
**EXTRACORPOREAL LIFE SUPPORT (ECLS) /
EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO)**

PURPOSE:

To provide guidelines for the care of the patient who requires ECLS (ECMO and related therapies)

POLICY:

1. A RN shall be in attendance at the bedside at all times.
2. ECLS patients will have a 2 to 1 nursing ratio following initiation of ECMO. Changes in the nursing ratio can be made at the discretion of the ECLS physician.
3. The ECLS specialist may be a RN or RT who has completed a credentialing course prior to taking care of this patient. The credentialing course must include 24 hours of didactic and 4 hours of water drills and the final exam. Yearly credentialing will be required that includes water drills and exam.
4. The cannulation and initiation of ECLS will occur under sterile technique in the MICU procedure room or other controlled environment per the ECLS physicians order. The approved infection control guidelines in place at this institution for percutaneous line placement will be followed.
5. The cannulating/initiating ECLS physician will be the attending physician, but may transfer this responsibility to another ECLS physician at his/her discretion.
6. Neonates shall be transferred to the PICU prior to Cannulation for ECMO
 - a. Surgeon shall be contacted by/or at the discretion of the ECLS physician if surgical cannulation is required.
 - b. Neonates shall remain in the PICU for their ECLS course.
 - c. Neonates shall be transferred back to the NICU after de – cannulation and stabilization.
 - d. The Neonatologist and the ECLS physician will co-manage neonatal ECLS patients.

PROCEDURE

Responsible Party: Actions

I. Pre – ECLS

MD

1. Obtain ultrasound of access veins and/or arteries as applicable.
2. Obtain informed consent.

RN/ ECLS Specialist

1. Document vital signs hourly and / or more often as needed.
2. Document intake and output hourly.
3. Monitor respiratory status closely and document changes in status as they occur.
4. The following labs should be completed and reports available prior to initiation of ECLS:
 - a. ABG with electrolytes

- b. CMP, Mg, Phos, CO2, Pt/Ptt, fibrinogen, AT-III, plasma-free HgB (notify lab that pt is on ECLS and that plasma-free should be run as drawn and not batched), lactate level
- c. Type and crossmatch 4 units of PRBCs should be available at all times.
(note: crossmatches expire in 72 hours)

5. Notify Perfusionist / ECLS specialist on call that the patient is going on ECLS.

MD/RN/RT/NA

- 1. If the patient is transported for procedure the patient shall be transported to procedure room on ventilator with PEEP ambu bag readily available.

ECLS Specialist / Perfusionist

- 1. Primes ECLS circuit
- 2. Verifies that ECLS pump is in good working order with battery charged for transport.
- 3. Call for 2 units PRBCs used for prime (to be sent in blood cooler) if needed.
- 4. Connects water bath tubing and begins to warm water bath to ordered temperature by the ECLS physician.

MD/RN

- 1. Performs 5-minute 4% chlorhexidine scrub to cannula access sites.
- 2. Cover sites with sterile towel after scrub to maintain sterility.
- 3. Open OR minor pack and prepare sterile field.
- 4. Assist MD with sterile gown
- 5. Assist with draping and positioning of patient
- 6. Assure that patient is adequately monitored
 - Patient must have arterial line and central venous line unless patient's condition precludes their placement (Keep arterial line and IV lines accessible)
 - Pulse oximeter
 - EKG monitor
- 7. Administer medications as ordered
 - Sedation as ordered
 - Neuromuscular blockers as ordered
 - Analgesia as ordered
 - Heparin loading dose as ordered (make note of time; if procedure is lengthy a second dose may be needed)
 - Have arrest medications available
 - Colloid/ volume resuscitation as ordered
- 8. Monitor patient during procedure
 - Inform MDs of vital signs as needed
 - Draw ABG's as ordered

MD

- 1. Access veins/artery using percutaneous insertion techniques under direct supervision by MD trained in ECLS, or assist surgeon in case of surgical cutdown. Ultrasound may be used to assist with percutaneous vein/artery visualization.

