

Prevalence and characteristics of pendelluft during spontaneous breathing in patients with moderate or severe acute hypoxemic respiratory failure

AUTHORS

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INTRODUCTION

Spontaneous breathing efforts are often encouraged during invasive mechanical ventilation (MV) for acute hypoxemic respiratory failure (AHRF) to promote weaning from ventilatory support.¹⁻³ Although spontaneous breathing effort may prevent diaphragm disuse atrophy, an excessive inspiratory effort may cause diaphragm myotrauma and patient-self-inflicted lung injury.³⁻⁵ Excessive spontaneous breathing effort in patients with acute lung injury might result in the movement of air from non-dependent lung regions to dependent lung regions during inspiration leading to dorsal lung inflation independent of tidal volume, also known as **pendelluft**.^{4,5} Pendelluft may contribute to ventilation-associated lung injury during assisted mechanical ventilation.

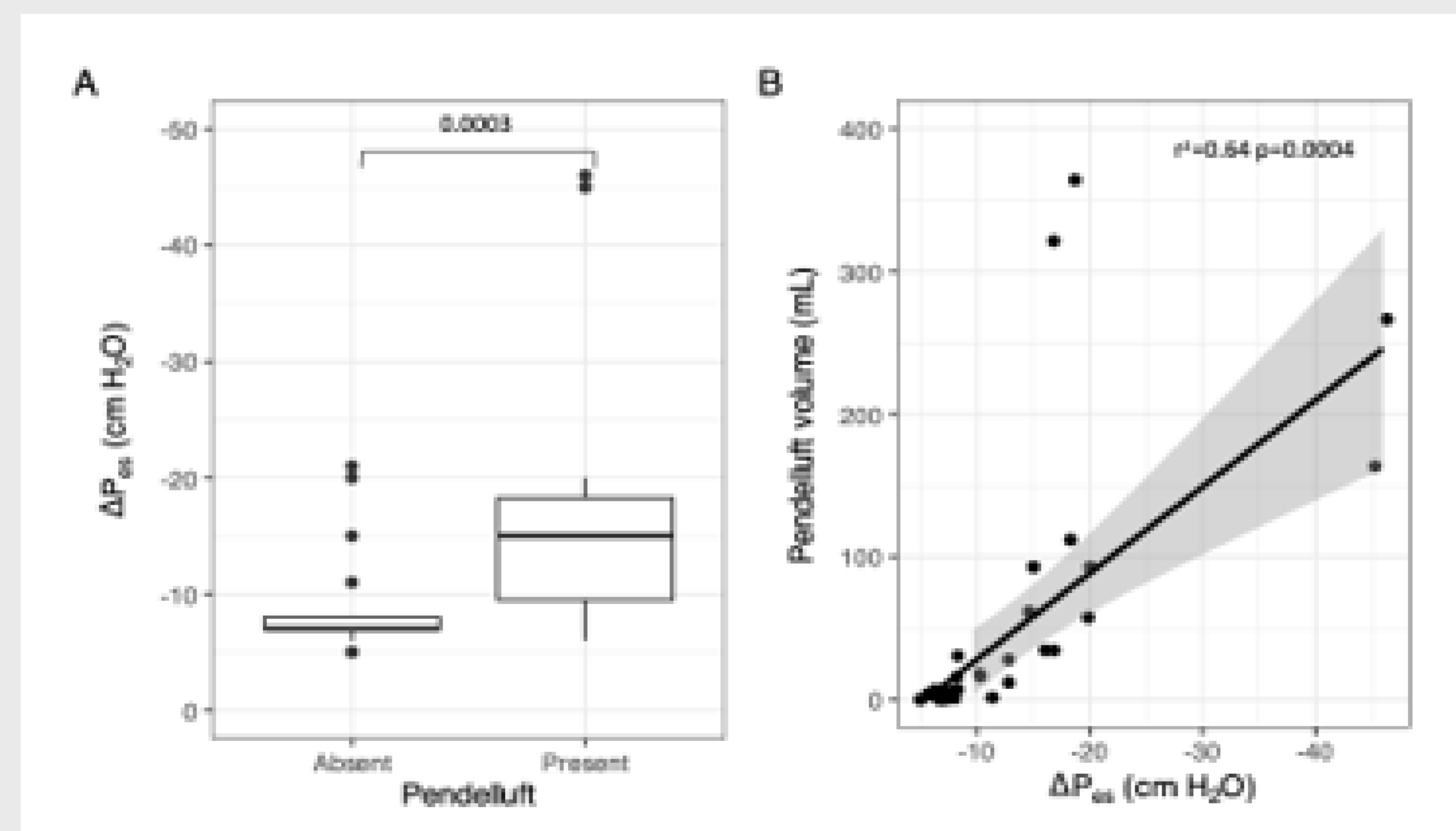
OBJECTIVES

This study investigated the characteristics and outcomes of patients with pendelluft detected by electrical impedance tomography (EIT) during assisted mechanical ventilation and compared various EIT measures to detect and quantify pendelluft.

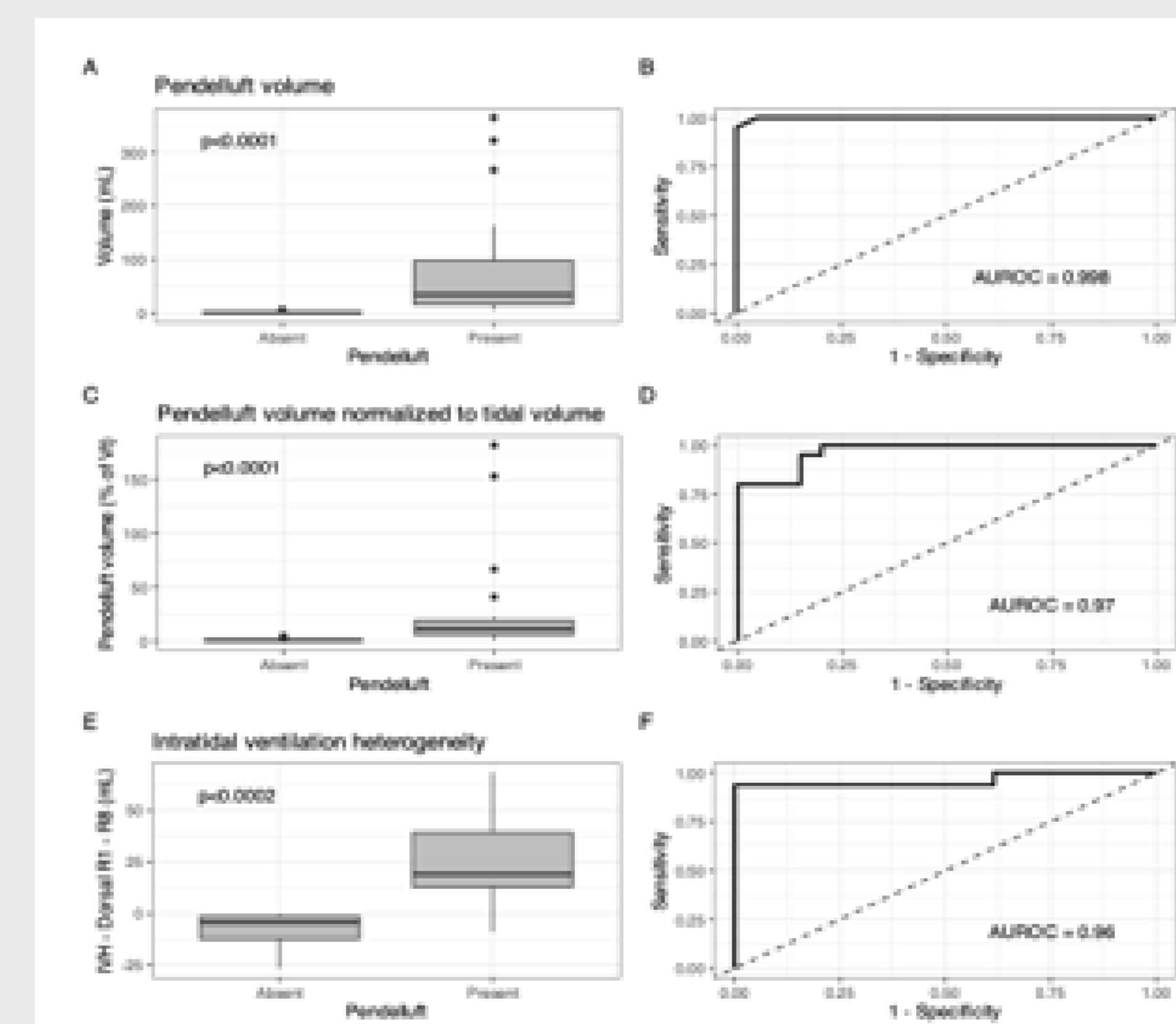
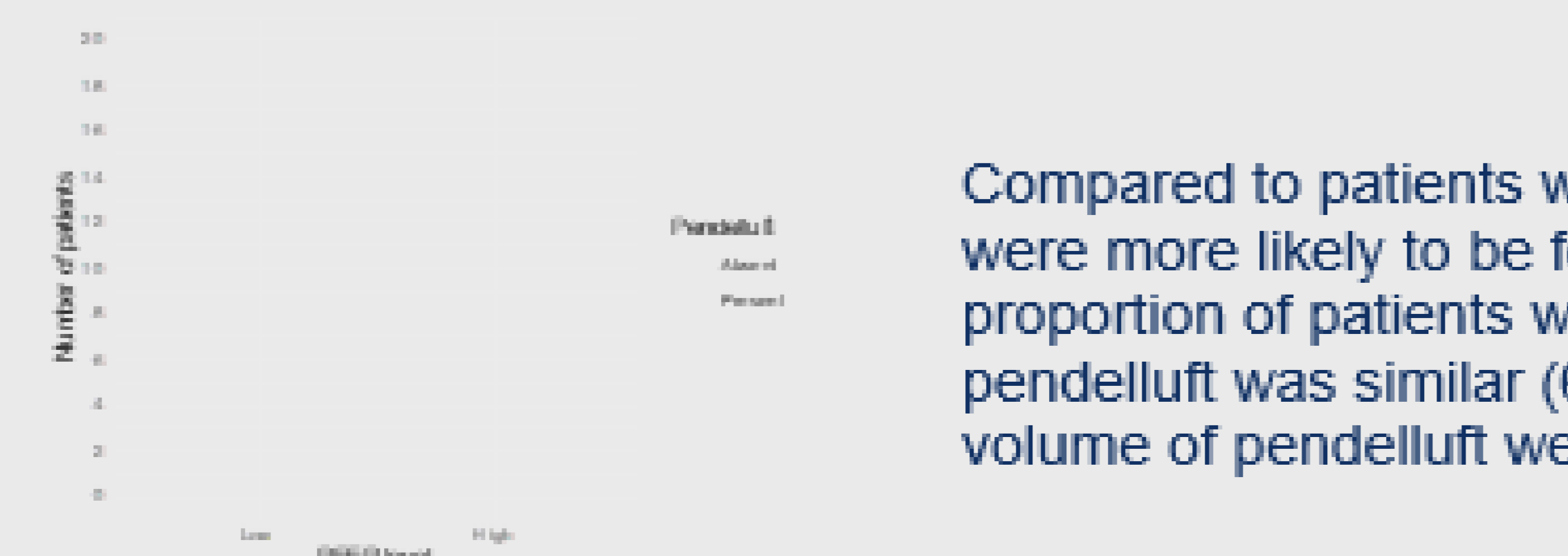
METHOD

