



Management of the Pediatric ECMO Patient

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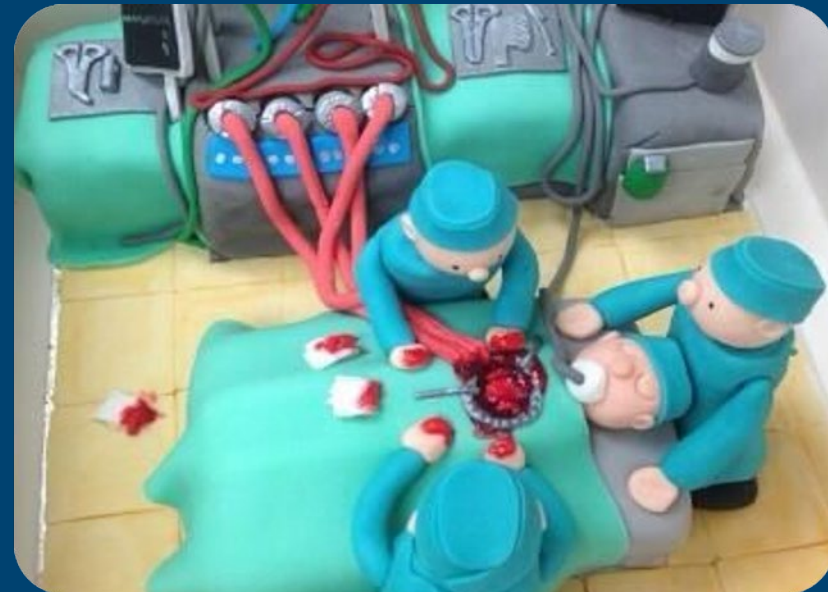


No Financial Disclosures

Agenda/Objectives



- Introduction to ECMO
- Inclusion & exclusion criteria
- Diagnoses prone to require ECMO
- ECMO Management: RN, RT, ECMO
- ECMO Pump Components
- Mechanical Ventilation
- Post ECMO care and Follow up
- Question and Answer session





ECMO: Extracorporeal Membrane Oxygenation

ECLS: Extracorporeal Life Support

ELSO: Extracorporeal Life Support Organization

>750 center members in >65 countries



What is ECMO?

Extracorporeal: Outside of the body

Cannulae: plastic “tubes” which are inserted into either a vein or an artery to facilitate to movement of blood.

Removing the blood, remove carbon dioxide, add Oxygen , and returning to the body

Last chance for survival when conventional therapy has failed

ECMO is considered at 50% mortality risk, but is indicated at 80% mortality risk

Allows the heart and/or lungs to rest, but does not “fix” anything

Veno-Arterial (VA): removing blood from the venous system and returning to the arterial system. Allows the heart and lungs to rest

Veno-Venous (VV): removing and returning blood to the venous system. Allows ONLY the lungs to rest. Zero cardiac support.

ECPR: CPR → ECMO



ELSO Age Groups

Neonate: 0-28 days

Pediatric: 29 days → 18 years

Adult: > 19 years



1971: First adult ECMO survivor. MVA
1975: First Neonatal survivor. Meconium Aspiration Syndrome



Fig. 14.4 (a) Photograph of Esperanza while she was on ECMO in 1975. (b) Photograph of Dr. Bartlett and Esperanza at age 34. Photos courtesy of Dr. Bartlett, with permission



ECMO pumps are non-pulsatile

Impact on kidneys

Preload dependent

Afterload resistant

Numerous pumps available but must choose the proper option for your program and patient population



Inclusion & Exclusion Criteria

Inclusion

- > 2 weeks and/or > 34 weeks Gestational age
- ≤ Grade I IVH
- Controllable bleeding
- Mechanical Ventilation ≤ 10-14 days
- Reversible condition
- Absence of concomitant condition (anomalies or cns dysfunction)
- Moderate or risk of dying from respiratory failure
- Failure to wean from CPB
- Failure of conventional medical management
- Bridge to transplant
- Cardiac Arrest
- Oxygen Index 25-40 despite use of pulmonary vasodilators

Exclusion

- < 2 weeks and/or < 34 weeks gestational age
- > Grade I IVH
- Uncontrollable bleeding
- Mechanical ventilation ≥ 10 days → 22-26% survival rate
- Chronic multi-organ dysfunction
- Irreversible brain damage
- Overwhelming sepsis
- Parental refusal????
- Cancer
- Incurable disease
- Lethal congenital abnormalities

Who Goes on ECMO?

RDS: Respiratory Distress Syndrome

Septic Shock

Pre & Post-op Congenital Cardiac surgery repair (HLHS, TGA, DORV, IAA, TAPVR, ASD, VSD, Truncus Arteriosus, etc)

