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Purpose/Objective(s): Patients are increasingly offered implant-based reconstruction prior to radiotherapy. However, it is unclear if the radiation treatment technique itself impacts upon toxicity. We performed this study to compare outcomes following implant-based reconstruction amongst breast cancer patients treated with a standard radiotherapy technique that irradiates the entire chest wall versus a novel technique which uses a smaller clinical target volume (CTV) to spare the implant. Need for corrective surgery, capsular contracture, and cosmetic outcomes were evaluated, with the hypothesis that the novel technique would result in fewer adverse outcomes and less need for corrective surgery.

Materials/Methods: A retrospective case-cohort analysis of 57 patients who had post-mastectomy, implant-based reconstruction was conducted. Patients with invasive mammary carcinoma (IMC) or ductal carcinoma in-situ (DCIS) who were treated either with the novel radiotherapy technique (n = 26) or standard PMRT (n = 31) were included. Patient demographics such as age, BMI, TNM stage, implant size, hormone receptor status, and radiation course was collected. Primary endpoint was the need for corrective surgery within two years and cosmetic outcomes, measured using the Baker Classification Scale for capsular contracture and the Modified Harvard Harris Cosmetic Scale. Secondary endpoint was radiation-induced toxicity measured using the National Cancer Institute Common Terminology Criteria for Adverse Events (NCI CTCAE). Cosmesis and toxicity were evaluated at 3 months post-radiation, 1 year, and after 13 months. Unpaired t-tests were used to compare need for corrective surgery, cosmesis (Baker Grade 2 or higher and Harvard Harris "Good" or worse), and toxicity (NCI CTCAE Grade 2 or higher).

Results: For the primary endpoint, need for corrective surgery, there was no significant difference between the novel and standard groups (two-sided p = 0.378, CI -0.38-0.14). The other primary endpoint of cosmesis, measured with the Baker scale and Harvard Harris, was also not significantly different (two-sided p = 0.147, CI -0.06-0.45), with the Harvard Harris cosmesis differences remaining insignificant across the 3 month, 1 year, and greater than 13 month periods (two-sided p = 0.854, 0.351, 0.468, respectively). The secondary endpoint, toxicity, was not significantly different between the novel and standard PMRT groups across 3 months and 1 year time periods (two-sided p = 0.328, 0.323, respectively). We will also be reporting the analysis for predictive factors related to toxicity, need for corrective surgery and cosmesis.

Conclusion: Compared with standard PMRT, the novel technique was not significantly different in rates of reoperation, toxicity and cosmetic outcomes. Better understanding the factors involved in PMRT outcomes for breast cancer patients with implant-based reconstructions will aid in the development of standardized approaches to treating the breast cancer patient population.

Author Disclosure: K. Manouchehri: None. A. Lokhandwala: None. A. Jayatilaka: None. D. Hadedeya: None. B.P. Yaremko: None. M. Brackstone: None. F. Perera: None. T. DeLyzer: None. A. Grant: None. M.I. Lock: Honoraria; Knight Therapeutics, AbbVie, Tersera, Eisai. Stock; Myovant.

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The New Quantum Image by Dynamic Nuclear Polarized MRI for the Assessment of Cardiac Radioablation to the Cavotricuspid Isthmus

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Purpose/Objective(s): Cardiac arrhythmias are usually treated with invasive, time consuming catheter ablation techniques. While recently stereotactic body radiotherapy (SBRT) is an emerging non-invasive treatment in the management of cardiac arrhythmias. To identify and assess the cardiac radioablation by MR examination, including diffusion-weighted MRI, dynamic Gd-enhanced MRI, MR spectroscopy, and T2-weighted MRI early after SBRT is very difficult. We have been developing the free radical imaging methods using Dynamic Nuclear Polarization (DNP)-MRI with nitroxyl radicals as a redox probe (e.g., 4-Methacryloyloxy-2,2,6,6-tetramethylpiperidine-1-oxyl (Tempo methacrylate; TempoMC)). In this study, we examined the possibility of in vivo spatiotemporal visualization of SBRT for cardiac radioablation to the cavotricuspid isthmus (CTI) based on redox reaction by in vivo DNP-MRI.

Materials/Methods: All animal procedures were approved by institutional animal care and use committee and performed in full compliance with its guidelines. This study was conducted with two approaches. First, four mini pigs underwent electrophysiology assessment using electroanatomic mapping (EAM) before and 3 months after SBRT with single-fraction doses of 25 Gy. The target of CTI was defined by cardiologist. We defined the planning target volume (PTV): the internal margin (IM) + set up margin (SM) = SI 15 mm, AP 10mm, LR 10 mm were added to the target. Radiotherapy plans were created by the software used in daily clinical practice. Second, free radical imaging by low filed type of DNP-MRI was performed on the four mice before and after 25 Gy and 10 Gy irradiation to whole heart. ESR signal measurements were also performed.

