ECMO Clinical Policy and Procedure:

Recommendations for When to Transfer Patients to an ECMO Center

The following studies are recommended when time permits for all ages prior to transfer to identify exclusions to ECMO:

- Echocardiogram
- Cranial ultrasound
- Plasma lactate
- Infectious workup

All criteria for transfer assume an effort to stabilize with adequate use of mechanical ventilation and inotropic therapy. Patients with rapidly escalating support require earlier transfer.

Listed below are guidelines to identify patients with a high likelihood of needing ECMO but at a point where transfer is still reasonably safe. These are not meant to be ECMO inclusion criteria. Keep in mind a minimum of two hours is needed to transport and initiate ECMO from any Twin Cities hospital.

Neonates (<28 days of age, 33-42 weeks gestational age, and >1800 grams)

For consultation with a Neonatologist call 612-813-6295

1. Inability to maintain a preductal saturation >92% or continuous pre and post ductal difference > 10 points on maximal respiratory support, and FiO2 at 100% for 6 hours.
    - Increased PaCO2 >55 and unresponsive to ventilator management changes.
    - St. Paul: PaCO2 >60 for >6 hours.
2. Diaphragmatic Hernia patients.
    - Amp >35 or PIP >20 or MAP >12 required to achieve SaO2 >92% and PCO2 <50 x 4 hours.
    - An OI > 15 within 4-6 hours of HFV and/or iNO if applicable.
3. Non-Diaphragmatic Hernia patients.
    - Amp >35 or Jet PIP >35 or MAP >15 required to achieve SaO2 >92% and PCO2 <50 x 4 hours.
    - St. Paul: AMP >45 or Jet PIP >35 or HFOV MAP >17 and not weaning for >6 hours in order to achieve SaO_2 >92% and PCO_2 < 50 x 4 hours.
4. Inadequate oxygen delivery with metabolic acidosis measured by elevated lactate:
    - ≥ 25 mg/dl (>3 mMol) and not improving.
    - St. Paul: >40 mg/dl and not improving.
5. Systemic hypotension (MAP <45-50) resistant to fluid/inotropic therapy on dopamine >7.5 mcg/kg/min.
    - St. Paul: Epinephrine infusion not exceeding 0.3 mcg/kg/min for >6 hours. Vasopressin >1 milliunits/kg/min.
6. An OI (Oxygenation index) >25 for 4 hours after iNO initiation.
    - OI = (MAP x FiO2 x 100) divided by PaO2.

Patients meeting any of the above criteria are prone to rapid deterioration prior to meeting ECMO inclusion criteria. These patients should be transferred early to an ECMO center.

Neonatal ECMO Contraindications:

1. Lethal Chromosomal Disorder (excludes Trisomy 21) or lethal anomaly.
2. Severe pre-existing brain damage.
3. Significant intraventricular hemorrhage > grade 2 bilaterally.
4. Evidence of serious brain injury or asphyxia with plasma lactate levels >225 mg/dL (highly predictive of death) or base deficit >30 on 2 ABGs.
5. Uncontrollable bleeding.
6. Vessel size too small for cannulation.

Neonatal ECMO Relative Contraindications:

1. Irreversible organ damage (unless considered for organ transplant).
2. <1800 grams (Consider vessel size assessment with ultrasound).
3. <34 weeks postmenstrual age.

Infants, Children, and Young Adults (28 days to 25 years)

For consultation with an intensivist, call 612-813-6266.

1. Any **one** of the below signs of hypoperfusion or severe cardiac dysfunction following appropriate volume resuscitation (≥60 ml/kg and/or CVP >10 and inotropic/vasopressor support).
    - Plasma lactate >25 mg/dl (>3 mMol/L) and not improving.
    - SVO2 <68%.
    - Rapidly deteriorating or severe ventricular dysfunction.
    - Intractable arrhythmia with poor perfusion.
    - Inotropic equivalent >35.
    - For patients with acute myocarditis/cardiomyopathy/sepsis (IE) >30.
        - IE = DOPamine (mcg/kg/min) + DOBUTamine (mcg/kg/min) + EPInephrine (100 x mcg/kg/min) + Norepinephrine (100 x mcg/kg/min) + Isoproterenol (100 x mcg/kg/min) + Milrinone (15 x mcg/kg/min) = Vasopressin (10 x mUnits/kg/min)
    - Accidental hypothermia: Core temp <32º C, cardiac arrest, non-perfusing rhythm, or hemodynamically unstable.
2. Any **one** of the following signs of respiratory failure with predicted high mortality rate:
    - Oxygenation Index (OI) >20 (Sensitivity 90%, Specificity 96% for needing ECMO).
        - OI = (MAP x FiO2 x 100) divided by PaO2.
    - Ventilation Index (VI) >25 (Sensitivity 90%, Specificity 96% for needing ECMO).
        - VI= (PIP x PaCO2 x Rate) divided by 1000 (Doesn't work for HFOV)
    - Hypercarbic respiratory failure with pH 7.20 despite mechanical ventilation with peak inflating pressure >35 cm H2O.

Patients meeting any of the above criteria are prone to rapid deterioration prior to meeting ECMO inclusion criteria. These patients should be transferred early to an ECMO center.

EXCLUSIONS FROM PEDIATRIC ECMO:

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

- Severe CNS injury or asphyxia.
- Persistent plasma lactate > 225 mg/dl is highly predictive of death Note: > 135 mg/dl is highly predictive of adverse neurologic sequela in neonates.
- Base deficit > 30 on 2 ABG's.
- Severe neurological exam persistent after respiratory and metabolic resuscitation.
- End-stage malignancies, advanced AIDS, or severe acquired or congenital immunodeficiency.
- Allogenic bone marrow transplant recipients with pulmonary infiltrates.
- Major burn exceeding TBSA > 80%.
- Advanced liver failure (Correctable Coagulopathy is NOT an exclusion).
- Severe fibrosis on lung biopsy.
- Lethal condition incompatible with long life, including trisomy 13 and 18.
- Accidental hypothermia patients with an initial K level > 8 mEq/l or pH <6.6.
- Warm water drowning with CPR in progress.

Relative contraindications

- Recent neurosurgical procedures or intracranial hemorrhage (within the last 1-7 days depending on neurosurgical advice).
- Severe pulmonary disease ventilated aggressively for > 14 days.

High Risk Patients

- Infants with Pertussis Pneumonia.
- Disseminated Herpes Disease.
- Severe Multiorgan Organ Failure.
- Severe Coagulopathy or Thrombocytopenia.
- Repeat Need for ECLS for the same condition.