Bridge to surgery/transplant

Trauma

Severe pneumonia

ECPR

Severe, life threatening cardiac or respiratory disease

Inhalation Injury

Status Asthmaticus

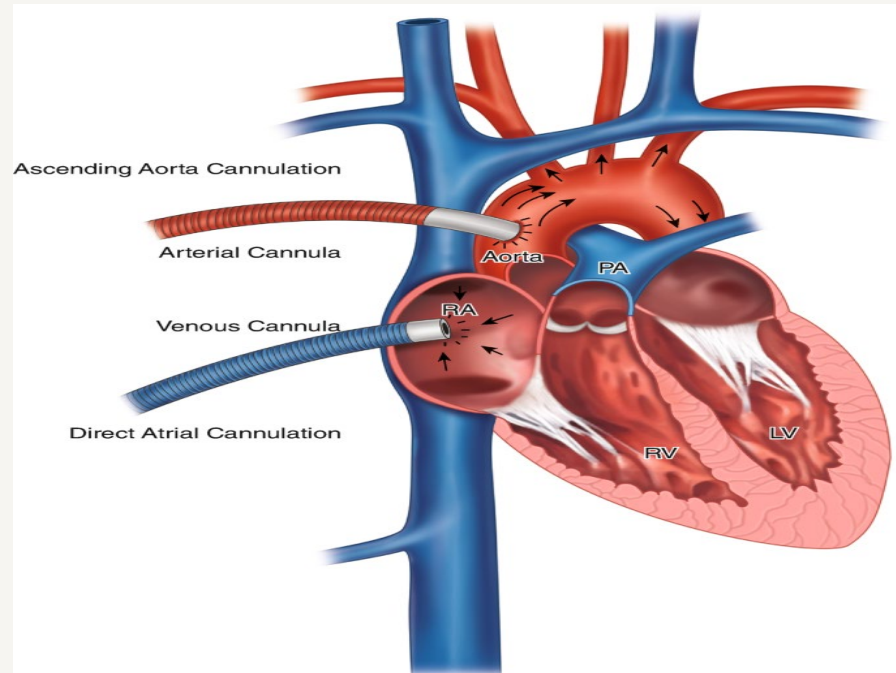
Veno Arterial (VA) ECMO

- Cardiac and Pulmonary support
- Provides immediate hemodynamic support
- 2 or more cannula
- Lung rest
- Potentially reduce the risk of mortality and morbidity associated with prolonged hypoxemia, acidosis, and/or cardiogenic shock.
- Reduce Inotropes and Pressors
- Remove blood from the venous system and returns to the arterial system
- Key aspects:
 - No compressions
 - Meds and shock

