

Effect of Endobronchial Valves on Hypercapnia

The clinical question

Does endobronchial valve therapy reduce the P_aCO_2 in patients with mild to severe hypercapnia?

AABIP take home message

BLVR in patients with mild to severe hypercapnia lead to a statistically significant reduction in P_aCO_2 in a carefully selected patient population. Further studies, preferentially prospective, are needed to verify this and determine its clinical significance.

Background

Study conclusion

Endobronchial valve therapy did lead to a statistically significant decrease in P_aCO_2 in patients with pre-existing hypercapnia. This warrants further study given the retrospective nature of this trial.

Study background

It is known that hypercapnia in patients with severe COPD is a sign of end-stage disease, and reductions in hypercapnia (through nocturnal NIV) are associated with improvements in survival¹. Retrospective studies have suggested improved survival in patients who achieve complete lobar collapse^{2,3,4}. However, the most recent large-scale trials of bronchoscopic lung volume reduction (BLVR) have excluded patients with hypercapnia.

Current practice / Guidelines

Currently, large scale trials have excluded hypercapnic patients due to a 2-3% rate of respiratory failure from BLVR^{5,6}. Exclusion criteria for recent trials of BLVR included LIBERATE ($P_aCO_2 > 50$ mmHg), STELVIO ($P_aCO_2 > 60$ mmHg), and EMPROVE ($P_aCO_2 > 50$ mmHg).

Study Design

Study Design

- **Type of trial:** Retrospective Cohort study. No control group utilized.
- **N:** 129
- **Study groups:** Single-arm (all treated with BLVR)

- **Settings:** Single-center (Thoraxklinik, University of Heidelberg)
- **Enrollment:** From 2005 – 2017
- **Treatment period:** Same as enrollment period
- **Follow up:** Patients followed at 3 and 6 months
- **Primary outcome:** Decrease in P_aCO_2 at 3 and 6 months.

Interventions

Retrospective study of patient's who underwent endoscopic placement of an endobronchial valve for lung volume reduction and had baseline hypercarbia (>45).

Population

Inclusion criteria

- $P_aCO_2 > 45$ mmHg
- Treated with endoscopic valve therapy at the trial center between 2005 – 2017.

Exclusion criteria

- $P_aCO_2 < 45$ mmHg
- If patient had change in oxygen therapy at the different time points of sampling blood gas analysis
- NIV started simultaneously to valve placement

Baseline Characteristics

- 43% Male
- Mean age 64 +/- 7
- Mean P_aCO_2 of 49.7 +/- 0.7
- Baseline O₂: 79%
- On NIV prior to valve insertion: 24%
- FEV₁: 0.66 ± 0.19 L
- FEV₁%: 25.6 ± 5.4 %
- RV: 6.18 ± 1.74 L
- RV%: 285.2 ± 22.2 %
- TLC%: 144.8 ± 1.8 %
- DLCO: 29.9 ± 10.7 %

Outcomes

Primary outcomes: Not definitively stated, but implied:

- Decrease in P_aCO_2 :
 - 3 Month: -3.7 ($p < 0.001$)
 - 6 Month: -2.8 ($p < 0.001$)

Secondary outcomes: Assessed at 3 and 6 months

- Change in P_aO_2 : -0.8 and -0.15 ($p = 0.39$ and $p = 0.148$)
- Change in FEV₁: +0.08 and +0.08 ($p < 0.001$)
- Change in FVC: +0.22 and +0.23 ($p < 0.001$)
- Change in DLCO: +6.3 and +6.7 ($p < 0.001$)

- Change in DLCO/VA: 4.5 and 4.3 ($p < 0.001$)
- Change in 6MWT: +31 and +28 ($p < 0.001$)
- Subgroup analysis performed on the above in patients who had total lobar collapse versus those with partial collapse

Adverse events:

- Pneumothorax: 21/129 patients (16%)
- Acute respiratory failure requiring NIV

Article critique

Study Strengths

- Large sample size.
- 3-month follow-up was very complete.
- Clinically relevant question.
- The study was funded by the authors.

Study Limitations and Potential for Bias

- Included patients had only mild hypercarbia based on mean and minimal standard deviation
- While change was statistically significant, unclear if this change in P_aCO_2 is clinically meaningful
- Exclusion of patients who started NIV around the time of valve placement likely limited the ability to detect adverse events
- It is a retrospective study, so inclusion of patients is likely to be influenced by the best practice of the time (which excluded P_aCO_2 of > 50). Hence the mean P_aCO_2 of 45 mmHg in this study.
- The retrospective nature may also bias towards the inclusion of healthier patients (as clinicians would be less likely to intervene on a patient with hypercapnia and multiple comorbidities than on one with hypercapnia alone).
- Higher loss to follow-up at 6 month time point assumed to be due to patients being far from the treatment center, but this could exclude patients with poor outcomes or adverse events from follow-up.
- The primary outcome of P_aCO_2 is a surrogate outcome and is not a direct measurement of patient-centered outcomes.

Research question

Does BLVR in patients with hypercarbia lead to a reduction in P_aCO_2 ?

Funding

Funding

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Suggested Reading

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Article citation

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