AbstractID: 8262 Title: Investigating the utility of dose-functional histograms in risk assessment of thoracic radiotherapy

Purpose: Dose-volume histograms (DVH) are commonly used for quality appraisal of treatment plans. However, since each volume of interest is treated as functionally and histologically uniform, the DVH reflects no information about the underlying anatomy. This simplification, while often reasonable, is excessive when applied to the lung. It has been frequently suggested that weighting dose distributions in thorax according to the relative functional integrity of the irradiated regions may provide better information for risk assessment of pneumonitis. We investigate the utility of dose-density-corrected histograms, and other potential dose-functional metrics, in treatment plan evaluation, risk assessment of the treatment complications, and clinical decision-making.
Method and Materials: In the first approximation, the tissue density, estimated from CT data, can serve as a surrogate measure of lung perfusion, ventilation, or both. Potentially, the dose-function histograms may be created based on more direct measurements of lung perfusion: e.g., with SPECT, helical CT with IV-contrast, while ventilation may be estimated from point density changes between the extreme phases in respiratory-correlated CT. For this study, clinical lung IMRT plans were analyzed using in-house software, and DVH were compared to histograms corrected for tissue density (standard CT) and tissue-density variations (respiratory-correlated CT).
Results: Generally, the DVH and density-corrected histograms differ wherever density variations are present within the volumes of interest: e.g., in radiotherapy of tumors in the lung, paranasal sinuses. Substantial changes in certain histogram metrics were observed, e.g., the relative difference of over 20% between the dose to 60% of volume (D_{60}) and that to 60% of the lung mass.
Conclusion: The adjustments to the shape of the histogram, resulting from density-correlated weighting of the dose, will result in a different data binning in the outcome analysis, which may, in its turn, lead to refinements in the risk assessment models.

Supported by NIH grants R01-CA103904, RO1-CA118200