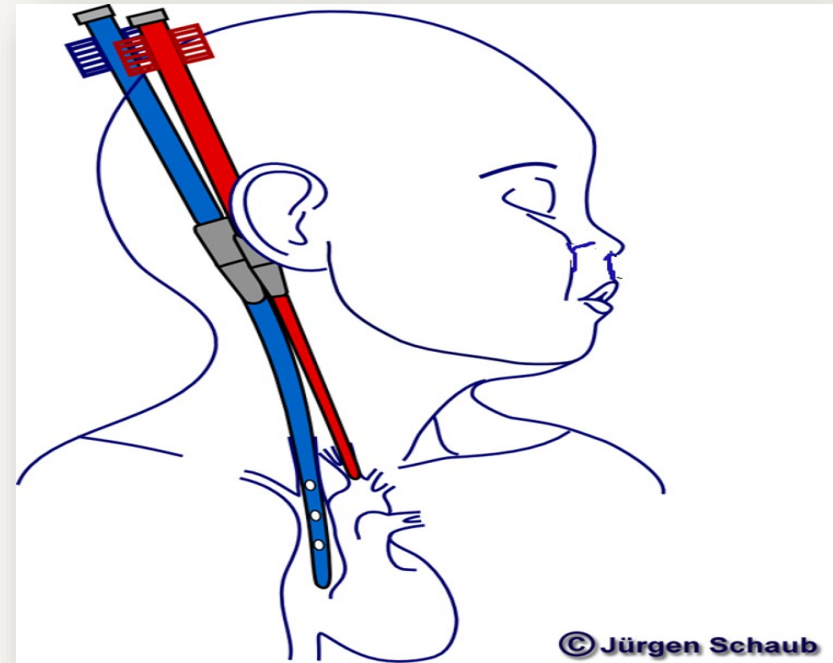


VA Cannulation Methods

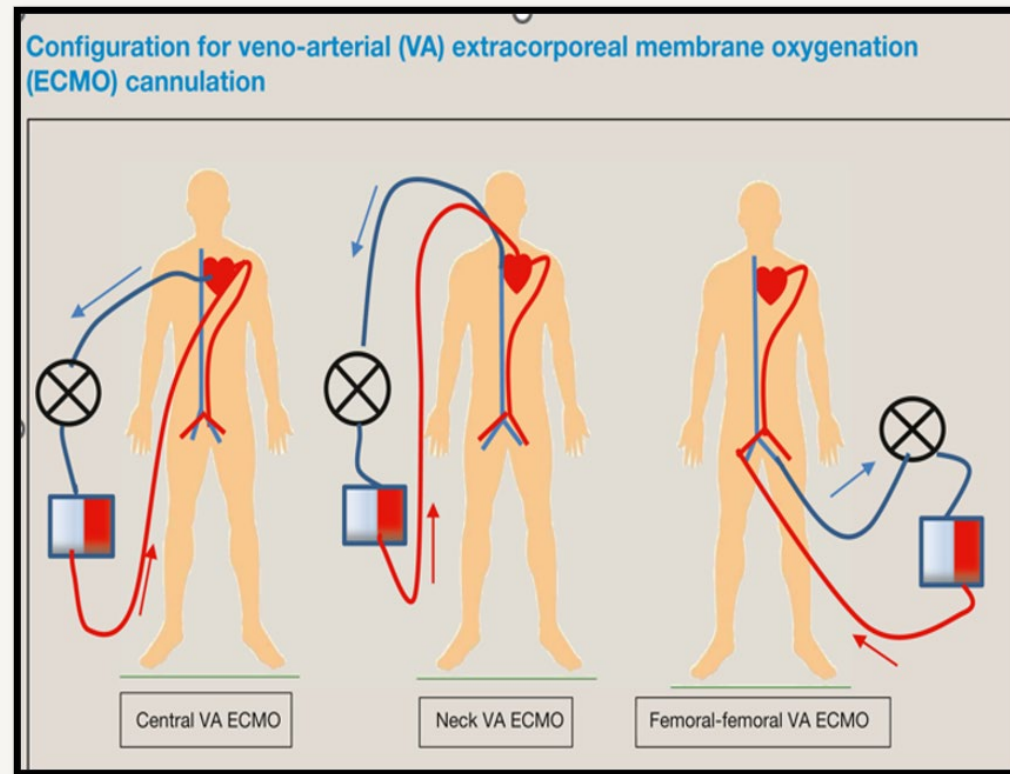
Central



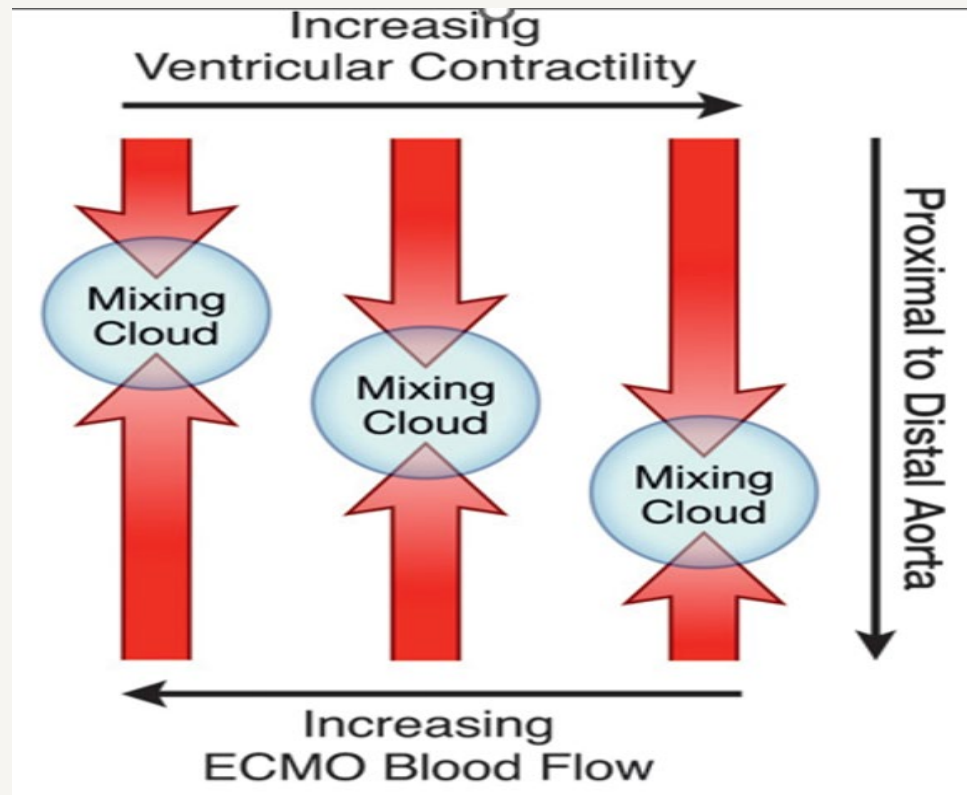
Cervical



