

Is Supplementary Oxygen Required for Non-Invasive Ventilation for Radiotherapy Applications?

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Introduction

Motion due to natural respiration introduces uncertainty in amplitude and frequency into radiotherapy treatments for thoracic and upper abdominal sites. Non-invasive ventilation (NIV) has been shown to be an effective motion management technique, delivering regularised, controlled breaths at frequencies tailored to the specific application. Research groups investigating NIV generally apply a mixture of 60% oxygen (60%O₂) for NIV-based breathing control strategies, which is effective and considered safe in healthy volunteers and most patient groups. However, use of 60% O₂ may not be appropriate in patients suffering from chronic obstructive pulmonary disease (COPD) and has associated risk of complications in patients with history of Bleomycin or Amiodarone, alongside requiring a more advanced ventilator with gas mixing capabilities. Furthermore, oxygen is classified as a drug and requires formal prescription, so use of ambient air (21% O₂) would enable a cheaper, more efficient workflow and mitigate risk for the aforementioned patient groups. Preliminary data acquired on healthy volunteers within Amsterdam UMC has shown that NIV is as feasible with 21% O₂ as 60% O₂. We aim to replicate this study in an alternative institution.

Aim

To investigate whether NIV-induced regularized breathing with 21% O₂ is as safe as NIV with 60% O₂ in a multi-centre setting.

Materials and Methods

Eight healthy volunteers were ventilated for 10 minutes at 45 and 60 breaths per minute (brpm) with both 21% O₂ and 60% O₂. Participants were blinded to the oxygen concentration delivered. During ventilation the participant's oxygen saturation (SpO₂), transcutaneous carbon dioxide (PtcCO₂), and heart rate (HR) were monitored and recorded, with ventilation terminated if any values exceeded pre-determined safety limits. The Wilcoxon signed-rank test will be used to test for statistically significant differences between 21% and 60%.

Results

This study is in the data acquisition phase. Preliminary data suggests that 21% O₂ is not only feasible but a safer alternative for higher-frequency ventilation, as at 60brpm with 60% O₂ an increase of PtcCO₂ past the safety limits was recorded for 2 out of 5 patients and ventilation was consequently terminated. No safety limit breaches have been recorded with 21% O₂ for these 5 participants. At 45brpm no breaches from safety limits were recorded for either oxygen concentration.

Conclusion

The demonstration of NIV using 21% O₂ being as safe as 60% O₂ will facilitate a cheaper, safer and more efficient workflow, enabling NIV to be more easily implemented clinically.