AbstractID: 12335 Title: Imaging for treatment assessment: Are we forgetting normal tissue?

The goal of treatment planning is to deliver therapeutic target doses while sparing normal tissues. Advances in imaging focus largely on target definition. Challenges defining normal tissues approaches to better define/quantify normal tissues are discussed.

Image Segmentation: Knowledge of normal anatomy facilitate target delineation; e.g. understanding mediastinal great vessel anatomy facilitates identification of cancerous lymph nodes; vessels are occasionally inadvertently defined as nodes.

Dose volume histograms (DVH) assume spatial homogeneity: DVHs describe/quantify normal tissue exposure. DVHs discard spatial information and inherently assume all regions are equally important. Physiologic-based imaging (e.g. SPECT [single photon emission computed tomography] lung perfusion) is a surrogate to quantify regional lung function. Dose function histograms (DFHs) consider the distribution of dose within the lung perfusion. MRI/SPECT/PET maybe useful to define critical sub-regions of the heart and brain.

Quantification to study (and reduce risk) of RT-induced injury: Nuclear medicine images provide unique quantifiable functional data (e.g. regional perfusion counts/pixel). Functional MRI (e.g. spectroscopy) is similar. We have used these technologies to quantitatively study RT-induced changes lung, heart and brain perfusion/function. Changes in regional lung/heart perfusion are assessed by pre & post-RT SPECT scans; providing 3D perfusion maps. Registering SPECTs with RT planning CTs (& 3D doses) allows perfusion changes to be related to regional RT dose; providing dose-response curves. The “sum” of regional SPECT perfusion changes are weakly related to changes in global lung (e.g PFTs) and heart (e.g. wall motion) function. We hypothesize that the degree of lung/heart changes are related to changes in global cardiopulmonary function (e.g. symptoms, peak O2 consumption).

Quantifiable imaging facilitates optimization to preferentially steered dose away from the better-perfused areas vs. lesser-perfused areas. IMRT affords particular flexibility in this regard. This approach has been termed biologically-based treatment planning. Supported in part by NIH grant R01 CA69579.