Secondary analysis of a clinical lung and diaphragm protection trial in acute hypoxemic respiratory failure patients. After initiating spontaneous breathing, EIT recordings were obtained at low and high positive end-expiratory pressure (PEEP) levels applied in random order. Pendelluft was judged as present or absent based on a qualitative visual assessment of the EIT output by two researchers blinded to group allocation. Various quantitative EIT parameters were compared to this qualitative visual assessment. EIT parameters analyzed included regional ventilation delay (RVD40), dorsal intratidal ventilation heterogeneity (IVHR1-R8), and global inhomogeneity (GI). Pendelluft volume and Pendelluft volume normalized to tidal volume were calculated by pixel-based offline software. The associations of EIT parameters with pendelluft were tested using mixed effects regression to account for within-subjects correlation. The utility of each EIT parameter to discriminate the presence or absence of pendelluft (qualitatively defined) was evaluated using the area under the receiver operating curve (AUROC).

RESULTS



Pendelluft was associated with higher respiratory effort (ΔP_{es} -15 vs. -7 cm H₂O, $p=0.0003$) (Figure A) and pendelluft volume was correlated with respiratory effort ($r^2=0.64$, $p=0.0004$) (Figure B).



EIT recordings where pendelluft was adjudicated as absent, in recordings where pendelluft was adjudicated to be present there was higher pendelluft volume (77 ml vs. 1 ml, $p<0.0001$, Figure A), higher pendelluft volume normalized to tidal volume (7% vs 1%, $p<0.0001$, Figure C), higher dorsal IVHR1-R8 (32% vs. -0.3%, $p<0.0002$, Figure E).

Compared to patients without pendelluft, patients with pendelluft were more likely to be female (42% vs. 13%, $p=0.038$). The proportion of patients with severe ARDS who did or did not have pendelluft was similar (67% vs. 62%, $p=0.3607$). Prevalence and volume of pendelluft were unaffected by PEEP level ($p=0.55$).

CONCLUSION

Pendelluft is common during assisted ventilation in acute hypoxemic respiratory failure and may substantially increase regional lung stress and strain in some patients. Pendelluft was correlated to respiratory effort level but was not susceptible to PEEP titration in this study.

