

# Adjuvant Proton Therapy for Breast Cancer Treatment: Why Black Women May Derive a Greater Benefit From This Treatment Modality

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## Background

- Breast cancer (BC) patients receiving radiation therapy (RT) may experience an increased risk of cardiovascular morbidity and mortality from a combination of cardiotoxic systemic therapy, pre-existing comorbidities, and radiation dose to the heart.
- To mitigate cardiovascular events, proton therapy (PT), can be utilized to decrease radiation dose to the heart. Yet, PT remains a scarce resource in the United States, especially for marginalized populations who reside in low socioeconomic areas.
- Black women are more likely to present with advanced breast cancer and are at higher risk for additional cardiac comorbidities when compared to other races.
- The Maryland Proton Treatment Center (MPTC) opened in 2016 and, due to its location in West Baltimore, MPTC treats a higher proportion of ethnically and socioeconomically diverse patients.

## Objectives

### Purpose:

- To compare cardiovascular events and risk factors in Black women versus non-Black women before and after receiving PT for BC.

### Hypothesis:

- Black women with BC will have a higher incidence of cardiovascular events and risk factors both before and after treatment and, hence, may derive a greater benefit from the cardiac-sparing effects of PT when compared to other races.

## Methods

- With IRB approval, we conducted a retrospective chart review of consecutively treated BC patients that underwent proton therapy at the Maryland Proton Treatment Center (MPTC) from June 2016 to October 2021
- Collected patient demographics, socioeconomic characteristics, BC history and treatment, and radiation specific data at two time points- MPTC consultation before PT initiated most recent follow-up.
- Chi-square tests and Mann-Whitney U tests used to assess differences between black vs. non-black patients; Kaplan Meier method was used to estimate overall survival and freedom from recurrence; and binary logistic regression used to identify predictors for cardiopulmonary events

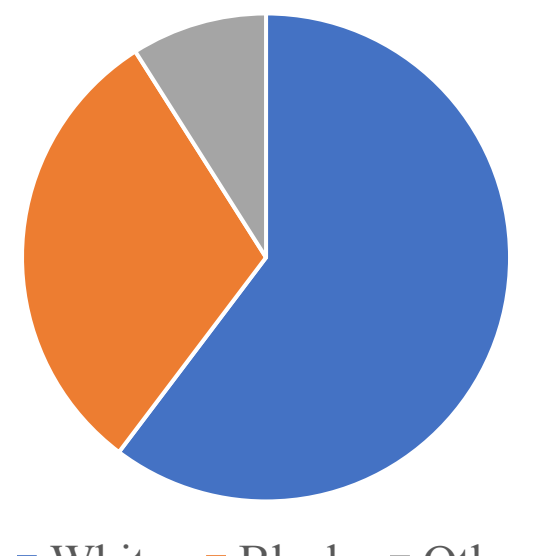
## Eligibility Criteria

- Patients diagnosed with pathologically proven invasive mammary carcinoma (ductal, lobular, or other) of the breast who underwent either mastectomy, lumpectomy, or local excision.
  - Older than 21 years of age
  - Received breast/chest wall +/- nodal (axillary, supraclavicular, or internal mammary lymph nodes) PT at MPTC.
  - Pertinent history/physical examination done within 30 days prior to receiving PT

## Results

Table 1. Patient Characteristics

RACE	N=392	Patient Characteristic			
White	236 (60.2%)	Black (n=119)	Non-Black (n=273)		p-Value
Black	119 (30.4%)				
Other	37 (9.4%)				



Patient Characteristic	Black (n=119)	Non-Black (n=273)		p-Value
Sex				
Female	117 (98.3%)	272 (99.6%)		0.220
Male	2 (1.7%)	1 (0.4%)		
Marital Status				
Single	45 (38.5%)	44 (16.6%)		< 0.001
Married	54 (46.2%)	181 (68.3%)		
Divorced	14 (12.0%)	28 (10.6%)		
Widowed	4 (3.4%)	12 (4.5%)		
Insurance				
Private	82 (68.9%)	185 (68.5%)		0.477
Medicare/ Medicaid	28 (23.5%)	69 (25.6%)		
Other	7 (5.9%)	8 (3.0%)		
Combination	2 (1.7%)	8 (3.0%)		
Mean Age at MPTC Visit (Range)	54.73 (21-81)	57.50 (28-85)		0.570
Median Income by Zip Code	\$72,992.00	\$91,242.00		< 0.001

