37 QUANTITATIVE LUNG AIRWAY MORPHOLOGY (QUALM) FEATURES ON CHEST CT SCANS ARE ASSOCIATED WITH RESPONSE AND OVERALL SURVIVAL IN LUNG CANCER PATIENTS TREATED WITH CHECKPOINT INHIBITORS

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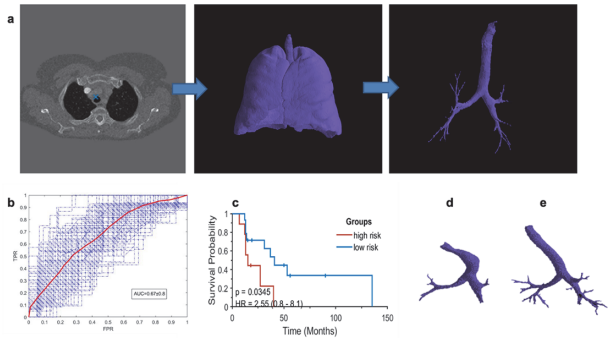
Background Immune checkpoint inhibitors (ICI) have revolutionized the management of lung tumors decreasing mortality rates. However, the response rates to these ICI drugs are limited, and identifying those patients who are most likely to benefit remains a clinical challenge. Due to the complex nature of the host immune response, tissue-based biomarker development for immunotherapy (IO) is challenging. Consequently, there is a critical unmet need to develop accurate, validated imaging biomarkers to predict which Non-Small Cell Lung Cancer (NSCLC) patients will benefit from IO. Airway deformations such as central airway obstruction can be considered an important manifestation of cancer aggressiveness or metastatic disease and may have a significant impact on therapeutic refractoriness. In this study, we sought to evaluate whether quantitative measurements of lung airway morphology (QuaLM) on baseline CT scans are associated with response and overall survival in NSCLC patients treated with ICI.

Methods In this retrospective study, 80 cases who underwent 2–3 cycles of PD1/PD-L1 ICI therapy (nivolumab/pembrolizumab/atezolizumab) were included. RECIST v1.1 was used to define 'responders' and 'non-responders'. Patients were randomly divided into a training (n=40) and a test set (n=40). A region growing algorithm is applied to the trachea, identified by Hough transform, to segment bronchi and bronchioles (figure 1a). 14 QuaLM features were extracted from segmented airway on CT scans. Wilcoxson ranksum test is used to identify the predictive QuaLM features. The top 4 QuaLM features in conjunction with a linear discriminant machine learning classifier were used to predict the response to IO. We also built a QuaLM risk score using the least absolute shrinkage and selection operator (LASSO) Cox regression model to predict overall survival (OS).



Abstract 37 Figure 1 a) The pipeline of airway segmentation includes trachea identification, segmenting the lung regions from surrounding anatomy, and segmenting the airway by applying a region-growing algorithm. b) ROC curve of QuaLM model for predicting IO response from baseline CT scans. c) Kaplan Meier curve analysis reveals dichotomization of patients into low risk and high-risk groups with distinct survival patterns based off QuaLM features. d,e) An example airway structure of a non-responder and a responder to ICI.

Abstract 37 Table 1 Predictive airway features that found to be significantly different among responders and non-responders to IO

Feature	Description	P-value
Major Axis Length	A measure of the axis on the ROI-enclosing ellipsoid which is longest.	0.010
Maximum 2D Diameter Column	The largest pairwise Euclidean distance between surface mesh vertices in the row-slice.	0.046
Maximum 3D Diameter	The largest pairwise Euclidean distance between any two vertices.	0.048
Sphericity	A measure of the roundness of the tumor region relative to a sphere	0.007

Results The response prediction model trained with top QuaLM features (table 1) predicts responders to ICI with an area under research operating characteristic curve (ROC AUC) of 0.67±0.08 (figure 1.b) in the training (St) and AUC=0.63 in the test set (Sv). The airway radiomics risk-score was found to be significantly associated with OS in St (HR=2.34, 95% CI:[1.08–5.07], P=0.008) and Sv (HR=2.55, 95% CI:[0.8–8.1], P=0.034) (figure 1.c).

Conclusions QuaLM features were able to distinguish responders from non-responders and also were found to be associated with OS for NSCLC patients treated with ICI. With additional validation, QuaLM could potentially serve as an imaging biomarker of ICI response assessment for NSCLC patients. This could allow the selection of NSCLC patients who will benefit from IO and help design more rational clinical trials with a combination of IO.

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