REFERENCES

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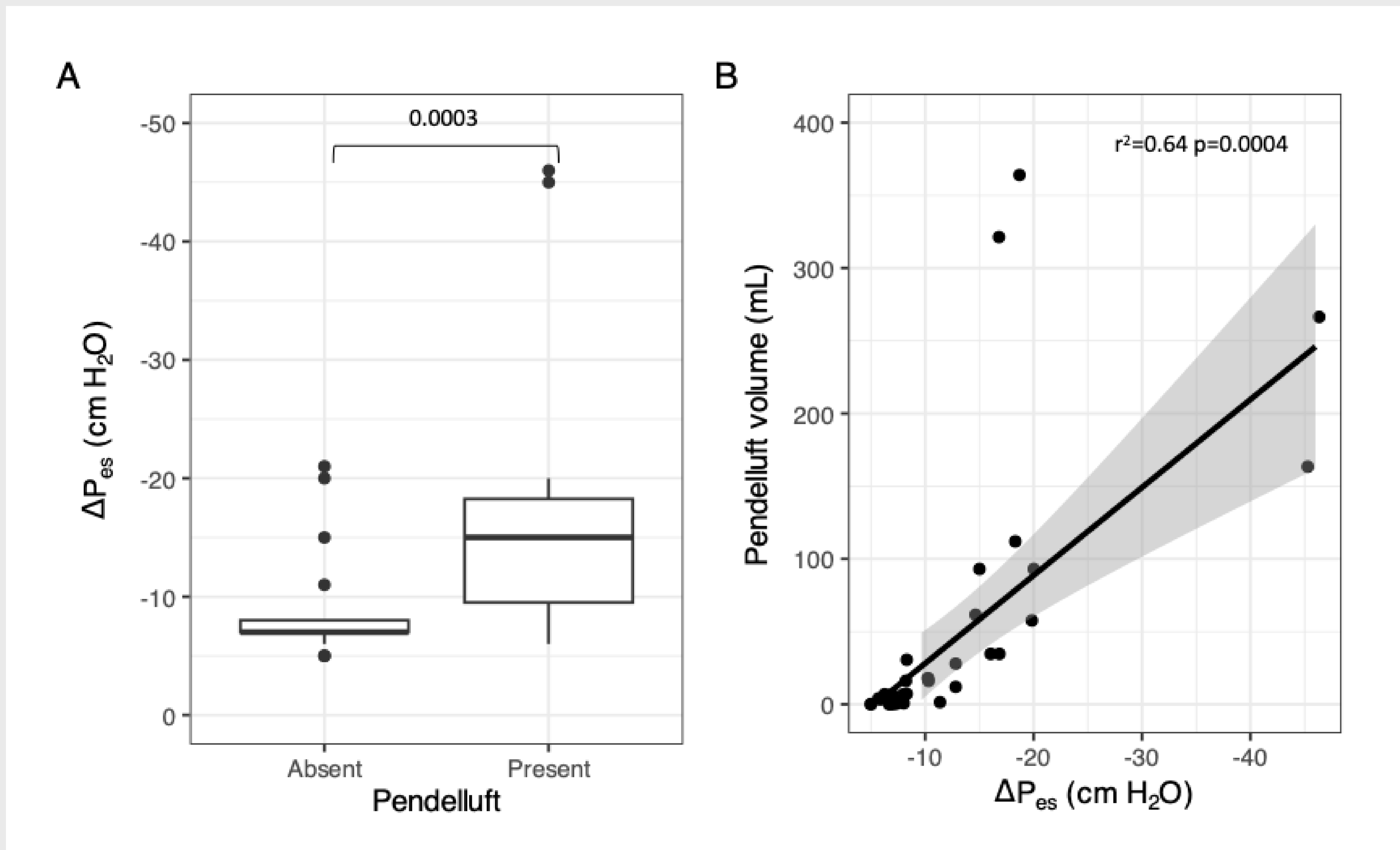
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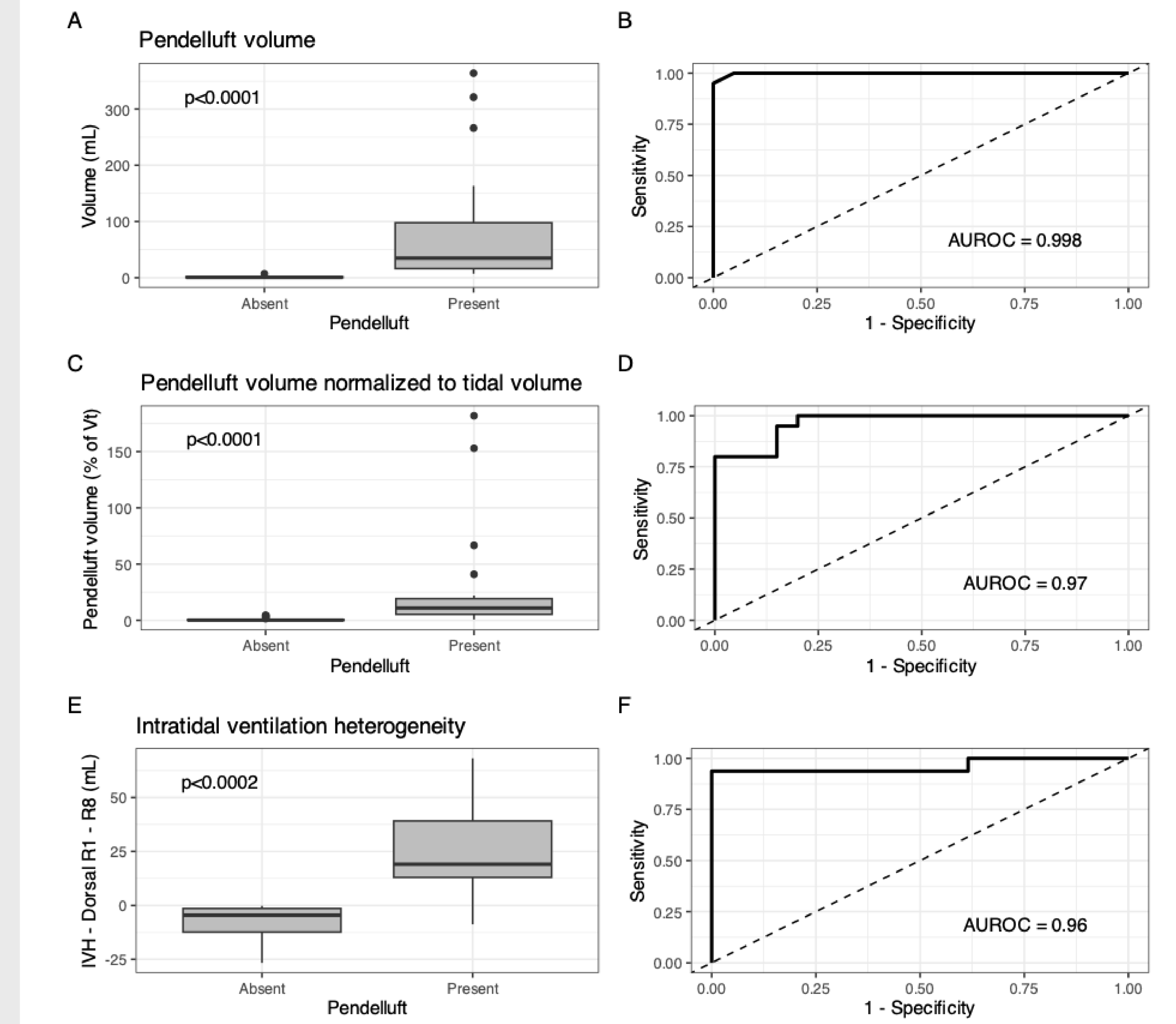