Figure 1. Patient Race Distribution

Table 2. Cancer Characteristics

Cancer Characteristic	Black	Non-Black	P-Value
ER+	68 (57.1%)	203 (74.9%)	< 0.001
PR+	57 (47.9%)	173 (64.1%)	0.004
HER2+	20 (16.9%)	62 (23.2%)	0.179
Triple Negative Disease	43 (36.1%)	43 (15.9%)	< 0.001
Stage (at time of MPTC visit)			
0	1 (0.8%)	6 (2.2%)	0.062
I	6 (5.0%)	36 (13.2%)	
II	35 (29.4%)	96 (35.2%)	
III	41 (34.5%)	67 (24.5%)	
IV	9 (7.6%)	9 (3.3%)	
Recurrence	27 (22.7%)	59 (21.6%)	
Recurrent Disease	35 (29.4%)	67 (24.5%)	0.319

Table 3. Cancer Treatment

Cancer Treatment	Black	Non-Black	P-Value
Prior RT to Treatment Area	26 (21.8%)	46 (16.8%)	0.258
Neoadjuvant Chemotherapy	69 (58.0%)	121 (44.5%)	0.016
Adjuvant Chemotherapy	33 (28.0%)	96 (35.3%)	0.162
Endocrine Therapy	67 (56.3%)	200 (74.9%)	< 0.001
Mean Total Dose RT Given (Gy)	57.5	54.4	0.018

Table 4. Co-morbidities Present at Consult

Health Status at Consult	Black	Non-Black	P-Value
BMI (mean; range)	32.22 (18.8-49.5)	28.04 (16.5-56.0)	<0.001
Diabetes Mellitus	22 (18.5%)	25 (9.2%)	0.011
Hypertension	68 (57.1%)	65 (23.8%)	< 0.001
Hyperlipidemia	32 (26.9%)	58 (21.2%)	0.241
Current Smoker	10 (8.5%)	11 (4.0%)	0.088
Cardiopulmonary Condition**	31 (26.1%)	31 (11.4%)	< 0.001

\*\*Cardiopulmonary conditions include atherosclerotic coronary heart disease or other heart disease death, myocardial infarction, coronary revascularization, hospitalization for major cardiovascular event (heart failure, valvular disease, arrhythmia, unstable angina, pericardial effusion, or other major cardiovascular event), pulmonary embolism, pleural effusion, COPD, pulmonary fibrosis, pneumonitis

Table 5. Co-morbidities Present at Latest Follow Up

\*Median follow up of 23.5 months

Health Status at Follow Up (post RT)	Black	Non-Black	P-Value
BMI (mean; range)	32.81 (21.51-50.19)	28.31 (17.44-49.06)	< 0.001
Diabetes Mellitus	22 (18.5%)	26 (9.6%)	0.018
Hypertension	69 (58.0%)	78 (28.9%)	< 0.001
Hyperlipidemia	30 (25.2%)	54 (20.0%)	0.285
NEW Cardiopulmonary Condition**	20 (16.8%)	24 (9.0%)	0.036
Cardiac Condition	7 (5.9%)	16 (6.0%)	1.00
Pulmonary Condition	12 (10.1%)	9 (3.4%)	0.013

