

A physiology based veno-venous ECMO weaning

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Background: Despite VV-ECMO being the standard treatment for refractory ARDS, weaning from VV-ECMO is still a rather unstandardized procedure. We put forward an VV-ECMO weaning protocol based on physiological changes in response to a step-wise reduction of the extracorporeal support.

Method: Weaning begins once the patient fits standardized criteria ($\text{PaO}_2/\text{FiO}_2 > 180$ mmHg, $\text{PaCO}_2 < 60$ mmHg, arterial $\text{pH} > 7.25$ and assisted-mode mechanical ventilation). The gas flow is then reduced by 33% steps without changing the blood flow every 30 minutes down to gas flow 0 if the following conditions are maintained: esophageal pressure swing (swingPES) < 15 cmH₂O, $\text{RR} < 30$ bpm, $\text{pH} > 7.25$, $\text{PaCO}_2 < 80$ mmHg, $\text{PaO}_2 > 60$ mmHg. We collected respiratory mechanics, hemodynamic and gas exchange variables for each step. Logistic regressions, ROC curve analysis and ANOVA were performed to assess the relation between variables and outcomes.

Results: Thirty-three patients met the inclusion criteria. Twenty-one (64%) were successfully weaned after a median of 9 days (IQR 9) and three (9%) died for causes unrelated to ARDS after a median of 10 days (IQR 15) from weaning. Patients successfully weaned presented at baseline a lower extracorporeal DO_2 ($p < 0.001$, best-value: 350 ml/min) and higher $\text{PaO}_2/\text{FiO}_2$ ($p < 0.001$, best-value: 205 mmHg), $\text{EtCO}_2/\text{PaCO}_2$ ($p < 0.001$, best-value: 0.80) and VCO_2 of the natural lung/total VCO_2 ($p < 0.001$, best-value: 0.38). During the steps, the proportional PaCO_2 increase and the swingPES were strong predictors of weaning success ($p < 0.001$ and $p < 0.001$ respectively). When the gas-flow was off, the swingPES ($p = 0.01$, best-value: 13 cmH₂O), its variation to the baseline and PaO_2 ($p = 0.006$, best-value: 80 mmHg) were significantly associated to successful weaning.

Conclusions: at baseline, a strong dependence on ECMO is associated to weaning failure. During our protocolized weaning, a strong increase in respiratory drive associated to worse oxygenation and CO_2 clearance prevented a successful weaning.

