB and breast, breast and nTIB, and TIB and nTIB volumes (all p<0.001).

Figure 3: Plans with V100, V105, and V107 of ≥2 cm^3 for TIB, breast, and nTIB volumes



- V107 is more common in nTIB than in breast structures.
- Increasing breast volume was associated with increasing nTIB V100 (rho= 0.30, p<0.001) but not nTIB V105 or 107.

Table 2: Significant multivariable logistic regressions for change in toxicity grade as function of TIB V100-V107 (in cm^3), controlling for breast V100-V107, treatment position, and boost

	Odds Ratio	95% CI	p-value
TIB V100			
Burning	1.004	1.001-1.007	**0.017**
Twinging	1.004	1.001-1.007	**0.015**
TIB V105			
Burning	1.025	1.007-1.043	**0.006**
Hyperpigmentation	1.017	1.001-1.033	**0.039**
TIB V107			
Burning	1.098	1.000-1.204	**0.049**

Threshold volumes associated with development of burning: TIB V105 >100 cm^3 and V107 >5 cm^3

Conclusions

- For HF-WBI, both breast and non-breast volumes within standard tangent fields commonly received doses in excess of the prescription.
- Such excess doses to TIB were associated with development of acute toxicity outcomes including burning/twinging pain and hyperpigmentation.
- TIB V105 >100 cm^3 and V107 >5 cm^3 were identified as threshold volumes associated with higher odds of developing of acute burning during HF-WBI.
- These data support inclusion of TIB as a region of interest in treatment planning and protocol design. For clinical use of threshold volumes, TIB can be approximated using the exterior structure (orange in Figure 1).