Introduction:
The primary outcome findings from the SUPERNOVA trial [1] demonstrated that the use of extracorporeal carbon dioxide reamoval (ECCO₂R) allows a reduction in tidal volume (TV) to ultraprotective levels (≈4 mL/kg predicted body weight or PBW) during mechanical ventilation in ARDS patients without significant increases in the arterial partial pressure of carbon dioxide (PaCO₂). Unfortunately, it was not feasible to directly measure ECCO₂R rates during the trial.

Methods:
We used a mathematical model of whole-body oxygen (O₂) and carbon dioxide (CO₂) transport and biochemistry [2] to calculate ECCO₂R rates that permit a fit to the data reported for Hemolung (ALung Technologies) and iLA (Novalung)/Cardiohelp (Getinge) devices in the SUPERNOVA trial [3]. The mathematical model was calibrated under baseline conditions where patients were mechanically ventilated at a TV of 6 mL/kg PBW in the absence of an ECCO₂R device; the O₂ consumption rate, CO₂ production rate and pulmonary shunt fraction were adjusted to match the measured baseline arterial partial pressure of O₂ and PaCO₂. Assuming all baseline parameters were fixed, TV was then reduced to 4.1 mL/kg PBW and the mathematical model predicted the ECCO₂R rate to the change in the PaCO₂ level.

Results:
Model predictions for the devices are tabulated.

Conclusion:
These predictions suggest that ECCO₂R rates for iLA/Cardiohelp devices were approximately twice those for Hemolung devices during the SUPERNOVA trial. These results may be useful to evaluate the expected performance of novel ECCO₂R devices.

References:

Table:

<table>
<thead>
<tr>
<th>Time After TV = 4.1 mL/kg PBW</th>
<th>8 hours</th>
<th>24 hours</th>
<th>8 hours</th>
<th>24 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECCO₂R Rate (mL/min)</td>
<td>44</td>
<td>71</td>
<td>131</td>
<td>141</td>
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Model Predicted Extracorporeal Carbon Dioxide Removal Rates