

TITLE: Unfractionated Heparin Management During Extracorporeal Membrane Oxygenation (ECMO) Protocol

STATEMENT:

The Unfractionated Heparin Management on ECMO Protocol is designed to provide the ECMO Specialist with specific instructions for maintaining adequate anticoagulation during extracorporeal therapy.

SCOPE:

The ECMO Specialist will implement this provider ordered protocol for heparin management as soon as the patient is placed on ECMO support.

ELABORATION:

1. This protocol helps meet quality measures to ensure safety, quality and consistency/standardization in patient care.
2. The Unfractionated Heparin Management during ECMO protocol is included in the initial and daily ECMO order sets.
3. Standard concentrations for the heparin drip will be utilized based on patient weight as outlined below:
 - a. <16 kg – 100 units/mL
 - b. ≥16 kg – 500 units/mL

**For emergent cannulations, a premixed bag of 100 units/ml heparin may be utilized for a patient of any weight until the drip can be changed to the proper concentration.*

4. The ECMO Specialist will titrate the heparin drip to maintain the activated clotting time (ACT) and heparin assay in the ordered ranges.

5. A baseline antithrombin activity level should be ordered to assess for deficiency. An antithrombin activity level will be ordered daily while on ECMO. Antithrombin levels below 25% may decrease heparin responsiveness.
6. The ECMO Specialist will document the ACT results, heparin dose, and any bolus doses or drip changes on the Pediatric ECMO Flowsheet in Sunrise or on the appropriate down-time form (BCHD # 7/13).
7. Upon initiation of ECMO, target ranges are as follows:
ACT range (i-STAT kaolin): 170-200 seconds
Heparin Assay range:
 - Neonates (< 30 days of age): 0.3-0.5 units/mL
 - Pediatrics: 0.3-0.7 units/mL

These ranges may be adjusted by the attending physician based on clinical needs (i.e. post-op bleeding or low-flow states).
8. The ECMO Specialist will notify the physician if the heparin assay is out of the specified range for more than 2 lab results.

PROTOCOL

1. Start the heparin drip at 30 units/kg/hr IV.
 - a. Attending physician may elect to start at 10 units/kg/hr if the patient is coagulopathic
 - b. If patient is bleeding or is a post-op, the attending physician may choose to not use heparin initially
2. Obtain an ACT and heparin assay immediately after ECMO is initiated.
3. Thereafter, obtain ACT every 1 hour and heparin assay every 4 hours until heparin assay is in goal range x 2.

4. Initially titrate the heparin drip based on ACT results (Optimization Phase) as shown on Table 1 until the heparin assay is within physician ordered goal range x 2. When heparin assay is in the physician ordered range x 2, proceed to step 5 (Maintenance Phase), and begin titrating based on the heparin assay, even if ACT is below range.

Table 1. Optimization Phase: Titration via ACT until Heparin Assay in Goal Range x 2

ACT (i-STAT kaolin) Titration		
ACT (seconds):	Bolus units/kg	Action
≥20 below range	15	Increase heparin infusion by 4 units/kg/hr
6-19 below range		Increase heparin infusion by 4 units/kg/hr
1-5 below range		No change
Within Ordered Range		No change
1-5 above range		No change
6-40 above range		Decrease heparin infusion rate by 2-4 units/kg/hr
>40 above range		Decrease heparin infusion rate by 6 units/kg/hr and notify MD

5. Titrate heparin drip based on the heparin assay as shown in table 2.

Table 2. Maintenance Phase: Titration via Heparin Assay After Initial ACT Stabilization

Heparin Assay Titration				
Heparin assay (units/mL)	Bolus units/kg	Hold, min	Action	Repeat heparin assay
<0.1	15	0	Increase by 6 units/kg/hr	4h
Below range	0	0	Increase by 4 units/kg/hr	4h
Within ordered range	0	0	No change	4h
Above range	0	0	Decrease by 4 units/kg/hr	4h
>1.0	0	60	Decrease by 6 units/kg/hr	4h

- a. Obtain antithrombin activity level daily
 - i. If antithrombin is <25%, notify physician
- b. Obtain an ACT every 2 hours
 - i. Frequency may be varied at physicians discretion
 - ii. If ACT is high and heparin assay is not at goal, notify physician
 - iii. If ACT is low and heparin assay is at or above target, ensure the daily antithrombin level is >25%. If antithrombin is >25 % continue to adjust heparin drip according to heparin assay. If antithrombin is <25% , notify physician
- c. Continue to obtain a heparin assay every 4 hours

6. Do not start weaning the heparin drip until the platelet count and fibrinogen level are in physician ordered ranges.
7. All adjustments must be made within 10 minutes of an “out of range” heparin assay.
8. If a change is NOT made, document the rationale and repeat the ACT in 30 minutes.
9. Notify MD if the heparin infusion rate is < 20 units/kg/hr or >50 units/kg/hr.
10. When trialing off of VA ECMO, the ACT range is increased to 280-320 seconds, unless otherwise specified by the physician.

REFERENCES:

1. Extracorporeal Membrane Oxygenation. ECMO Extracorporeal Cardiopulmonary Support in Critical Care. 4th Edition.
2. ECMO Specialist Training Manual. 3rd Edition.
3. Northrop MS, Sideonio RF, Phillips SE, et al. The use of an Extracorporeal Membrane Oxygenation Anticoagulation Laboratory Protocol is Associated with Decreased Blood Product Use, Decreased Hemorrhagic Complications, and Increased Circuit Life. *Pediatr Crit Care Med* 2015;16:66-74).