ECMO Specialist/Perfusionist

- 1. After cannulas are in place the Perfusionist or ECLS Specialist will hand the appropriately primed tubing to the MD to be connected to cannulas (verify with MD that you are handing the drainage portion or patient return portion prior to connecting).

2. After ECLS tubing is appropriately secured and all clamps are off and tubing is patent, slowly initiate bypass by increasing pump speed as directed by the ECLS Physician. Be sure to add sweep at 1-2 times the blood flow rate. Sweep gas FIO₂ will be at 100% unless otherwise instructed.
3. Patient must continuously be monitored during initiation of bypass due to sudden fluid shifts that may alter hemodynamics. (Have all emergency drugs readily available).
4. As you increase the flow, be sure to increase sweep to ordered level.
5. Patient may require calcium replacement during initiation of bypass, amount to be determined by MD.
6. After bypass has been initiated ventilator settings should be decreased to "rest settings" (as determined by MD). The MD should also have standing emergency ventilator settings ordered. RT will be responsible for all ventilator changes per their policies.
7. Call for post procedure CXR
8. After patient is stabilized they may be moved onto a rotating bed as ordered. These beds are specifically designed to rotate patient from side to side to help mobilize secretions and prevent skin breakdown. Have the bed ordered early to prevent delays in therapy.
9. If patient is stable for transport they will be transported on ECLS to assigned room. Make sure hallway is cleared and if necessary to use elevator, have security on standby. The ECLS Specialist/Perfusionist is responsible for making sure the battery is operable prior to transport. The sweep gas will be connected to the portable O₂ tanks located under the ECLS console. Air tanks are not necessary.
10. Make sure the hand crank is readily available for emergency use.
11. These patients may benefit from proning. If proning patient, ECLS physician must be in attendance.

II. During ECLS

RN/ECLS Specialist

1. RN, ECLS Specialist, or MD will be at bedside at all times
2. Daily CXRs and weights will be obtained. ECLS Specialist must be in attendance and assist with any movement of patient.
3. Accurate daily fluid balance is essential for patient management
4. Routine lab work as ordered at least once a day but more often as needed(usually includes but is not limited to)
 - ABG with lytes
 - CMP, phos, Mg, CO₂
 - Pt/Ptt
 - Fibrinogen
 - AT III
 - Plasma free HgB

- Lactate level
 - HgB, Hct, and platelets
5. ACTs will be done every hour until adequate anticoagulation is achieved then every 2 hours. The MD will write the heparin sliding scale to be followed.
 6. During VA support, mixed venous blood gases will be obtained every 1 to 2 hours, or at the discretion of the ECLS physician.
 7. Every hour or more often as needed document VS, sweep, and flow.
 8. Assure that ECLS machine is plugged into a red emergency outlet.
 9. Cannula sites will be cleaned with 4-minute 4% chlorhexidine scrub every day with clean dressing applied (or more often as the dressings become soiled).
 10. Assures there are at least 4 tubing clamps at the bedside at all times.
 11. Offer family members the Family Guide to ECLS and or educates family regarding the patients disease process and treatment plan.

III. Transport of ECLS patient

1. Patients may need to be transported while undergoing ECLS
2. Communication shall be done between the ECLS specialist and receiving area to ensure capabilities of maintaining system while in designated area
 - a. Oxygen supply
 - b. Electricity source
 - i. Electrical outlet must be compatible with ECLS pump
 - c. Physical space of equipment
3. ECLS physician shall be present during transport
 - a. Transport is a high risk procedure. ECLS physician is available for Cannulation issues and crisis intervention
4. ECLS specialist shall be present during transport
5. A hand crank will be available on all transports
6. All paths shall be clear and elevators shall be ready and available for rapid transport. This will ensure the least amount of time in transit.
7. Oxygen source shall be place on an E – Cylinder for transport. Assurance of a full O₂ E – cylinder shall be done prior to leaving any area.
8. All care shall be maintained per standard during transport
9. If transporting to outlying facility the following shall occur:
 - a. ECLS coordinator shall be notified to set up transport
 - b. ECLS physician, ECLS specialist and ECLS coordinator/perfusion shall accompany patient during transport