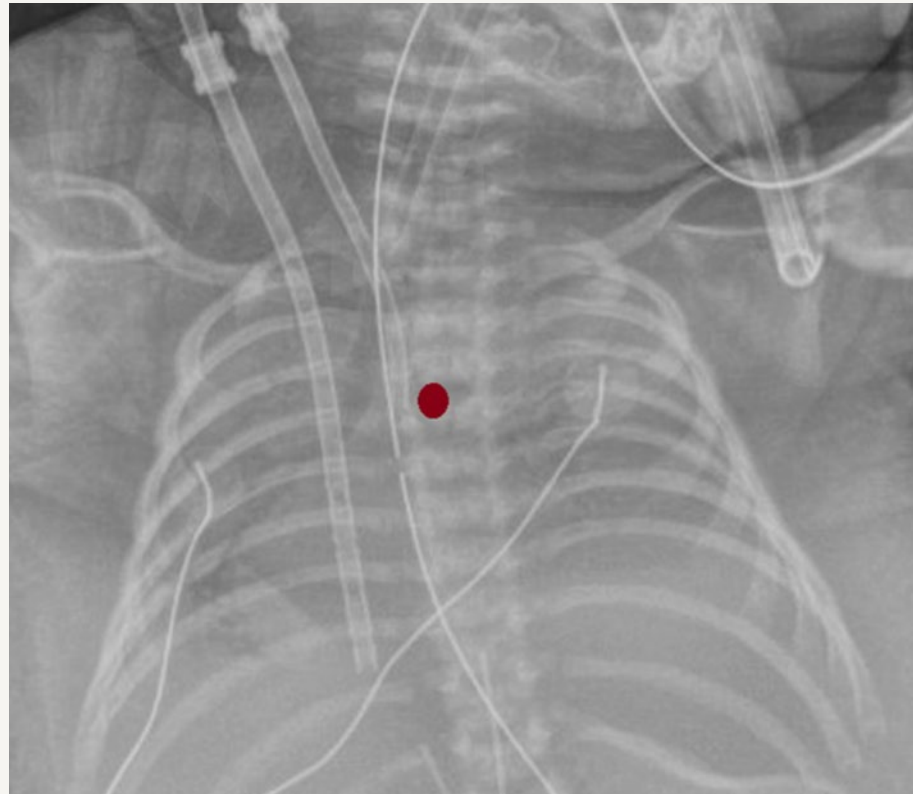
VA Cannulation Methods



Mixing Cloud



Chest Xray

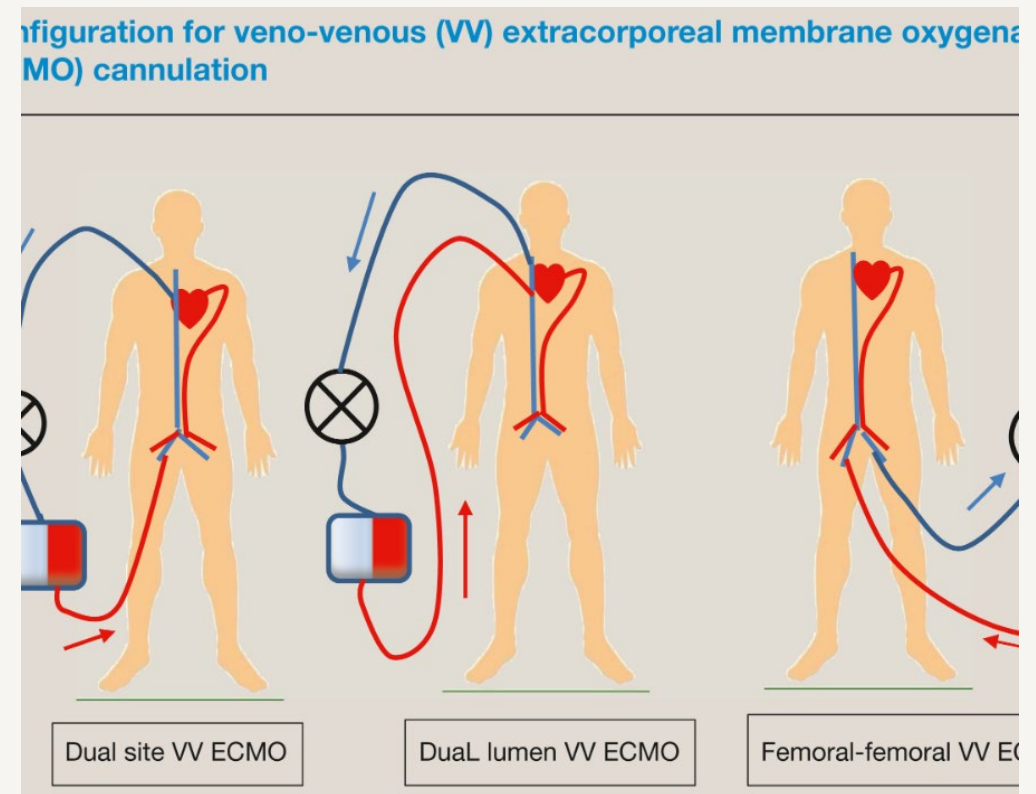
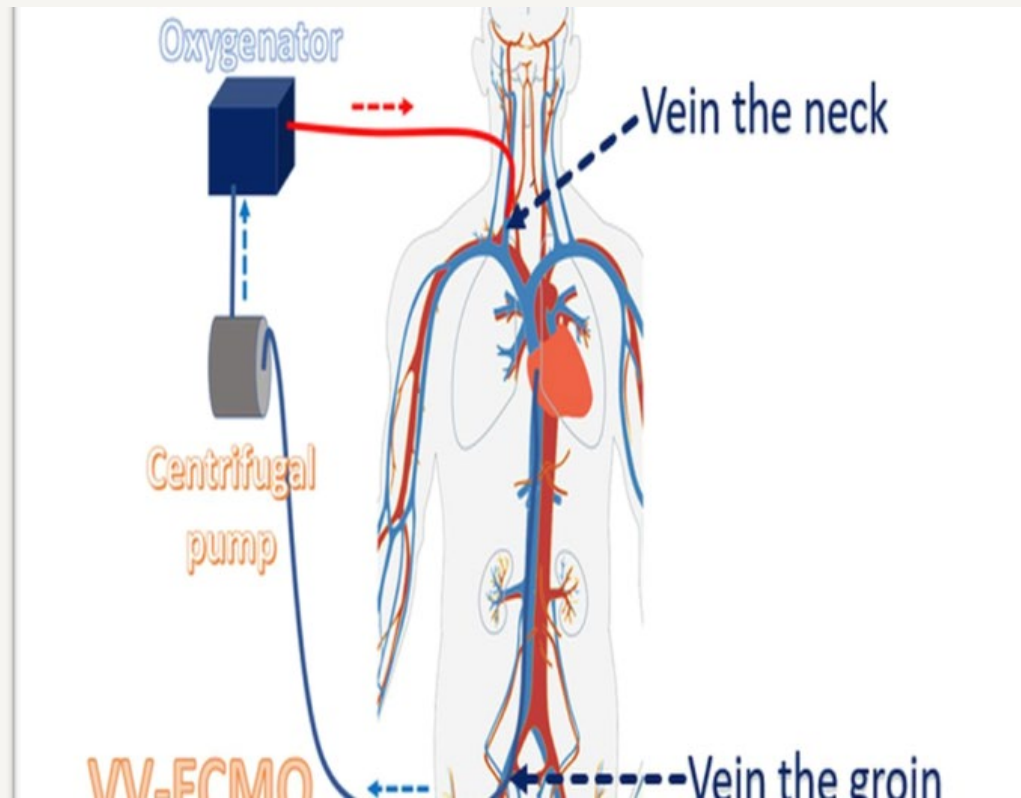


