ECMO Neuromonitoring and Acute Brain Injury:
Intracranial Hemorrhage on ECMO
Associated Power Plan: ECMO Bleeding Algorithm

Children's Mercy KANSAS CITY | Evidence Based Practice

QR code for mobile view

Exclusion criteria:
- Ischemic brain injury without hemorrhage

Beside Huddle Team
- ECMO Physician
- ECMO Specialist
- Bedside RN
- ECMO Core Team Specialist
- Hematology (Coagulation Team)
- Neurosurgery

Coagulation Considerations
(*tiered approach*)
1. Platelets, fresh frozen plasma, cryoprecipitate replacement as indicated
2. Antifibrinolytics (tranexamic acid, aminocaproic acid), if not already using
3. Factor replacement (prothrombin complex concentrate, activated factor VII)
4. Protamine, if patient is on heparin, not responding to other therapies, and life threatening operative bleeding is noted

Prophylactic Heparin Considerations
- Is there evidence of clot formation in the circuit?
- Is there evidence of impending circuit dysfunction/failure due to the lack of anticoagulation?
- Is the patient receiving veno-venous or veno-arterial ECMO?
- Is there lab evidence of worsening coagulopathy while off anticoagulation?

Patient on ECMO with intracranial hemorrhage (ICH) reported on head CT

- **Activate** ECMO Bleeding Algorithm, ideally start at Tier 3, unless circuit concerns
- **Complete** a bedside or phone huddle as a team and discuss intervention with Neurosurgery
- **Start** prophylactic levetiracetam (Keppra): Load 60 mg/kg (*max 4500 mg*) then 20 mg/kg/dose (*max 1000 mg*) every 12 hours for 7 days

Does the patient require neurosurgical intervention?

Yes
- **Discuss** coagulation considerations with Bedside Huddle Team and Anesthesiology (*if going to Operating Room*)
  - These therapies risk circuit clotting
  - Have back-up circuit and IV access contingency plan, and discuss with General Surgery and ECMO leadership
  - Obtain ROTEM
- **Stat call** EEG tech to remove EEG leads
- **Proceed** with neurosurgical intervention
- **Remain** off anticoagulation circuit integrity maintained

ECMO Management for Neurosurgical Procedure/Operation

Post-Neurosurgical Intervention on ECMO

No

Is the patient stable enough to decannulate?

Yes

Off Pathway. Manage as intracranial hemorrhage

No

- **Continue** ECMO Bleeding Algorithm transfusion thresholds
- **Discuss** intervention with Neurosurgery
- **Provide** neuromonitoring and neuroprotection
- **Re-evaluate** blood pressure goals (*systolic blood pressure and mean arterial pressure*) to limit hemorrhagic progression while also maintaining cerebral perfusion
- **Monitor** neurological examination (*hourly neuro checks*)
- **Repeat** head CT every 12 hours until ICH is stable (*timing can be adjusted based off clinical exam and multidisciplinary discussion*)

Are there signs of enlarging ICH on head CT?

No
- **Consider** restarting prophylactic heparin at a minimum of 12 hours after ICH determined to be stable with head CT and multidisciplinary discussion
  - ***Start*** heparin at 10 units/kg/hr
  - ***Repeat*** head CT and labs 6 hours after restarting low dose anticoagulation
  - ***Increase*** per Anticoagulation Guidelines as patient and circuit allow
- **Complete** head CT after therapeutic heparin levels achieved
- **Assess** daily for readiness to come off ECMO
- **Continue** neuromonitoring and revisit neuroprotective goals daily

Is the patient stable on therapeutic anticoagulation?

No

Yes
- **Discuss** with multidisciplinary team about when to de-escalate off ECMO Bleeding Algorithm
- If stable exam, **resume** standard care

Yes

Does the patient require neurosurgical intervention?

No
- **Continue** to assess neurologic function
- **Discuss** timing for repeat head imaging
- **Continue to monitor circuit integrity**
- **In the setting of catastrophic injury**, consider if withdrawal from ECMO is appropriate

Yes
- **Discuss** coagulation considerations with Bedside Huddle Team and Anesthesiology
  - These therapies risk circuit clotting
  - Have back-up circuit and IV access contingency plan, and discuss with General Surgery and ECMO leadership
- **Stat call** EEG tech to remove EEG leads
- **Proceed** with neurosurgical intervention
- **Remain** off anticoagulation if circuit integrity maintained

ECMO Management for Neurosurgical Procedure/Operation

Post-Neurosurgical Intervention on ECMO