Perfusion Techniques for Initiating ECMO

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Purpose

- Avoid unwanted complications of ECMO that may be caused during the initiation period
  - Neurologic – more prevalent in pediatrics
  - ICH – 7.6% (neonates)
  - Cerebral infarction – 6.9% (neonates)
  - Acute Kidney Injury

Goals

- Discuss techniques to initiate ECMO efficiently
- Discuss techniques related to each phase of ECMO initiation
  - Pre-Initiation
  - Initiation
  - Post-Initiation & Beyond

Efficiency

- eCPR: “Every minute counts.”
  - Be prepared 24/7
- Simulations/Training – Multidisciplinary
  - Perfusionists, ICU & OR nursing staff, ICU physicians, etc.
- Collaboration
  - Nursing
  - Blood bank
  - O-Log release of blood for eCPR
  - Communication with IR and anesthesia for expedited cross matched blood available for inpatients
  - Positive reinforcement
Delegation to available staff prior to arrival
  - HPH
  - Drug Res
  - Consider ICU assistance with priming and other ancillary tasks
  - Location of equipment
  - Dedicated location in the ICU
  - Supplies in operating room
  - Travel cart
  - Be prepared
  - Multiple sets of canulas immediately available
  - Dilator kits

Documentation:
- Location of equipment
- Dilator kits
- Supplies in operating room
- Note skipped steps during initiation process due to emergent situations

Setup
- Consider RN assistance with priming and other ancillary tasks
- Setup
  - Identical each time
  - Two person sign off
  - Priming
  - Consistency in blood products and medications, sequencing
  - Initiation

Pre-Initiation
- Established Institutional Protocols
  - Patient injection, vasoconstrictors, troubleshoot, anticoagulation
- Checklists ✓
  - Setup
    - Identical each time
    - Two person sign off
    - Priming
    - Consistency in blood products and medications, sequencing
    - Initiation

Pre-Initiation
- Checklists (continued)
  - Provide consistency in care
  - Documentation
    - Equipment and lot numbers
    - Process
  - Note skipped steps during initiation process due to emergent situations
  - Bloodless initiation due to lack of blood available or eCPR
**Initiation**

- **Priming Techniques**
- **Physiologic Prima**
- **Blood Gas Management**
- **Monitoring**
  - \( pO_2 \)
  - \( pCO_2 \)
  - Temperature Considerations

**Blood Gas Management**

- Incorporate continuous blood gas monitoring to monitor prime values and immediate post initiation values
- **CDI**
- Spectrum M4
- Cerebral/Somatic NIRS monitoring

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**Priming Techniques**

- Similar to CPB
- Physiologic Prima
  - Avoid
    - Avoid Hypothermia (Temperature below 32°C improves mortality)
    - Avoid Hypertension (Temperature above 32°C improves mortality)
- Calcium
- Potassium
- UDF: Use if EVACED to avoid hypotension caused from sudden unmasked blood loss initiation
- Clorax
- Arterial/Arachnoid pressure
- Obtain Prime Supplies and correct deficiencies
- Documentation

**Especially important in VV ECMO**
Blood Gas Management – pCO₂

- Critical to correct hypercapnia slowly
- Consider matching pre-ECLS values – slowly brought into target range
- Congenital Diaphragmatic Hernia – pCO₂ > 100 mmHg
- Be sure sweep is OFF in closed system
- Have exogenous CO₂ available
- Priming
- Oxygenator efficiency

Blood Gas Management – pO₂

- FiO₂ considerations
  - 21% post resuscitation
  - Avoid reperfusion injury
  - 50-70% VA
  - 100% VV
- Maximize dissolved oxygen going through the lungs
Temperature Considerations

- Hypothermia post arrest/eCPR?
  - Confirm with physician
  - Set heater cooler temperature appropriately
  - Prevent reperfusion injury
  - Ability to remove CO2 more effectively (more soluble)
  - Avoid unwanted hypothermia
  - Post-Cardiac??
  - Avoid hyperthermia
  - Note equipment default settings

Post-Initiation – Reevaluate Plan of Care

- Blood pressure considerations
  - Reduce dopamine, inotropic support
  - Limit increase in fluid and blood/pressure medications
- Ventilator Considerations
  - Reduce support - trends in ventilator settings (avoid complete rest)
- Optimal flows
  - Venous return increased flow to avoid reversed circulation/flow/vascular injury
  - Avoid aggressive treatment of acidosis
  - Limit treatment with NaHCO3 to avoid post arrest alkalosis
  - Volume resuscitation
    - Circuit has distensible volume
    - Cytokine response may vasodilation and increased capillary permeability
    - Options: Blood products, albumin, crystalloid

Temperature Management Literature Review

- NEST Trial
  - Randomized neonates, no improved outcomes at 2 years of age
- THAPCA Trial
  - No difference in outcomes between TH and control patients
- Guaman 2018, Bleeding Complications and Mortality in Neonates Receiving TH and ECMO
  - No difference in mortality between those who did and did not receive TH, TH not contraindicated
- Cashen 2018
  - Therapeutic hypothermia independently associated with hemorrhage in neonates
  - Secondary analysis of BATE study, Prospective data collection, n=20
    - 40% vs 15.8% ICH, Temperature <34deg C
- Cheng 2018, Post Arrest Therapeutic Hypothermia in Patients with CHD
  - CHD post arrest can be treated safely and safely with TH, decrease incidence of seizures, n=30
- Lou 2015, Safety of TH in children on VA ECMO after cardiac surgery.
  - Retrospective review, n=96.
  - TH can be safely provided with no increase in complication rates

In conclusion...

- As Perfusionists, optimize what is within our control during this phase of ECMO
  - Efficiency in preparedness
  - Circuit Prime
  - Initial pump and patient blood gases
  - Temperature
- Not every initiation is the same
  - Variable physiology
  - Same circuit
References


