"Clots in the ECMO circuit are the most common mechanical complication during ECMO."

"Normal clots are small in size and usually have no potential to cause harm to the patient or circuit."
ELSO Database International Report

- **Mechanical: Clots: Other**
  - Overall incidence across all age groups/diagnosis and ECMO modes
    - 34-57%

- **Neurologic: CNS infarction by US/CT**
  - Overall incidence across all age groups/diagnosis and ECMO modes
    - 23-53%

69% of autopsies revealed evidence for systemic thromboses

*Laboratory and clinical predictors of thrombosis and hemorrhage in 29 pediatric extracorporeal membrane oxygenation nonsurvivors.*


Seattle Children’s ECMO Team

- Intensivists
- Attending Cardiac Surgeon
- ECMO Fellow
- Perfusionist
  - Two crystalloid primed pumps at all times (>14kg)
  - 30 minute response
  - Present for all interventions
- Specialists (RN/RT)
  - Monitoring in CICU, PICU and NICU (Two ECMO)
  - Blood Prime Circuit
Nursing Perspective (Specialists)

Specialist threshold variation of allowable fibrin formation in arterial cannula

- Justification for circuit intervention
  - Physical (Looks like it’s getting worse...)
  - Mechanical (Flow, Pre/Post Membrane Pressure)

Intensivist Perspective

Changing attitudes toward interventions

- Short-term memory
- Cycle based on acute outcomes

Perfusionist Perspective

- What happens if I say does not need to be cleaned?
- If needs to be done, do I intervene before leaving for the day?
- Does the attending surgeon know?
- Who can put the cannula back in?
"When a blood clot forms in an arterial cannula, emergent cannula removal is required to prevent massive systemic embolism."

2015 ECMO at Children’s

- 23 VA ECMO Patients
  - 61% had minimum of 1 circuit change
  - Of those... 64% had 2-3 more circuit changes
  - 35 circuit changes

- 23 VA ECMO Patients
  - 42% had minimum 1 arterial cannula clean out
  - Of those... 43% had 2-4 more arterial cannula clean outs
  - 19 isolated arterial cannula clean outs

- 246 VA ECMO days...

Only 26% of the VA ECMO patients (6 of 23) did not require an ECMO intervention after initiation.
ECMO Circuit

- LivaNova (Sorin) S-III consoles
- Maquet Quadrox ID Adult oxygenator
- Revolution centrifugal pump
- 1/8 shunt from Post Oxygenator to Pre-pump with one way valve
- Pre, post and negative pressure monitoring
- Maquet Bioline coated taper tubing for arterial line for kids less than 14kg.

Perfusion Intervention Kit

- 6 small sterile tubing clamps
- 2 Large sterile tubing clamps
- 2 butterfly needles
- 2 pair sterile scissors
- 2 Sterile 15 blades
- 3 pair size 7 gloves
- 3 ChloraPrep’s
- 2 60ml syringes
- 1 sterile gown
- 1 pack of sterile towels
- 1 sterile ¾ drape
- 2 ½ x ¼ connectors

Clot Extraction Tools
Sterile Preparation

Don't Score the Connector

Flush Out
Future Clot?

Final Flush and Reconnect

Common Collections
Never disappoints…

Can only go one way…

What can go wrong?

- On the clock!
- Pneumothorax
- Flow Obstruction
What if we don’t do it?

Clot breaks off and blocks flow!

Alternative Method of Intervention

Anticoagulation and Measurement

- ACT device
- Sig elite
- Response 200-220 seconds
  Q hourly
- aPTT 60-90 seconds
  Q12 or 24
- Unfractionated Heparin (Xa).3-.7 IU/ml
  Q6, 12 or 24
If planning to intervene

• Consistent method of clot removal
• Resources available (Specialist, ECMO Fellow, Attending)
• Clean-out kit
• Time-out, organize the event
• Record Interventions
• Future Study (Anticoagulation, IVH, Infarcts)

Thank you....