Veno-Venous(VV) ECMO

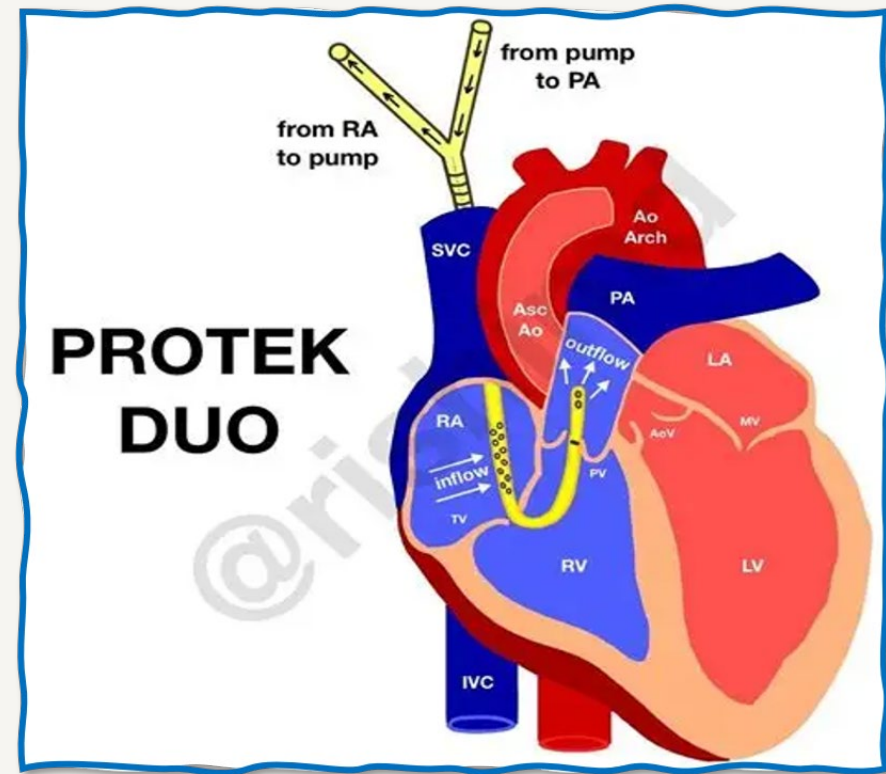
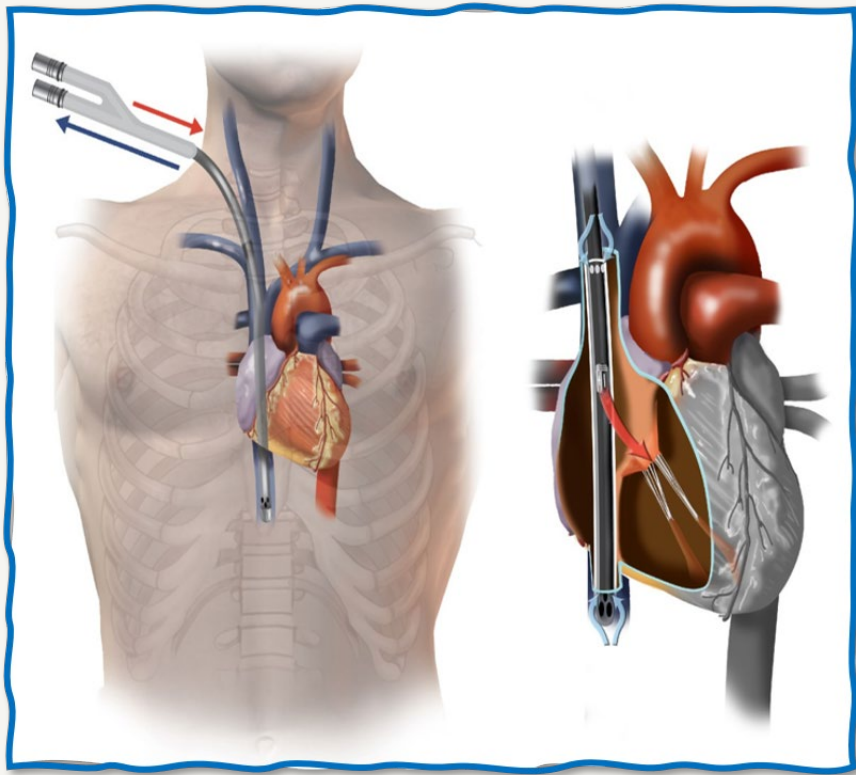
- Strictly pulmonary support
- ZERO cardiac support
- Remove & return blood to the venous system
- 1, 2, or more cannula
- Compressions! Treat as a normal patient off ECMO
- Convert to VA
- Maintain or increase inotropes and pressors
- Lung rest



