Comparison of ventilatory parameters with nasal versus oral breathing during submaximal exercise in patients with cardiac disease and healthy people

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Funding Acknowledgements: None.

Introduction: Inefficient ventilation, namely a high ventilation/carbon dioxide production ratio (VE/VCO\textsubscript{2}) is a well established predictor for disease progression and mortality in patients with heart failure (HF). Two previous studies in healthy people have found improved ventilatory efficiency with nasal compared to oral breathing during submaximal exercise. No study has compared nasal with oral breathing in patients with HF or coronary heart disease.

Method: Four study groups were recruited: Patients with HF, patients with acute or chronic coronary syndrome (ACS/CCS), old healthy controls (age > 45 years) and young healthy controls (age > 20 years and < 35 years). Acute measurements of 5 min (after 3 min warm-up) with nasal and 5 min with oral breathing in randomized order were performed at 50% peak power. Ventilation parameters were averaged over the last minute of each condition and analysed by linear mixed models adjusted for body mass index.

Results: We present data of 8 patients with HF, 8 with ACS/CCS, 10 old and 15 young healthy controls. Minute ventilation, breathing frequency and end-tidal oxygen partial pressure (PETO\textsubscript{2}) were significantly lower and tidal volume and end-tidal carbon dioxide partial pressure (PETCO\textsubscript{2}) significantly higher during nasal compared to oral breathing in all groups (Figure 1). Differences between breathing modes were between 5-20\% and similar in all groups except for breathing frequency that declined more from oral to nasal breathing, namely by 27\%, in patients with HF compared to the other groups. The largest discrepancies between patients and healthy controls were found for VE/VCO\textsubscript{2} ratio, PETCO\textsubscript{2} and PETO\textsubscript{2}.

Conclusion: Nasal breathing during submaximal exercise significantly improved the abnormal breathing pattern of patients with HF and ACS/CCS. Nasal breathing during exercise may be promising in patients with inefficient ventilation as it increases PETCO\textsubscript{2} and is likely to increase arterial partial CO\textsubscript{2} pressure, a known vasodilator, herewith facilitating perfusion of the working musculature.
Figure 1: Interaction plot of effects of breathing modes and groups on ventilation (top left), breathing frequency (top middle), tidal volume (top right), VE/VO2 ratio (bottom left), PETCO2 (bottom middle) and PETO2 (bottom right).