Results: A total dose of 25 Gy was successfully delivered to PTV in a single procedure in all mini pigs. EAM visualized the irradiated site and confirmed clockwise conduction block across the CTI. Although routine MRI could not detect the cardiac radiation injury clearly, the four mice of heart were well delineated on MRI and clearly visualized by DNP-MRI. DNP-MRI signal of TempoMC were decreased depending on prescribed irradiation dose.

Conclusion: These data demonstrated the safety and feasibility of SBRT for creating conduction block across the CTI in mini pigs. Although to identify and assess the irradiated site by routine MR examination was impossible, the free radical imaging methods using Dynamic Nuclear Polarization (DNP)-MRI with TempoMC could be a promising successful method for the assessment of cardiac radioablation. This new quantum image by DNP-MRI will open the possibility of treating cardiac arrhythmias by SBRT safety and noninvasively.

Author Disclosure: M. Matsuo: None. F. Hyodo: None. T. Mori: None. K. Hiroshi: None. R. Iwasaki: None. N. Takasugi: None. H. Tomita: None. T. Mori: None.

2413

Impact of Breast Volume on Achieving a Conservative Heart and Target Coverage Metric for Patients Receiving Whole Breast Radiotherapy in a Statewide Consortium

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Purpose/Objective(s): Radiation to large breast volumes (BV) has been associated with increased dose inhomogeneities, breast fibrosis, and induration. Radiation exposure to the heart during breast radiotherapy has been associated with late cardiovascular morbidity and mortality. This study,

therefore, investigates the impact of BV on achieving optimal lumpectomy cavity target coverage (V95% [%] ≥95) while maintaining mean heart dose constraints (MHD, mean [Gy] ≤1) across a range of BV from patients enrolled in a statewide consortium.

Materials/Methods: A retrospective analysis was conducted for 2,506 patients receiving left-sided whole breast moderately-hypofractionated (2.5-2.8 Gy/fx) radiotherapy without nodal fields between 2018-2022. The BV was calculated for each patient from contours in the treatment planning system, and the volume distribution partitioned into quartiles. Dosimetric parameters were calculated from dose-volume histograms. The percentage of patients in which the metrics were achieved was calculated for each BV quartile for different treatment positions: all positions, supine, supine with breathing motion management, and prone.

Results: The BV ranges within the quartiles (~620 patients/quartile) were ≤720.0 cc, 720.1 to ≤1065.0 cc, 1065.1 to ≤1500.0 cc, and >1500.0 cc for quartiles Q1-Q4, respectively. Of the 2,506 patients, 76% were treated supine (of which 41.6% were treated using breathing motion management techniques), 23.5% were treated prone, and 0.5% were treated decubitus. Discrete percentages of patients able to meet the metrics are provided in the table. An increase in BV from Q1 to Q4 correlated with lower percentages of patients meeting the MHD metric, however no correlation was observed between BV and target coverage. Treating supine with breathing motion management resulted in a higher percentage of patients meeting the MHD metric (odds ratio (OR) = 1.96 relative to supine without motion management, p<0.0001), while the prone setup proved to be the superior technique across all quartiles (OR = 3.95 relative to supine, p<0.0001).

Conclusion: Increasing BVs resulted in lower percentages of patients receiving MHD≤1 Gy. Thus, cardiac sparing may be more difficult to achieve in patients with larger BV. Utilization of alternate treatment positions, such as supine with breathing motion management and prone, greatly improved the percentage of patients able to meet the MHD metric without sacrificing target coverage in all quartiles. Prone positioning was the technique least susceptible to BV effects in meeting the MHD≤1 Gy goal.

