Long term effects of non-invasive ventilation in hypercapnic COPD patients

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Patients with severe COPD (FEV1 < 50%) often develop chronic hypercapnic respiratory failure

Their prognosis worsens and they are more likely to develop exacerbations

To diminish the number of exacerbations and improve survival significantly:

- Long-acting bronchodilators
- Inhaled corticosteroids
- Long-term oxygen therapy (LTOT)
- Volume reduction surgery improve survival

In hypercapnic patients non-invasive ventilation (NIV) is often added to the treatment to:

- Improve gas exchange
- Unload the respiratory muscles
- Reset the central respiratory drive.

Last 2 only in well selected patients.
Introduction

- It was shown that NIV in acute setting
  - Can prevent intubation, and invasive ventilation [1]
  - Reduces hospital mortality [2]

- Nevertheless, there is few information about chronic NIV [3-5]
  - Which patient should be treated preferably
  - What could be the effect

This trial aims to understand the exact changes induced by long term NIV in stable, hypercapnic COPD patients using functional respiratory imaging (FRI).
Functional Respiratory Imaging

1. Image Acquisition

2. Structure Segmentation

3. Flow Simulation

- Outcome parameters on
  - Lung structure (airways, blood vessels, lobes)
  - Lung tissue (emphysema, fibrosis, airway wall)
  - Lung function (ventilation, perfusion, resistance, V/Q)
  - Exposure of treatment

Study setup

- 10 COPD patients
  - Persistent hypercapnia (>5 days) after hospitalization
  - Treated for 6 months with NIV (nocturnal) in a home setting

Outcome parameters
- Blood gasses
- Lung function
- Exercise capacity
- Patient feeling (PRO)
- FRI analysis

Three study visits
- Baseline
- After 1 month of treatment *
- After 6 months of treatment *

* (evaluation without NIV)
Very heterogeneous changes in lung structure and function [1,2]

- Decreased airway dimensions
- Increased airway resistance
- Increased expiratory volumes
- Decreased inspiratory capacity

[2] Int J COPD 2017 (accepted)
Dynamics of COPD exacerbations

- Very heterogeneous changes in lung structure and function [1,2]
  - Between and within patients

- Increased chances on ventilation perfusion (V/Q) mismatch [2]
Dynamics of COPD exacerbations

- Very heterogeneous changes in lung structure and function between and within patients

- Increased chances on ventilation perfusion (V/Q) mismatch

- Long term NIV does cause a redistribution in the ventilatory patterns during the recovery of COPD exacerbation [1], possibly leading to improved V/Q balance
Significantly improved arterial blood gases and self reported anxiety scores
Results

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- Non significant improvements in 6MWD (clinically meaningful difference of +51m), airway volumes and resistances
Results

- Significantly improved arterial blood gases and self-reported anxiety scores
- Non-significant improvements in 6MWD (clinically meaningful difference of +51m), airway volumes and resistances
- Changes in desaturation and oxygen saturation during 6MWT are driven by changes in inspiratory capacity
Change in 6MWD is driven by improved V/Q balance
Change in anxiety score is driven by more stable (larger) distal airways
Conclusions

- Long term NIV has the possibility to improve stable hypercapnic COPD patients

- Clinical improvements were observed in
  - Blood oxygenation
  - Anxiety score
  - 6MWD (non significant)

- Clinical improvements were shown to be linked to changes in
  - Inspiratory capacity
  - Airway constriction and resistance
  - Regional V/Q balance obtained from CT
Future work

✔ This small pilot study gives confidence to evaluate the effect of long term NIV in a larger population

✔ Patient improvement was shown to be linked to regional changes in FRI parameters (V/Q) indicating that these might have the potential to predict responses at baseline, that needs further investigation.