The Effect of Prone Position Ventilation on Lung Recruitment and Oxygenation in Patients with SARS-Cov-2 Induced Severe Adult Respiratory Distress Syndrome Treated with Veno-Venous Extra Corporal Membrane Oxygenation: a nationwide cohort study from Denmark

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Background: Prone position ventilation (PPV) has been reported to reduce oxygen demand and increase lung recruitment in patients with SARS-Cov-2 (Covid-19) induced Severe Adult Respiratory Distress Syndrome (ARDS) treated with Veno-Venous Extra Corporal Membrane Oxygenation (V-V ECMO).

Method: Data on all patients treated with V-V ECMO for Covid-19 induced ARDS in Denmark were retrospectively analyzed. Indications for V-V ECMO followed the ELSO guidelines and included severe ARDS defined as PaO_2/FiO_2 < 10kPa for more than 6 hours or PaO_2/FiO_2 < 7kPa for more than 3 hours or pH < 7,25 and $PaCO_2 \geq 8$ kPa for more than 6 hours despite optimal ventilator settings. The effect of PPV on total oxygen requirements from both ventilator and V-V ECMO and on lung compliance was assessed. A positive oxygen response was pre-defined as >20% decrease in total oxygen supplement during PPV and a negative response as an increase in total oxygen supplement >20% during PPV. A positive lung recruitment effect was pre-defined as >3 ml/cm H_2O in dynamic compliance during PPV and a negative response as a decrease in dynamic compliance >3 ml/cm H_2O. Finally, a survival analysis including the effect of PPV was conducted.

Results: A total of 68 patients from the two Danish V-V ECMO centers admitted from 17th of March 2020 to 31st of December 2021 were included in the analyses. Patients were median 55 years old (IQR 45;60) and predominantly male (66%). PPV was instigated in 65% of the patients with a median number of pronings per patient of 3 (IQR 2;6, range 1-15). However, PPV was not used equally frequent in both centers (75% vs. 27%). Median time spent in prone was 16 hours (IQR 15;18). PPV had a positive impact on oxygenation in 15% of the PPV sessions and a negative impact in 6% of the sessions. PPV showed a positive impact on alveolar recruitment in 38% of the PPV sessions and a negative impact in 20% of the sessions. It was not possible to establish any timely pattern in oxygenation or alveolar recruitment effect related to the number of PPV session. The overall survival after 90 days was 42.6% (95%CI 32.4;56.2). A time-varying effects model showed a decreased mortality in the PPV group in the early phase (<20 days) (HR 0.11 (95%CI 0.014;0.94, p =0.043), a similar mortality in the groups in the medium phase (20-40 days) (HR 1.19(95%CI 0.39;3.67, p=0.75) and an increased mortality for the PPV group in the late phase (>40 days) (HR 6.03(95%CI 1.52;24.0).

Conclusion: During the Covid-19 pandemic, PPV was used in 44 out of 68 Danish patients treated with V-V ECMO for severe ARDS, although the use varied between centers. PPV had a positive effect on oxygenation and lung recruitment in some patients, but it was not possible to establish a pattern in this response. We found that patients in the PPV group had a lower mortality in the early treatment phase but an increased mortality in the late phase.