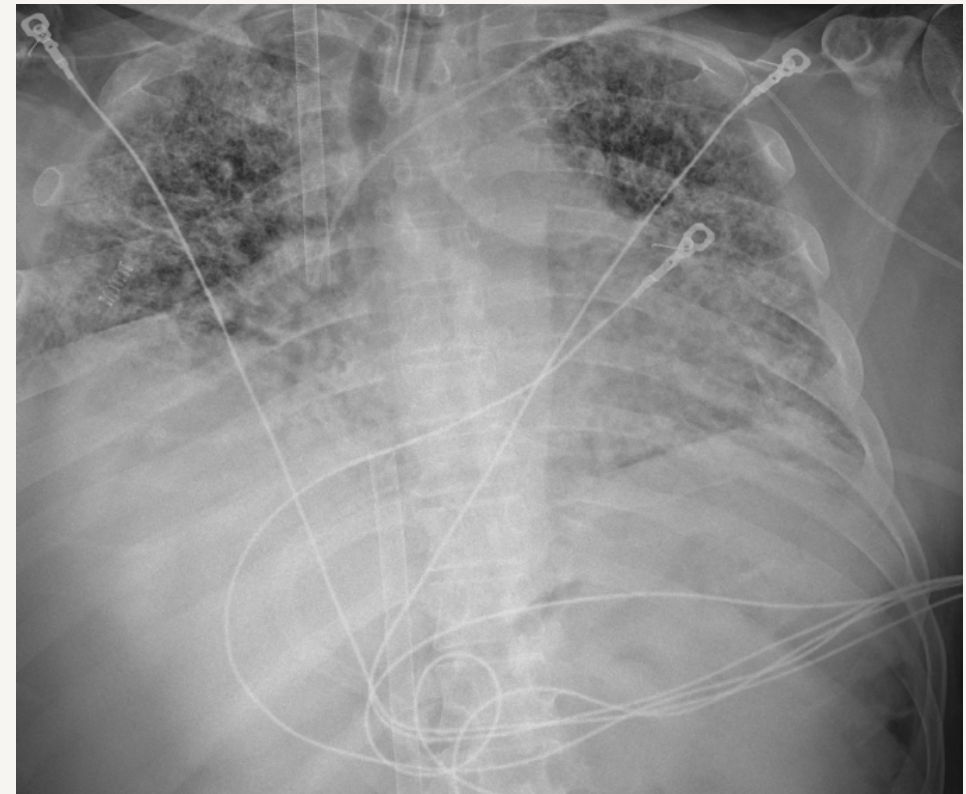
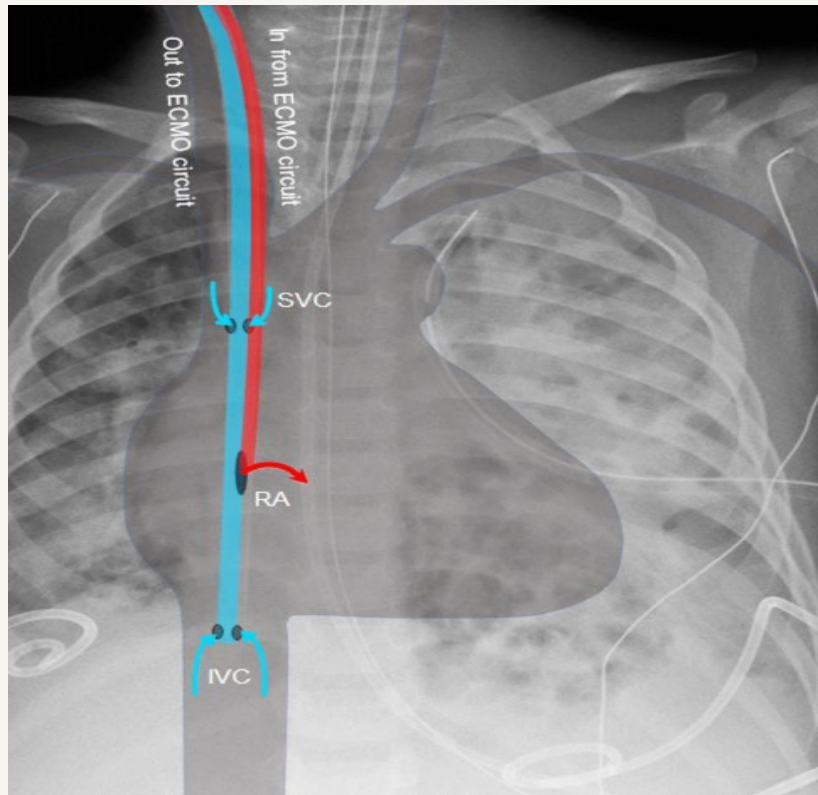
VV Cannulation Methods