Table 6. Predictive Factors of New Cardiopulmonary Events at Follow Up

Characteristic	Odds Ratio	95% CI	P-Value
Univariate Analysis			
Race (Black vs non-Black)	2.045	1.081-3.871	0.028
Age (continuous variable)	1.036	1.011-1.062	0.005
Recurrent Disease	1.934	1.005-3.723	0.048
ECOG PS	1.800	1.152-2.814	0.010
Hypertension @ consult	2.636	1.395-4.978	0.003
Hypertension @ follow up	2.164	1.149-4.076	0.017
Hyperlipidemia @ follow up	2.084	1.058-4.104	0.034
Multivariate Analysis			
Hypertension @ consult	2.557	1.353-4.831	0.004

Table 7. Clinical Outcomes

Survival	Black	Non-Black	Hazard Ratio	95% CI	P-Value
Median Survival (months)	53 months	**Not Reached	2.287	1.074-4.870	0.032
Freedom from recurrence	8 months	15 months	1.797	0.962-3.359	0.063

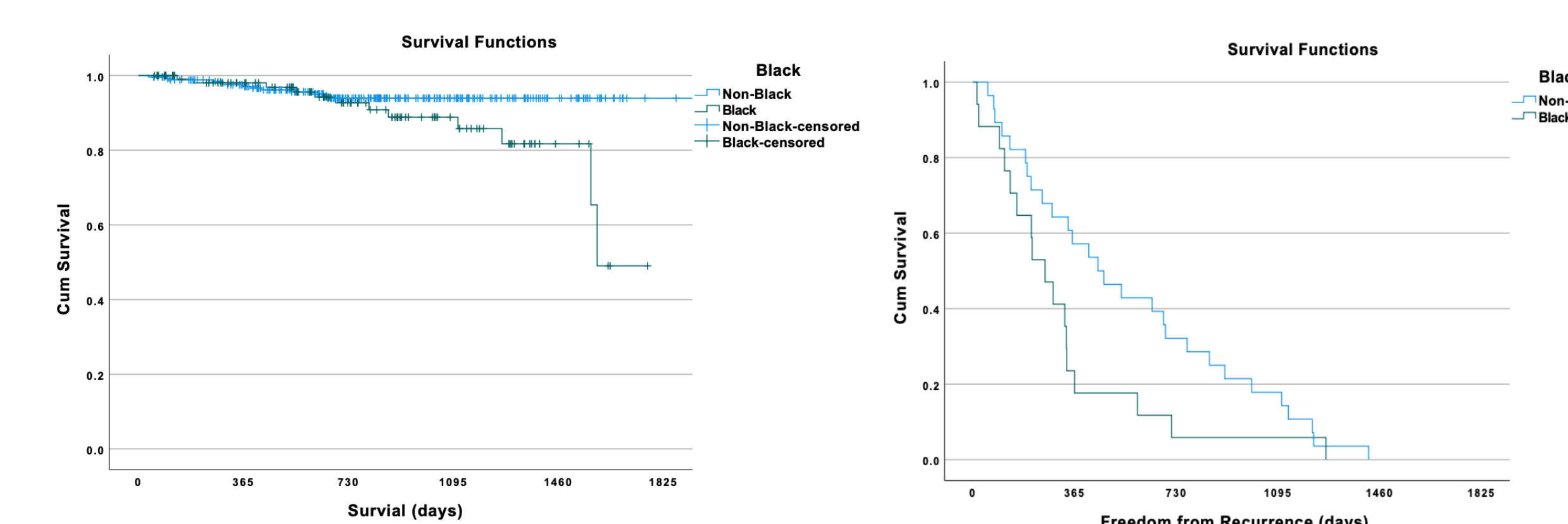


Figure 2. Kaplan Meir Survival Outcomes

## Conclusions and Future Directions

- Black BC patients present with more aggressive, advanced disease with significantly increased incidence of pulmonary events and cardiopulmonary risk factors both before and after RT treatment
  - Indicates that Black women may derive a greater benefit to advanced RT techniques, such as proton therapy, which can decrease integral radiation dose to the heart, potentially diminishing further cardiopulmonary toxicity
  - Emphasizes importance of improving PT accessibility for marginalized populations
- Further study
  - Larger sample size (N=550)
  - Dosimetric contributions to cardiopulmonary toxicities
  - Extended median time to follow-up