ECMO Neuromonitoring and Acute Brain Injury:

Intracranial Hemorrhage on ECMO

Associated Power Plan: ECMO Bleeding Algorithm



Evidence Based Practice

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)

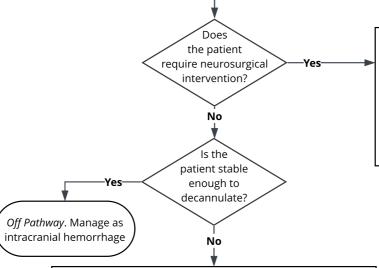
- 1. Platelets, fresh frozen plasma, cryoprecipitate replacement as indicated
- 2. Antifibrinolytics (tranexamic acid, aminocaproic acid), if not already 3. Factor replacement (prothrombin
- complex concentrate, activated factor VII) 4. Protamine, if patient is on
- heparin, not responding to other therapies, 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



- 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

- 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

 Consider restarting prophylactic heparin at Are there signs a minimum of 12 hours after ICH of enlarging ICH on determined to be stable with head CT and head CT? multidisciplinary discussion • Start heparin at 10 units/kg/hr Yes • Repeat head CT and labs 6 hours after restarting low dose anticoagulation • Increase per Anticoagulation Guidelines as • Discuss options with Neurosurgery

- Discuss escalating tiered coagulation considerations with Bedside Huddle Team These therapies risk circuit clotting
- Have back-up circuit and IV access contingency plan, and discuss with General Surgery and ECMO leadership

Does

the patient

intervention?

Yes

- Obtain ROTEM **Review** circuit integrity
- 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

require neurosurgical

- **Discuss** coagulation considerations with Bedside Huddle Team and Anesthesiology
- These therapies risk circuit clotting
- $\,{}^{_{\! \odot}}$ 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

- 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

the patient stable on therapeutic anticoagulation? Yes

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

Contact: EvidenceBasedPractice @cmh.edu

Link to: synopsis and references