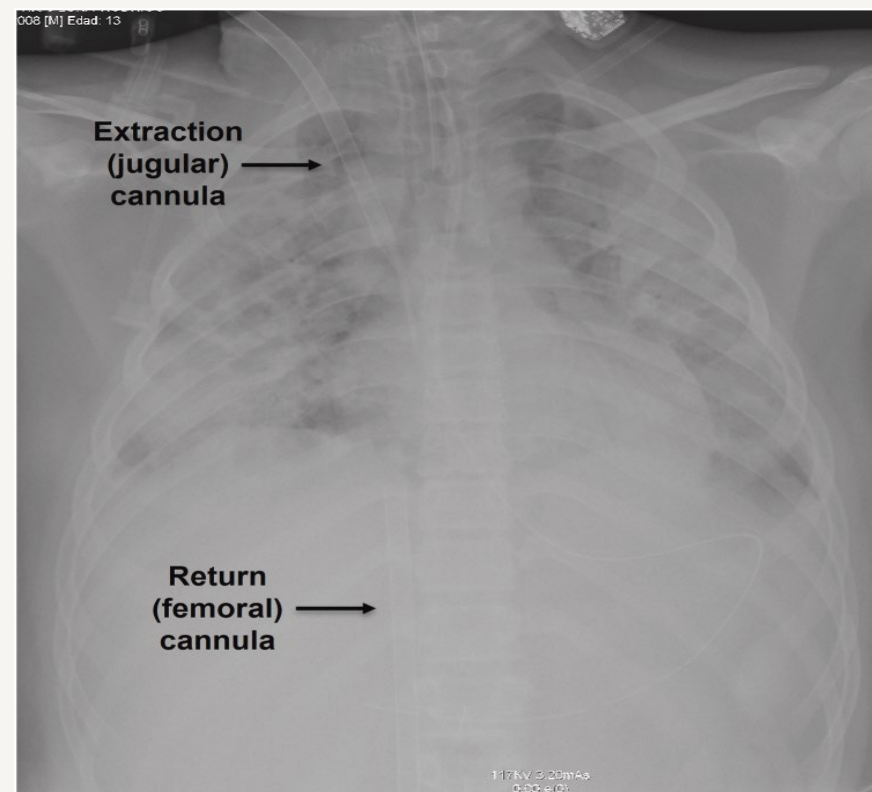
VV Cannulation Methods



Chest Xray



Chest Xray



Why not VV?

- Vessel size
- Patient anatomy and size
- Cannula options limited
- No cardiac support
- Conversion to VA factors:
time, anatomy, staff
availability



Risks/Complications of ECMO

- Bleeding
- Infection
- Death
- Accidental decannulation leading to poor outcomes
- Emboli
- Malfunctioning equipment
- Stroke
- Loss of limb





ECMO Management

Management of an ECMO patient is a team effort and every player is equally important!!

Nursing bedside duties:

- advocacy
- sedation
- paralytics
- wound care
- lab draws
- monitor vitals
- maintain stability

Assist with bedside activities: echo, cxr, cannulation and decannulation,
ECMO rounds, family interaction



Management of an ECMO patient is a team effort, and every player is equally important!!

Respiratory Therapy duties:

- advocacy
- maintain airway
- ventilator management
- ABG draws and interpretation
- ECMO rounds
- assist at bedside