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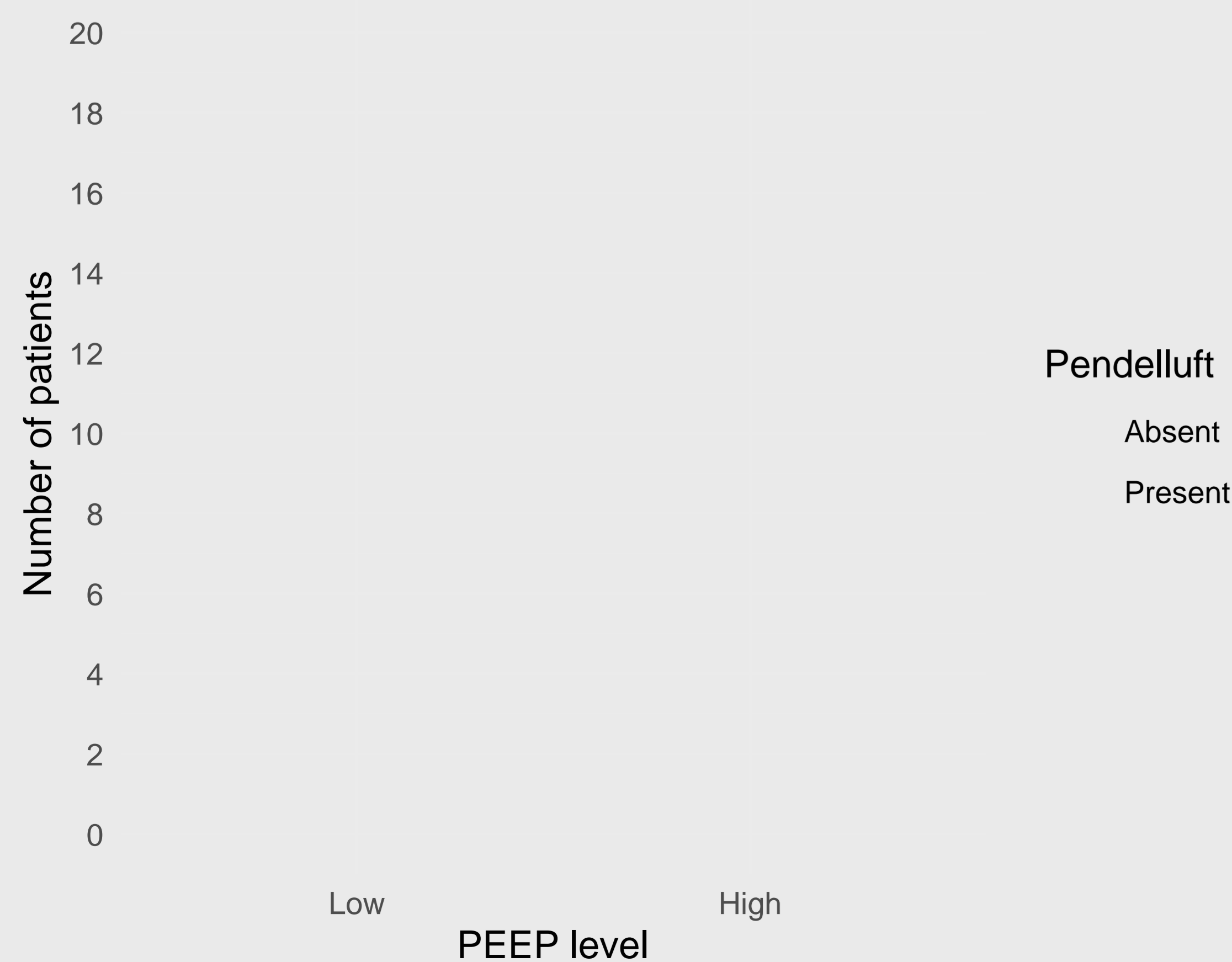


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