

## ECMO Clinical Policy and Procedure

### Recommendations for When to Transfer Patients to an ECMO Center

#### Neonates - <28 days of age

For consultation with a neonatologist, call 612-813-6295.

All criteria for transfer assume an effort to stabilize with appropriate use of mechanical ventilation and inotropic therapy. These are not criteria for ECMO (see separate document); they are an attempt to identify patients with a high likelihood of benefiting from ECMO, at a point where transfer is reasonably safe.

- An OI (oxygenation index)  $\geq 25$ . ( $\geq 15$  for diaphragmatic hernia patients).  
OI = (MAP x FiO<sub>2</sub> x 100) divided by PaO<sub>2</sub>  
Ex. OI = (15 x 1.00 x 100) / 60 = 25
- Mean airway pressure of >15 cm H<sub>2</sub>O (>12 for diaphragmatic hernia patients)
- Amplitude or Peak Inflating Pressure of  $\geq 35$  ( $\geq 25$  for diaphragmatic hernia patients)
- Failure to improve within 4-6 hours of high frequency ventilation or nitric oxide to an OI <25
- Hypercarbic respiratory failure with pH < 7.25, on a PIP >30, or AMP >35
- A plasma lactate >25 mg/dl (>3mM/L), and not improving on moderate inotropic therapy.
- Mixed venous saturation <65 % in 100% oxygen and dopamine  $\geq 10$  mcg/kg/min.
- Persistent hypotension or acidosis (pH <7.25 or base deficit > 5) despite an Inotropic Equivalent >35. Inotropic Equivalent = DOPamine(mcg/kg/min) + DOButamine(mcg/kg/min) + EPInephrine(100Xs mcg/kg/min) + NORepinephrine(100Xs mcg/kg/min) + ISOproterenol(100Xs mcg/kg/min) + MILrinone(15Xs mcg/kg/min).

Patients with congenital diaphragmatic hernia, sepsis, shock, or poor myocardial function are prone to rapid deterioration, including death, prior to meeting ECMO criteria. These patients should be transferred early, depending on the distance from the ECMO center.

#### Recommended studies prior to transfer (if time allows) to rule out exclusions to ECMO:

- Cardiac ultrasound
- Cranial ultrasound
- Plasma lactate

## Exclusions to Neonatal ECMO

1. Gestational age < 34 weeks
2. Birth weight or current dry weight <1700 grams
3. Serious ongoing hemorrhage
4. Coagulopathy that is unlikely to resolve with transfusion therapy. Ex. Liver failure.
5. Recent (<3 days) intracranial hemorrhage > Grade I germinal matrix hemorrhage
6. Irreversible lung disease, or high pressure mechanical ventilation >14 days
7. Cardiac lesion that cannot be corrected or palliated
8. Lethal condition incompatible with long life, including trisomy 13 and 18.
9. Evidence of serious brain injury or asphyxia

## Infants, Children, and Young Adults ( $\leq$ 25 years)

We recommend consultation with a pediatric critical care physician at 612-813-6266 when a patient age 4 weeks – 25 years reaches any one of the following levels of severity with cardiac and/or respiratory failure:

- **Any one** of the below signs of hypoperfusion or severe cardiac dysfunction, following appropriate volume resuscitation ( $\geq$  60 ml/kg and/or CVP > 10) and inotropic/ vasopressor support:
  - Plasma lactate > 25 mg/dl (> 3 mM/L) and not improving.
  - SVO<sub>2</sub> < 65% (estimated Cardiac Index < 2).
  - Rapidly deteriorating or severe ventricular dysfunction.
  - Intractable arrhythmia with poor perfusion.
  - Inotropic equivalent (IE) >35, IE = DOPamine(mcg/kg/min) + DOBUTamine(mcg/kg/min) + EPInephrine(100Xs mcg/kg/min) + NORepinephrine(100Xs mcg/kg/min) + Isoproterenol(100Xs mcg/kg/min) + Milrinone(15Xs mcg/kg/min).
- **Any one** of the following signs of severe respiratory failure with predicted high mortality rate:
  - PaO<sub>2</sub>/FiO<sub>2</sub> ratio <300
  - Oxygenation Index >25.  
OI = MAP x FiO<sub>2</sub> x 100 divided by PaO<sub>2</sub>
  - Hypercarbic respiratory failure with pH <7.25 despite mechanical ventilation with peak inflating pressure  $\geq$  35 cm H<sub>2</sub>O.
  - Ventilator settings exceeding: PIP of 35, MAP of 20, or an AMPlitude of 45.
  - Murray Score >2.5 in patients 12-25 years old.

