Percent Predicted Peak Exercise Oxygen Pulse Is a Marker of Cardiac Reserve Following Thoracic Radiotherapy
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OBJECTIVES/SPECIFIC AIMS: Cardiac radiation exposure following anti-cancer (CA) thoracic radiotherapy (RT) treatment increases risk of heart failure in a dose-dependent manner with a predominantly restrictive cardiomyopathy phenotype and is characterized by a diffuse fibrosis within the myocardium. The peak oxygen pulse (O2Pulse) determined at cardiopulmonary exercise testing (CPET) is the quotient of oxygen consumption (VO2) divided by the heart rate (HR) at peak exercise. Through deduction of the Fick equation (VO2 = cardiac output (CO) x arteriovenous oxygen difference) it provides a noninvasive estimate of the stroke volume response to exercise. Knowledge of the relationship between cardiac radiation dose and O2Pulse may provide mechanistic insight into the cardiac reserve of the CA survivor following thoracic RT.

METHODS/STUDY POPULATION: Patients without a history of cardiovascular disease with a history of thoracic RT for CA treatment with significant incidental heart exposure (≥5 Gray (Gy) to ≥10% of the heart volume) underwent treadmill CPET to determine cardiorespiratory fitness and cardiac magnetic resonance (CMR) imaging to quantify central hemodynamics and for myocardial tissue characterization. The mean cardiac radiation dose (MCRD) and %volume of heart dose was determined from dose-volume histograms reflective of the dose contributions from all RT treatments for each patient. The oxygen pulse (milliliters (mL) of O2 per heart beat) was determined by dividing the absolute VO2 by the HR (beats per minute, bpm) at peak exercise and reported as %-predicted values to account for age and gender differences. Data are reported as number (%) or median (interquartile range). A stepwise multivariate linear regression model was created from significant univariate RT and CMR variables to determine independent predictors of %O2Pulse. RESULTS/ANTICIPATED RESULTS: Thirty patients (age = 63 [57-67] years, 18 [60%] female, 2.0 [0.1-28.7] years since completion of RT) underwent study procedures. The peak VO2=1376 mL/min-1 (62% of predicted) and peak HR = 150 (122-164) bpm resulted in a peak O2Pulse of 9.2 mL/beat (82% of predicted). The MCRD = 5.6 [3.7-17.8] Gy was inversely associated with %O2Pulse at univariate analysis (R = -0.514, p < .01), but was not retained at multivariate analysis. The CMR-derived CO ([4.9 (4.09-5.90) Liters/minute], β = +.374, p < .01), CMR-extracellular volume ([ECV, 26.9 (24.8-29.2)%], β = -.536, p < .01), and volume of the heart exposed to ≥30 Gy ([2.5 (0-15.0)Gy], β = -3.45, p = .01) were retained in the model (R2 = .709, F(3,19) = 15.438, p < .001) and were independent predictors of the %O2Pulse. DISCUSSION/SIGNIFICANCE OF IMPACT: In patients with significant heart exposure following RT, %O2Pulse (a surrogate of stroke volume response to exercise) is inversely associated with cardiac radiation dose and is related to central hemodynamics (CO) and markers of diffuse fibrosis (ECV).