INTERNAL AIRFLOW DISTRIBUTION IS DRIVEN BY LOBAR VOLUME, HYPERINFLATION AND EMPHYSEMA SCORE IN COPD PATIENTS

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Functional respiratory imaging (FRI)

In the FRI workflow, CT images are converted into 3D patient specific quantifiable endpoints. FRI yields the following parameters:

- Internal airflow lobar distribution (IALD)
- Airway resistance (iRaw)
- Lung volume (iVlung)
- Lobar perfusion (BVD)
- Lobe volume (iVlobe)
- Aerosol deposition
- Airway volume (iVaw)

Previously it was shown that:

- FRI is 3-8 times more sensitive than the classic pulmonary function tests (PFT) to evaluate treatment\(^1,2\).
- FRI is optimal to understand the exact mode of action of a treatment in early clinical research\(^3\).
- Changes in FRI parameters correlate with changes in lung function and changes in patient feeling\(^2\).

Aim

COPD is characterized by tissue and airway wall inflammation, distortion and destruction (emphysema, small airway disease). This trial tries to identify the influence of hallmark characteristics of COPD on regional ventilation in patients.

Methods

For 28 patients (21M, 66.3 ± 6.4 y; 8/18/2 GOLD II/III/IV, FEV\(_1\) = 43.9 ± 11.9 %) FRI-based regional measures on lobar volume, hyperinflation, perfusion, emphysema and ventilation were obtained from breathing gated HRCT scans at FRC and TLC. A generalized estimating equation was fit to the data in order to predict regional ventilation in function of the other parameters, correcting for lobar repeated measures within a patient.

Results

A positive correlation was found between regional ventilation and static lung volume (p<0.001). Emphysema (p=0.017) and hyperinflation (p=0.028), independently, have a negative correlation with ventilation, while perfusion does not have a direct influence on ventilation (p=0.98).

Conclusions

It could be seen that airflow distribution is mainly driven by the static lobe volume, i.e. larger lobes attract more air than smaller lobes. However, this correlation is counteracted by the presence of emphysema and/or other reasons for hyperinflation. This means that also hyperinflated regions with predominant small airways disease receive less ventilation and hence a less optimal distribution of inhaled treatments.

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