IV. Weaning from ECLS

1. As the patients' native lung function improves they will require less support from the ECLS system, increase vent settings as ordered and gradually decrease amount of sweep.
2. ABG's will be monitored during this weaning period

V. Trial off ECLS

1. When patient is ready the ECLS physician may order a trial off ECLS, if so, the ventilator settings will be adjusted per order and the sweep gas turned off. Monitor the patient closely during this time and document all findings.
2. If the patient does well on their trial off ECLS it may be time to discontinue ECLS support.

VI. Discontinuing ECLS

1. Gather supplies: two 60cc catheter tip syringes (filled with Saline)
4x4 gauze
Tape
3. Flush cannulas with saline in 60 cc syringes.
4. Assist MD with removal of catheters.
5. For percutaneously placed cannulas, pressure will need to be held for approximately 30 minutes.
6. Insertion site may require suture.
7. Routine ICU care post-procedure.

VII. Supplies for Pump Head Change

1. Gather supplies: one 60cc catheter tip syringe
Sterile irrigation bucket
250 cc Normal Saline
One 30 cc Luer lock syringe
4 tubing clamps
BPX 80 (adults)
BPX 50 (pediatric and neonates)
2. Calls Perfusionist or ECLS physician once supplies ready
3. Prepares 60cc catheter tip syringe with Normal Saline
4. Turns ECLS flow off for pump head change
5. Assist Perfusionist or ECLS physician with changing of pump head
6. Alerts Perfusionist or ECLS physician with critical vital sign changes
7. Resumes appropriate ECMO flow once pump head is back in the driver

VIII. Supplies for Oxygenator Change

1. Gather supplies:
 - one 60cc catheter tip syringe
 - Sterile irrigation bucket
 - 250cc Normal Saline
 - 1 liter of Normasol with 2000cc units of Heparin
 - 6 inches of plain ¼ inch tubing
 - 1 hemostat
 - 4 tubing clamps
 - 4 inches of 3/8 inch tubing
 - 1 Lopez valve
 - IV tubing
 - 2 stopcocks
 - Desired Oxygenator
2. Calls Perfusionist/ECLS physician/ECLS coordinator when supplies ready
3. Prepares 60cc catheter tip syringe with Normal Saline
4. Perfusionist/ECLS physician/ECLS coordinator primes oxygenator
5. Turns ECLS flow < 100 rpm or off for oxygenator change
6. Assists in the changing of the oxygenator
7. Alerts of any critical vital sign changes
8. Resumes appropriate flow once oxygenator changes
9. Assures replacement of oxygen line to the oxygenator
10. Assures no obstruction to oxygenator exhaust.

IX. Emergency Evacuation Plan

1. The ECMO pump is plugged into a red (generator back – up) plug at all times to avoid using battery power during main electrical power.
2. Notify the ECLS physician of situation if time permitting.
3. All previous standards of care will be met to the extent possible.
4. In face of evacuation ECMO patients will be laterally transferred as much as possible to remove from danger.
5. Transfer shall be attempted to area with both air and oxygen source. If not available H cylinders may be obtained to sustain gas supply. If no H tanks available E cylinders shall be used until supply depleted.

Reference:

1. Zwischenberger, J., Bartlett, R. (2005). Extracorporeal Cardiopulmonary Support in Critical Care (3rd ed). ELSO: Ann Arbor.
2. Infection Control Guidelines IC 16
3. Bigatello, L. (2006). Critical Care Handbook of the Massachusetts General Hospital (4th ed).