Mater Misericordiae University Hospital

Referral of Acute Respiratory Failure patients for consideration of V-V ECMO

V-V ECMO for Respiratory Support

Venous blood is aspirated from the superior vena cava (SVC), inferior vena cava (IVC) or right atrium (RA) using a centrifugal pump to an external circuit and gas exchange device (membrane lung) where O_2 is added and CO_2 removed. Fully oxygenated blood is then pumped back to the RA.

V-V ECMO is indicated in patients with acute, severe potentially reversible lung failure who continue to deteriorate despite 'lung protective' mechanical ventilation (low tidal volumes, limited plateau pressures [P_{plat}]) or other advanced therapies (prone position, inhaled pulmonary vasodilators, neuromuscular blockade). The 60-day mortality in patients with severe acute respiratory distress syndrome (ARDS) treated with early V-V ECMO was 35% compared to 46% in patients treated with conventional mechanical ventilation (Combes A, et al. N Engl J Med 2018;378:1965-75). V-V ECMO should be considered before refractory lung failure or multi-organ failure has developed.

Pathologic conditions that may require V-V ECMO:
- ARDS
- Severe Air Leak Syndrome
- Pulmonary contusion
- Status asthmaticus
- Airway Obstruction/Surgery
- Primary graft failure following lung transplant

Standard criteria for starting V-V ECMO:
1. Hypoxaemia/Hypercapnia:
   a) PaO_2/FiO_2 < 7kPa for > 1hrs
   b) PaO_2/FiO_2 < 11kPa for > 6hrs
   c) pH < 7.25mmHg with $PaCO_2$ ≥ 8kPa for > 6hrs
2. Murray score > 3 (see below)
3. P_{plat} > 30cmH$_2$O, in absence of high pleural pressures (e.g. abdominal distension)
4. Static Compliance of respiratory system: < 20mls/cmH$_2$O
5. Corrected Minute Ventilation: > 10 L/min
   (surrogate marker of increased dead space: Minute Ventilation x $PaCO_2$/5.4)

Murray Lung Injury Score:

Score	0	1	2	3	4
PaO_2/FiO_2 ratio	> 40	30 – 40	20 – 30	10 – 20	< 10
Compliance	> 80	60 – 80	40 – 60	20 – 40	< 20
PEEP (cmH_2O)	< 5	6 – 8	9 – 11	12 – 14	≥ 15
CXR infiltrates: (quadrants)	none	1	2	3	4

Compliance (mls/cmH_2O) = tidal volume/P_{plat} – PEEP

Total score/4 = Murray Lung Injury Score

Absolute contraindications for V-V ECMO:
− Progressive non-recoverable lung disease, not amenable to lung transplantation
− Advanced malignancy
− Severe cardiac failure / Cardiac arrest (consider V-A ECMO)
− Lung Failure associated with bone marrow transplantation

Relative contraindications for V-V ECMO:
− Age > 60yrs
− Contraindication to anticoagulation therapy
− Recent spinal cord or central nervous system trauma or haemorrhage
− Chronic organ dysfunction
− Trauma with multiple bleeding sites
− BMI < 18
− Prolonged high pressure mechanical ventilation

Referring an Acute Respiratory Failure patient for ECMO

To refer an acute severe respiratory failure patient for consideration of ECMO, contact the Mater Hospital Critical Care Medicine Consultant on duty (Mater Hospital Swithboard: 01-8032000). The case will be discussed immediately with the Mater ECMO service to formulate an appropriate management plan. A trial of prone positioning should be considered in all patients prior to consideration of ECMO.

If the patient is accepted, the transfer of the patient to the Mater Hospital will be facilitated as soon as possible. In some cases, an ECMO retrieval team is required to transfer the patient safely to the Mater ICU.

Survival Prediction with RESP score:

The RESP score (Schmidt M, et al. Am J Respir Crit Care Med 2014;189:1374-1382) predicts hospital survival for patients receiving V-V ECMO for acute severe respiratory failure. Twelve pre-ECMO variables are used to compute the RESP score (range: -22 to +15). A RESP score of ≥ 6 predicts hospital survival of 92%, whereas a score of ≤ -6 predicts hospital survival of 18% after V-V ECMO. This tool is intended for use as an adjunct to clinical judgment.

RESP SCORE

Parameter	Score
Age, yr	
18 to 49	0
50 to 59	−2
≥60	−3
Immunocompromised status*	−2
Mechanical ventilation prior to initiation of ECMO	
<48 h	3
48 h to 7 d	1
>7 d	0
Acute respiratory diagnosis group (select only one)	
Viral pneumonia	3
Bacterial pneumonia	3
Asthma	11
Trauma and burn	3
Aspiration pneumonitis	5
Other acute respiratory diagnoses	1
Nonrespiratory and chronic respiratory diagnoses	0
Central nervous system dysfunction[†]	−7
Acute associated (nonpulmonary) infection[‡]	−3
Neuromuscular blockade agents before ECMO	1
Nitric oxide use before ECMO	−1
Bicarbonate infusion before ECMO	−2
Cardiac arrest before ECMO	−2
Pa_{CO_2}, mm Hg	
<75	0
≥75	−1
Peak inspiratory pressure, cm H_2O	
<42	0
≥42	−1
Total score	−22 to 15

Hospital Survival by Risk Class		
Total RESP Score	**Risk Class**	**Survival**
≥6	I	92%
3 to 5	II	76%
−1 to 2	III	57%
−5 to −2	IV	33%
≤−6	V	18%

Definition of abbreviations: ECMO = extracorporeal membrane oxygenation; RESP = Respiratory ECMO Survival Prediction.
An online calculator is available at www.respscore.com.
*"Immunocompromised" is defined as hematological malignancies, solid tumor, solid organ transplantation, human immunodeficiency virus, and cirrhosis.
[†]"Central nervous system dysfunction" diagnosis combined neurotrauma, stroke, encephalopathy, cerebral embolism, and seizure and epileptic syndrome.
[‡]"Acute associated (nonpulmonary) infection" is defined as another bacterial, viral, parasitic, or fungal infection that did not involve the lung.