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Preliminary Experience with Continuous Negative Pressure Ventilation (CNEP) in Covid-19 patients requiring respiratory support

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Background: The recent pandemic has forced hospitals to explore alternative ways of providing respiratory support, to prevent intubation or reduce time on mechanical support. Continuous negative pressure therapy (CNEP) using a simple thoracic shell, (-5 to -25 cmsH₂O), applied to the thorax has been purported to increase FRC, reduce atelectasis and improve oxygenation. Electrical Impedance Tomography (EIT) used concomitantly can allow for the visualization of the recruitment of lung zones in real-time by the bedside (thoracic belt) during CNEP. We sought to assess the feasibility of CNEP -EIT, whether it allowed for periods of pause during CPAP mask therapy, and any improvements in oxygenation during mechanical ventilation.

Methods: A negative pressure shell was applied to 20 patients (10 intubated patients/10 non-intubated patients with CPAP). Therapy lasted from 30 mins to 2 hours. EIT images were visualized in real-time, (baseline measures compared to CNEP). In non-intubated patients, compliance and comfort during CNEP was assessed. For intubated patients, interference with mechanical ventilation and ease of application were evaluated.

Results: There were no complications related to CNEP-EIT in any patients All non-

intubated patients tolerated CNEP well. Therapy lasted from 1-2 hours, twice daily. CPAP mask time was reduced by approx. 3-4 hours /day. Lung zone aeration shifted from the apical zones to basal zones during CNEP sessions, (>15-20% increase in EIT quadrants 3-4). A moderate increase in oxygen saturations (90.3%-93.4%) was observed.

Intubated patients: CNEP allowed for improvements in oxygenation saturations (90.1-93.4%) and reduction in airway pressures (35.7; 30.2 cmH₂O Paw) without interfering with mechanical ventilation (triggering). P/F ratios increased from 19.2 to 21.2 during CNEP-EIT. In patients where oxygen saturations or P/F ratios increased minimally, (n=2), there was also little change visualized in EIT lung zone images (<5%). CNEP reduced esophageal pressures in 2 obese patients (BMI 64, BMI 30: 18 to 10 cmH₂O, and 15 to 10 cmH₂O respectively).

Conclusion: Our first experience with CNEP-EIT in Covid-19 patients requiring respiratory support appears promising. The use of EIT as a feedback system during CNEP therapy allows for the immediate visualization of the benefits of the therapy for that particular patient. Trials should determine whether CNEP can prevent intubation, or reduce time on mechanical respiratory support.