Meet The Expert
Significant CO2 amount is contained in 400 ml/min of Blood
Avoid intubation when NIV fails
Facilitate protective ventilation

Clinical Benefits

Duscio et al, CCM 2018
What is the role of ECCO$_2$R in the management of respiratory failure?
Does ECCO$_2$R in COPD patients prevent endotracheal intubation?
What about intermittent ECCO$_2$R?
ECCO$_2$R: arterio-venous or veno-venous device?
iLA Membrane Ventilator®

**Blood flow rate:** 100–1500 mL/min

**Membrane oxygenator surface area:** 1.3 m²

**Catheter size:** 13–21

**Insertion site:** femoral artery/vein

**RRT connection:** 2 Luer lock connectors in post-membrane limb

Fresenius/Xenios, Heilbronn, Germany
**iLA activve®**

- **Blood flow rate:** 500–4500 mL/min
- **Membrane oxygenator surface area:** 1.3 m²
- **Catheter size:** 18–24
- **Insertion site:** Internal jugular vein/femoral vein
- **RRT connection:** 2 Luer lock connectors in post-membrane limb

*Fresenius/Xenios, Heilbronn, Germany*
Decap Smart®

B. Braun Avitum, Melsungen, Germany (previously: Hemodec, Salerno, Italy)

Blood flow rate: 200–500 mL/min
Membrane oxygenator surface area: 1.35–1.8 m²
Catheter size: 13
Insertion site: Internal jugular vein/femoral vein
RRT connection: alone or in series with HD hardware (Diapact, Omni)
Blood flow rate: 450 mL/min
Membrane oxygenator surface area: 1.8 m²
Catheter size: 13.5
Insertion site: Internal jugular vein/femoral vein
RRT connection: officially none
**Blood flow rate:** 350–550 mL/min

**Membrane oxygenator surface area:** 0.67 m²

**Catheter size:** 15–21

**Insertion site:** Internal jugular vein/femoral vein

**RRT connection:** officially none by the manufacturer
Prismalung®

Blood flow rate: <450 mL/min
Membrane oxygenator surface area: 0.32 m²
Catheter size: 13–14
Insertion site: Internal jugular vein
RRT connection: First extracorporeal lung specifically designed for in-line attachment to existing HD hardware (PRISMAFLEX)

Gambro/Baxter, Unterschleissheim, Germany
Blood flow rate: 200–2800 mL/min
Membrane oxygenator surface area: 0.98 m²
Catheter size: 13–21
Insertion site: Internal jugular vein/femoral vein
RRT connection: officially none by the manufacturer
**Advanced Organ Support (ADVOS)®**

**Blood flow rate:** 100–400 mL/min  
**Membrane oxygenator surface area:** none  
**Catheter size:** 13–14  
**Insertion site:** Internal jugular vein/femoral vein  
**RRT connection:** combined kidney, liver, lung support

\[ \text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3 \leftrightarrow \text{H}^+ + \text{HCO}_3^- \]
What is the role of ECCO$_2$R in the management of moderate ARDS?
A ventilation strategy using lower tidal volumes is associated with a lower risk for developing ARDS. ARDSnet strategy might not protect against tidal hyperinflation (when Pplat remains >28-30 cm H2O). 

**Acute Respiratory Distress Syndrome**

**The Berlin Definition**

- **ECMO**
- **Inhaled NO**
- **Neuromuscular Blockade**
- **Prone Positioning**
- **ECCO2R**
- **HFOV**
- **Higher PEEP**
- **NIV**
- **Low-Moderate PEEP**
- **Low Tidal Volume Ventilation**
- **Mild ARDS**
- **Moderate ARDS**
- **Severe ARDS**

**MINI-INVASIVE ECCO2-R**

**for PREVENTING VILI**

Extracorporeal CO2 removal may provide the physiologic prerequisites for controlling VENTILATOR INDUCED LUNG INJURY and to allow further reduction of Vt/Pplat/∆P.

Neto et al, JAMA 2012
Terragni e al, Curr Opin Crit Care, 2012
The ARDS Definition Taskforce. JAMA 2014
Duscio et al, CCM 2018
Should the efficiency of each device be an important consideration for clinicians?
The efficiency of each device (i.e., the quantity of CO2 removed per minute, adjusted to blood flow) determines the blood flow rate and hence the catheter size needed for adequate CO2 removal.

Manufacturers and researchers should measure the efficiency of ECCO2R devices through the quantification of CO2 removed per minute and per 100 mL of blood flow under standardised clinical conditions.

Duscio et al. as main result of their study demonstrated that a considerable amount of CO$_2$ was removed by the ProLung system using only a minimally invasive cannulation and a blood flow rate similar to that used in renal dialysis. Accepting a PaCO$_2$ of 74 mm Hg and pH 7.3, they were able to remove up to 138.8 mL/min of CO$_2$. This allowed us to reduce total ventilation from 7.4 to 1.9 L/min with a corresponding reduction in mechanical power from 9.3 to 2.6 J/min with no detectable drawbacks.

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What should we expect from a minimal invasive ECCO$_2$R device?
WHAT SHOULD WE ASK TO A MINI-INVASIVE ECCO2-R SYSTEM?

A) PERFORMANT CO₂ REMOVAL CAPABILITY

B) PROLONGED SET DURATION, MEMBRANE BIOCOMPATIBILITY

B) VCO₂ MONITORING

C) REDUCED PRIMING VOLUME

A) MINI- INVASIVITY

B) REDUCED COOLING OF PATIENT BLOOD

C) AUTOMATED GAS SWEEP FLOW

<table>
<thead>
<tr>
<th>LF-ECCO2-R SYSTEM</th>
<th>ARTIFICIAL LUNG (MEMBRANE)</th>
<th>ARTIFICIAL LUNG (SURFACE mq)</th>
<th>TECHNOLOGY</th>
<th>VCO2 MONITORING</th>
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<tbody>
<tr>
<td>BELLCO – ABYLCP (MEDTRONIC)</td>
<td>POLYMETHYLPIENENE</td>
<td>0.67</td>
<td>Peristaltic Pump Catheter ≤ 14 Fr</td>
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<td>BAXTER – PRISMA LUNG</td>
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What should we use integrated systems?
Integrated systems

About 35% to 60% of the patients undergoing respiratory therapies need renal-replacement therapies.

We Know

- Applicable in non specialized centers.
- No additional catheter placements are needed (unique vascular access).
- Possibility to run regional citrate-calcium anticoagulation.

We don’t know

- Adequate anticoagulation and citrate dosing requirements at desired Qb (400 ml/min).
- Qb achievable considering Artificial Lung + Hemofilter in line.
- Volume Control.
- If is possible to guarantee a VCO₂ ≈ 100 ml/min.
- The strategy for Dialysate Liquid/Reinfusate (Lactate as buffer = septic shock; Bicarbonate as buffer = CO₂).

Adding a membrane oxygenator within a CRRT circuit, in patients presenting with both ARDS and AKI, is safe and provides efficient extracorporeal Co₂ removal with a reduction of PaCo₂ by 21%.