Comparison Of Inspiration And Expiration Density-based CT Measurements With CT Texture-based Radiomics In Predicting COPD Symptoms

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Purpose: To investigate the association between texture-based radiomics on inspiration and expiration computed tomography (CT) with Chronic Obstructive Pulmonary Disease (COPD) symptoms, and compare these emerging features to established density-based CT measurements

Rationale

- Existing CT biomarkers, such as density-based CT measurements[1,2] derived from inspiration and expiration images, are pathologically validated in quantifying emphysema and gas trapping in COPD but do not fully capture the complex structural changes that occur in the lung
- Texture-based radiomics[3] is a novel technique that extracts detailed grey-level based textural information that quantifies the spatial relationships of voxels

Methods

Canadian Cohort Obstructive Lung Disease (CanCOLD)

Cohort between 45-90 years of age selected by random digit dialling from the general Canadian population[4].

Pulmonary Function Testing (PFT)

Forced expiratory volume in 1 second (FEV_1) was obtained at each CanCOLD centre by technicians. Lung function decline (ΔFEV_1) was calculated using annualized change in FEV_1

Symptom Questionnaires

St. George's Respiratory Questionnaire (SGRQ) ≥ 25 and Body-mass index (B), the degree of airflow obstruction (O) and dyspnea (D), and exercise capacity (E): BODE Index ≥ 1 were used as the COPD Symptom Assessment thresholds[5]

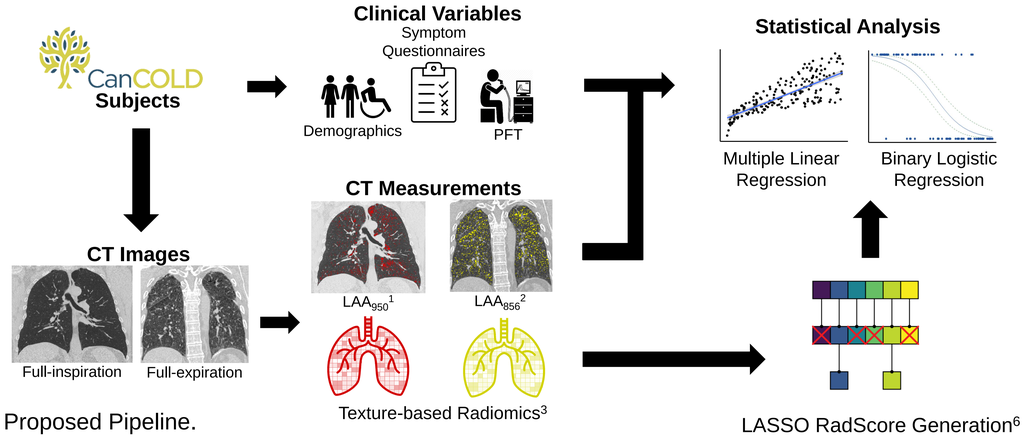

Figure 1: Proposed Pipeline.

Results

Demographics

We investigated n=572 no COPD and n=579 COPD subjects. Subjects were not different with respect to race (p=0.251) and BMI (p=0.287). FEV_1 worsens with increasing COPD severity (No COPD: 2.8 ± 0.8 L; COPD: 2.4 ± 0.8 L).

Table 1: Multiple Linear Regression Models

CT Measurement	FEV_1 (n=1151)		ΔFEV_1 (n=687)	
	Std. Est. of QCT	P-value	Std. Est. of QCT	P-value
Density-based Inspiration(LAA_{950})	-0.033	0.273	-0.016	0.809
Density-based Expiration (LAA_{856})	-0.014	0.681	-0.172	**0.035**
Texture-based Inspiration ($RadScore_{Insp}$)	-0.080	**0.006**	-0.028	0.650
Texture-based Expiration ($RadScore_{Expr}$)	-0.378	**<.001**	-0.137	**0.049**

Significance of difference: p<0.05

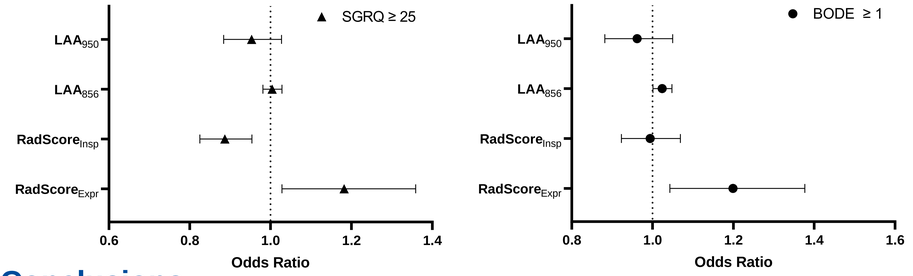

Figure 2: Odds Ratio (OR) plots of our CT measurements with a 95% confidence interval (CI), predicting binary outcomes of SGRQ ≥ 25 and BODE ≥ 1. An OR=1 indicates that the measurement does not affect the odds of a given outcome. An OR>1 indicates that the measurement is associated with a higher odds of a given outcome whereas an OR<1 is associated with a lower odds of an outcome.

Conclusions

Our results showed that texture-based radiomics extracted from CT images provide complementary information to existing CT features. These emerging biomarkers may detect structural changes that can be used for predicting the occurrence of COPD symptoms and longitudinal lung function decline.

References

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Acknowledgments

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