AbstractID: 6624 Title: Prediction of lung Radiation-Induced Pneumonitis using the support vector machine algorithm

Purpose: To build and test a Support Vector Machine (SVM) model to predict the occurrence of lung radiation-induced Grade 2+ pneumonitis. SVM is a sophisticated statistical technique that is capable of using complex hypersurfaces to separate the cases with and without pneumonitis.

Method and Materials: Two SVM models were built using data from 235 patients with lung cancer treated using radiotherapy (34 diagnosed with pneumonitis). One model (SVM_{all}) selected input features from all dose-volume and non-dose factors. For comparison, the other model (SVM_{dose}) selected input features only from lung dose-volume factors. The models were built with in-house developed software that employed a unique strategy to sequentially add/remove/substitute features. The SVM models were tested using ten-fold cross-validation, wherein $1/10^{th}$ of the data were tested, in turn, using the model built with the remaining $9/10^{th}$ of the data.

Results: The input features selected to build SVM_{all} were the lung generalized equivalent uniform dose (EUD) with exponents a=1.2, 1.3, 1.4, chemotherapy prior to radiotherapy (yes/no), tumor location (central/peripheral), gender, and histology (adenocarcinoma/other; small cell/other). The input features for SVM_{dose} were EUD a = 1.1, 1.3, 1.4, lung volume receiving > 48 Gy (V48), and V50. Both models selected EUD a ≈ 1 (EUD a=1 is the mean lung dose, which frequently appears as a strong predictor of radiation pneumonitis in literature). The area under the cross-validated SVM_{all} Receiver Operating Characteristics curve was 0.76 (sensitivity/specificity = 74%/75%), compared to the corresponding SVM_{dose} area of 0.71 (sensitivity/specificity = 68%/68%). SVM_{all} was statistically superior (p=0.01), indicating that non-dose features significantly contribute to separating patients with and without pneumonitis.

Conclusions: The SVM model constructed from dose and non-dose input factors is a valuable prospective tool for predicting the occurrence of radiation-induced lung pneumonitis.