Components of the Murray Lung Injury Score. The final value is obtained by dividing the aggregate sum by the number of components that were used (1-4).

Chest roentgenogram score	No alveolar consolidation	0
	Alveolar consolidation confined to 1 quadrant	1
	Alveolar consolidation confined to 2 quadrants	2
	Alveolar consolidation confined to 3 quadrants	3
	Alveolar consolidation confined to 4 quadrants	4
Hypoxemia Score Assumes 100% FiO <sub>2</sub> for 20 minutes	PaO <sub>2</sub> /FiO <sub>2</sub> >300	0
	PaO <sub>2</sub> /FiO <sub>2</sub> 225-299	1
	PaO <sub>2</sub> /FiO <sub>2</sub> 175-224	2
	PaO <sub>2</sub> /FiO <sub>2</sub> 100-174	3
	PaO <sub>2</sub> /FiO <sub>2</sub> <100	4
PEEP Score (when ventilated)	PEEP ≤ 5	0
	PEEP 6-8 cm H <sub>2</sub> O	1
	PEEP 9-11 cm H <sub>2</sub> O	2
	PEEP 12-14 cm H <sub>2</sub> O	3
	PEEP >15 cm H <sub>2</sub> O	4
Respiratory Compliance Score (Tidal Volume/PIP-PEEP)	Compliance > 80 mL/cm H <sub>2</sub> O	0
	Compliance 60-79 mL/cm H <sub>2</sub> O	1
	Compliance 40-59 mL/cm H <sub>2</sub> O	2
	Compliance 20-39 mL/cm H <sub>2</sub> O	3
	Compliance < 19 mL/cm H <sub>2</sub> O	4

### EXCLUSIONS FROM PEDIATRIC ECMO:

Any one of the following underlying imminently fatal or irreversible disease states excludes the patient from ECMO:

- \_\_\_ Severe CNS injury, asphyxia, or hemorrhage
- \_\_\_ End-stage malignancies or advanced AIDS
- \_\_\_ Severe acquired or congenital immunodeficiency
- \_\_\_ Major burn
- \_\_\_ Advanced liver failure
- \_\_\_ Evidence of ongoing uncontrolled bleeding.
- \_\_\_ Severe fibrosis on lung biopsy
- \_\_\_ Severe pulmonary disease ventilated aggressively for > 10 days
- \_\_\_ Lethal condition incompatible with long life, including trisomy 13 and 18.

### References:

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Flori HR, et al. Pediatric Acute Lung Injury: Prospective Evaluation of Risk Factors Associated with Mortality, Am J Respir Crit Care Med 2005; 171:995-1001.

Cheung P, Etches P, et al: Use of plasma lactate to predict early mortality and adverse outcome after neonatal extracorporeal membrane oxygenation: A prospective cohort in early childhood. *Crit Care Med* 2002;30 (9): 2135-2139.

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Carcillo JA, Fields AI, et al: Clinical practice parameters for hemodynamic support of pediatric and neonatal patients in septic shock. *Crit. Care Med* 2002; 30:1365-1378.

Cesar Trial (preliminary result); Society of Critical Care Medicine, presented Feb 3, 2008