Abstract 2413 — Table 1

		% of Plans Meeting Metric per Quartile			
Treatment Position	Metric	Q1	Q2	Q3	Q4
All	V95% [%] ≥95 & MHD [Gy] ≤1	82	72	68	67
All	V95% [%] ≥95	95	96	99	98
All	MHD [Gy] ≤1	86	75	69	68
Supine	MHD [Gy] ≤1	82	61	57	54
Supine + breathing motion management	MHD [Gy] ≤1	86	79	67	67
Prone	MHD [Gy] ≤1	95	90	90	83

Author Disclosure: A. Moncion: Copyright/Patent/License/Royalty; University of Michigan. K. Griffith: Michigan Radiation Oncology coordinating center staff; Blue Cross Blue Shield of Michigan. Compensation/Payment; University of Chicago. E.M. Walker: None. R. Jagsi: unpaid adjunct faculty; University of Michigan. Grant/research funding; NIH, Doris Duke Charitable Foundation, Komen Foundation, American Cancer Society. Honoraria; Greenwell Foundation, academic institutions and societies. Travel expenses; Komen Foundation, Greenwell Foundation, academic institutions and societies. Stock options; Equity Q. M.M. Dominello: Grant/research funding; Novocure. PIU Grant; Ehmet Health. Stock; GSK, PTPI. M. Wilson: Chairperson of board of directors; Michigan Society of Radiologic Technologists. M. Mietzel: Salary support from blue cross blue shield of Michigan as program manager of MROQC; Blue Cross Blue Shield of Michigan. M. Grubb: salary support from blue cross blue shield of Michigan as program manager for MROQC; Blue Cross Blue Shield of Michigan. R. Marsh: salary support from blue cross blue shield of Michigan for MROQC; Blue Cross Blue Shield of Michigan. F.A. Vicini: None. L.J. Pierce: Employee; Michigan Medicine. Travel expenses; BCRF Scientific Advisory Board, BMS Foundation DCIDCP National Advisory Committee, Damon Runyon Cancer Research Foundation, PER. Compensation/Payment; Up to Date, PER. Executive Leadership; American Society of Clinical Oncology, MROQC.

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Practice Patterns and Disparities of Fractionation Schemes for Post-Mastectomy Comprehensive Nodal Irradiation

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Purpose/Objective(s): Hypofractionated (HF) radiotherapy is the established standard of care for whole breast irradiation and is being investigated for comprehensive nodal irradiation, but appropriate patient selection for the latter is currently undefined. This study aims to report national practice patterns and patient selection for HF comprehensive nodal irradiation compared to conventional fractionation (CF). The hypothesis is that the rate of HF for comprehensive nodal irradiation in breast cancer has been increasing over time and is more likely to be offered to disparate demographic populations.

Materials/Methods: We queried the National Cancer Database and identified 128,693 patients who received comprehensive nodal irradiation between 2008-2016 in the United States. No patient who underwent lumpectomy received HF nodal irradiation; therefore, only post-mastectomy patients were included in this study. After the exclusion, 29,053 post-mastectomy patients with adjuvant comprehensive nodal irradiation remained. A multivariable binomial regression analysis between HF and CF patients was performed.

Results: Of the patients identified, 1,910 received HF (6.57%), and 27,143 received CF (93.43%) radiotherapy. All patients had locally advanced breast cancer treated with mastectomy, lymph node dissection, adjuvant radiation, and +/- chemotherapy. The median dose in the HF group was 4,256 cGy in 16 fractions, and in the CF group was 6,040 cGy in 33 fractions. HF rate grew from 3.56% in 2004-2007, 5.29% in 2008-2011, 7.42% in 2012-2013, and 12.05% in 2014-2016. HF was favored in older patients (median age 66 vs. 51, OR = 1.16, 95% Cl 1.11-1.22) and those who lived in suburban or rural regions compared to urban or metropolitan regions (OR = 9.48, 95% CI 1.17-76.9). However, there was no correlation when distance from treatment site was evaluated as a continuous variable. A "boost" dose was used in only 10.58% of HF patients compared to 54.6% of CF patients (OR = 0.17, 95% Cl 0.14-0.21). Chemotherapy was delivered in 36.91% of HF patients compared to 78.14% of CF patients (OR = 0.77, 95% Cl 0.59-0.99). There were no statistically significant correlates of either fractionation scheme for breast laterality, stage, grade, or receptor status. Notably, other than population density and age, demographic factors including race, Hispanic origin, insurance type, median income, and education level demonstrated no correlation with radiation fractionation scheme.

Conclusion: HF for comprehensive nodal irradiation in breast cancer is still uncommon but growing in popularity. Currently, HF is more likely to be used in elderly patients and lower population density centers and less likely to be used in those determined to benefit from receipt of a boost or chemotherapy.

Author Disclosure: J.L. Muallem: Travel expenses; New York Proton Center. Compensation/Payment; New York Proton Center. S. Hasan: Travel expenses; New York Proton Center. Compensation/Payment; New York Proton Center. Chair prostate guideline committee chair; American College of Radiation Oncology. D.C. Marshall: None. J.L. Fox: None. R.L.