AbstractID: 6616 Title: A Neural Network Model to Predict Lung Radiation-Induced Pneumonitis

Purpose: To build and test a feed-forward neural network model to predict the occurrence of lung radiation-induced Grade 2+ pneumonitis.

Method and Materials: The database comprised 235 patients with lung cancer treated using radiotherapy (34 diagnosed with pneumonitis). The neural network was constructed using a unique algorithm that alternately grew and pruned it, starting from the smallest possible network, until a satisfactory solution was found. The weights and biases of the network were computed using the error back-propagation approach. The network was 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 network was constructed with input features selected from dose and non-dose variables. The selected input features were: lung volume receiving > 16 Gy (V_{16}), mean lung dose, generalized equivalent uniform dose (gEUD) for the exponent a=3.5, free expiratory volume in 1s (FEV_1), diffusion capacity of Carbon Monoxide (DLCO%), and whether or not the patient underwent chemotherapy prior to radiotherapy. With the exception of FEV1, all input features were found to be individually significant ($p < 0.05$). The area under the Receiver Operating Characteristics (ROC) curve for cross-validated testing was 0.76 (sensitivity: 68%, specificity: 69%). To gauge the impact of non-dose variables on model predictive capability, a second network was constructed with input features selected only from lung dose-volume histogram variables. The area under the ROC curve for cross-validation was 0.67 (sensitivity: 53%, specificity: 69%). The network constructed from dose and non-dose variables was statistically superior (p=0.020), indicating that the addition of non-dose features significantly improves the generalization capability of the network.

Conclusions: The neural network constructed from dose and non-dose variables can be used to prospectively predict radiotherapy-induced pneumonitis and, thereby, appropriately alter radiotherapy plans to reduce this possibility.