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PET/CT Radiomics predict Pulmonary Lymphangitic Carcinomatosis (PLC) in Non-Small Cell Lung Cancer (NSCLC)

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Abstract

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Introduction: Pulmonary lymphangitic carcinomatosis (PLC) is defined as the spread of cancer through the lymphatic system into the lung interstitium and its accurate radiologic diagnosis is challenging. We propose and evaluate a PET/CT Radiomics analysis to predict the definitive diagnosis of PLC based on histopathologic examination in NSCLC.

Methods: Ninety patients addressed for initial staging of NSCLC were retrospectively included (PLC 67/90=74%, non-PLC 23/67=26%). This dataset was split into a training set and a validation set. The training set included only images from our institution. The validation set included only images from different medical centers. An initial set of 224 radiomic features were extracted from F-18-FDG PET/CT with QuantImage [1] and PyRadiomics [2], including intensity and 3-D texture features from the tumoral (GTV-T), peritumoral (P-GTV) and contralateral normal lung volumes (NLV). The machine learning pipeline included feature selection, principal component analysis and logistic regression. The pipeline was trained and optimized on the training set for different features subsets from PET and CT for each GTV and for P-GTV minus NLV. Performance averages and confidence intervals [95%CI] were assessed with bootstrap analysis on the validation set.

Results: The following performances were observed for P-GTV for CT (i) and PET (ii): Area Under the ROC Curve (AUC) (i) 0.85 [0.68-0.98], (ii) 0.79 [0.58-0.96], accuracy (i) 0.80 [0.68-0.98], (ii) 0.79 [0.58-0.96], sensitivity (i) 0.77 [0.63-0.93], (ii) 1.00 [1.00-1.00] and specificity (i) 0.75 [0.38-1.00], (ii) 0.26 [0-0.63]. GTV-T and (P-GTV minus NLV) showed an AUC of (i) 0.71 [0.45-0.93], (ii) 0.71 [0.51-0.87] and (i) 0.79 [0.63-0.92], (ii) 0.72 [0.48-0.93], respectively.

Conclusions: These results suggest that FDG-PET/CT Radiomics analysis of the peritumoral NSCLC space can help predict PLC using both CT- and PET-derived features. Our proposed radiomics model may help to probe the peritumoral environment by having the capacity to leverage higher order 3-D textural information that is invisible to the naked eye, thus allowing to predict PLC.

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