AbstractID: 1963 Title: Predicting radiation-induced normal organs injury using the functional equivalent uniform dose (FEUD) model

Radiation-induced normal-organs injury is one of the limiting factors for not escalating the tumoricidal dose in RT. Despite this fact, there are no good tools for predicting patients who are more likely to develop complications prior to a course of RT. The objective of this work is to predict the risk of radiation-induced lung and heart injury using the functional equivalent uniform dose (FEUD) model. The FEUD approach accounts for the spatial variation in normal-organ function (EUD assumes spatially-uniform function). In 38 lung and 18 left-sided breast/chest-wall cancer patients, the RT-induced changes in SPECT regional perfusion of lung and left-ventricle (LV), respectively, were correlated to the FEUD/EUD ratio (R_{FE}). This ratio was later used to predict the risk of radiation-induced lung pneumonitis (RILP) and reduction in LV ejection fraction (LVEF). Results show there is a correlation between R_{FE} and RILP, lung tumor-staging, and LVEF. An $R_{FE} \geq 1$ was associated with 6 out of 8 patients who developed RILP, and $R_{FE} < 1$ with 23 out of 30 patients who did not. Lung patients with stage 2, 3, and 4 disease have $R_{FE} < 1$. The lung function R_{FE} values decrease with increasing tumor aggressiveness, possibly due to tumor obstruction of blood flow to the lung vessels. Results also show that few patients with pre-treatment LVEF<60%, $R_{FE} \geq 1$, and high FEUD are at greater risk of post-treatment complications due to higher doses to functional LV. In conclusion, the FEUD/EUD ratio predicts radiation-induced lung and heart toxicity, a fact that is not revealed by the EUD data alone.