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Title: Improved Detection of Subclinical Cardiovascular Toxicity Following Thoracic Radiotherapy for Locally Advanced Lung Cancer via Quantitative Regional MRI Metrics of the Myocardium and Aorta

Radiation therapy is an integral part of curative cancer treatment for patients with lung cancer. Radiotherapy improves cure rates, but has also been shown to cause damage to the heart. This damage might affect valves, coronary arteries, and the heart muscle itself. In the worst case, cancer treatment might lead to the patient's death, while the cancer has been controlled. Typically, these side effects from radiotherapy have been noticed 10 years or more after the treatment was completed. More recent observations indicate, however, that damage to the heart might become clinically symptomatic as early as 2 years or even sooner after radiotherapy. Our hypothesis is that radiotherapy may cause acute or early toxic changes in the heart and aorta during and after treatment that so far have gone unnoticed and which later develop into overt heart damage.
This project is designed to investigate novel cardiac magnetic resonance imaging (CMR) methods (DENSE and T1/T2 mapping) to identify acute heart damage during and after radiotherapy for patients with lung cancer involving radiotherapy of the heart. In addition, a set of markers in the blood will be investigated as well. Markers in the blood and CMR will be tested before and after the end of radiotherapy, as well as during the regular 3 and 6 month follow up visits to identify early changes associated with radiation treatment. Potential associations between the test results of serum markers and CMR and correlations with the radiation dose delivered to the heart will be analyzed. Measurements will be obtained on an IRB-approved protocol in 15 lung cancer patients who undergo radiotherapy to the chest for their cancer disease and who receive radiation to the heart due to a tumor location close to the heart. Identification of imaging findings and/or markers in the blood indicative of radiation-related heart damage may allow us to develop new therapies to treat heart damage at an early stage, prevent its progression to clinically evident late damage, and reduce treatment-related cardiac death. The proposed study will also lead to detailed knowledge of radiation dose parameters that are related to cardiac damage. This information will be pivotal in advancing the decision-making process in radiotherapy and the development of new radiation treatment techniques with the goal of sparing the heart from excessive radiation dose. The proposed investigation is particularly beneficial for patient groups where preexisting cardiovascular conditions are more prevalent and who are therefore expected to have a higher risk of heart damage from radiation therapy, such as African American patients.