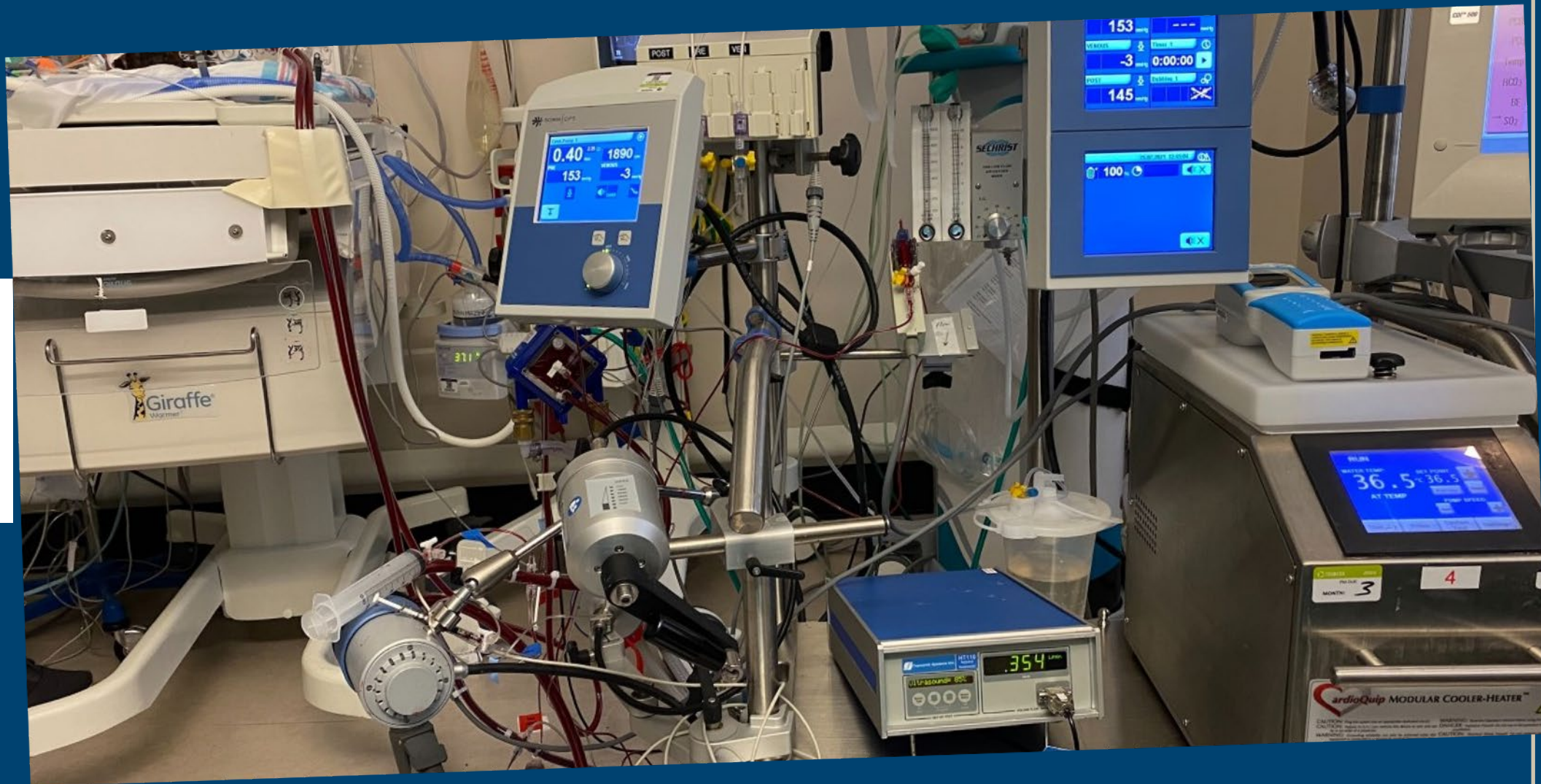


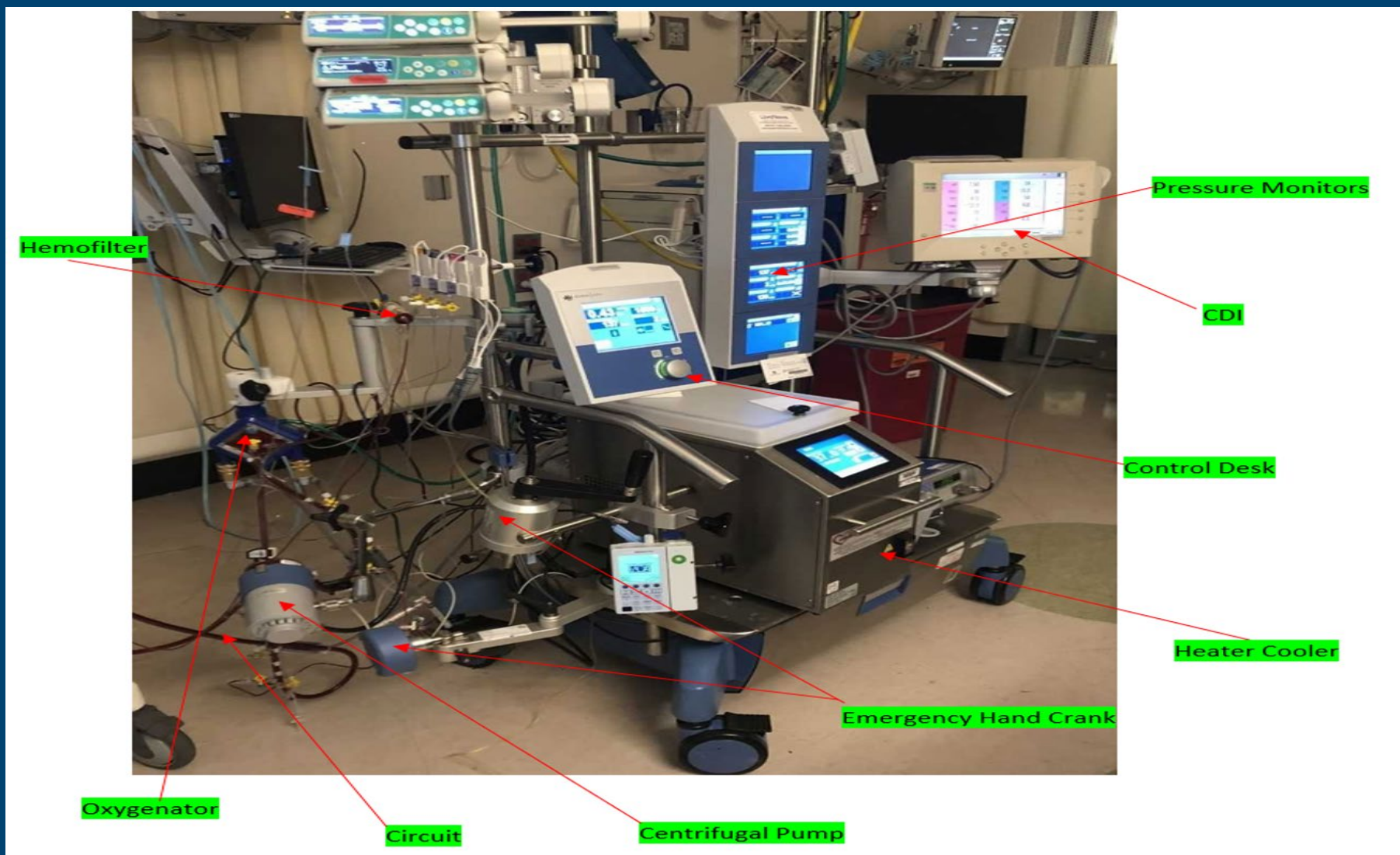
Management of an ECMO patient is a team effort, and every player is equally important!!

ECMO Specialist duties:

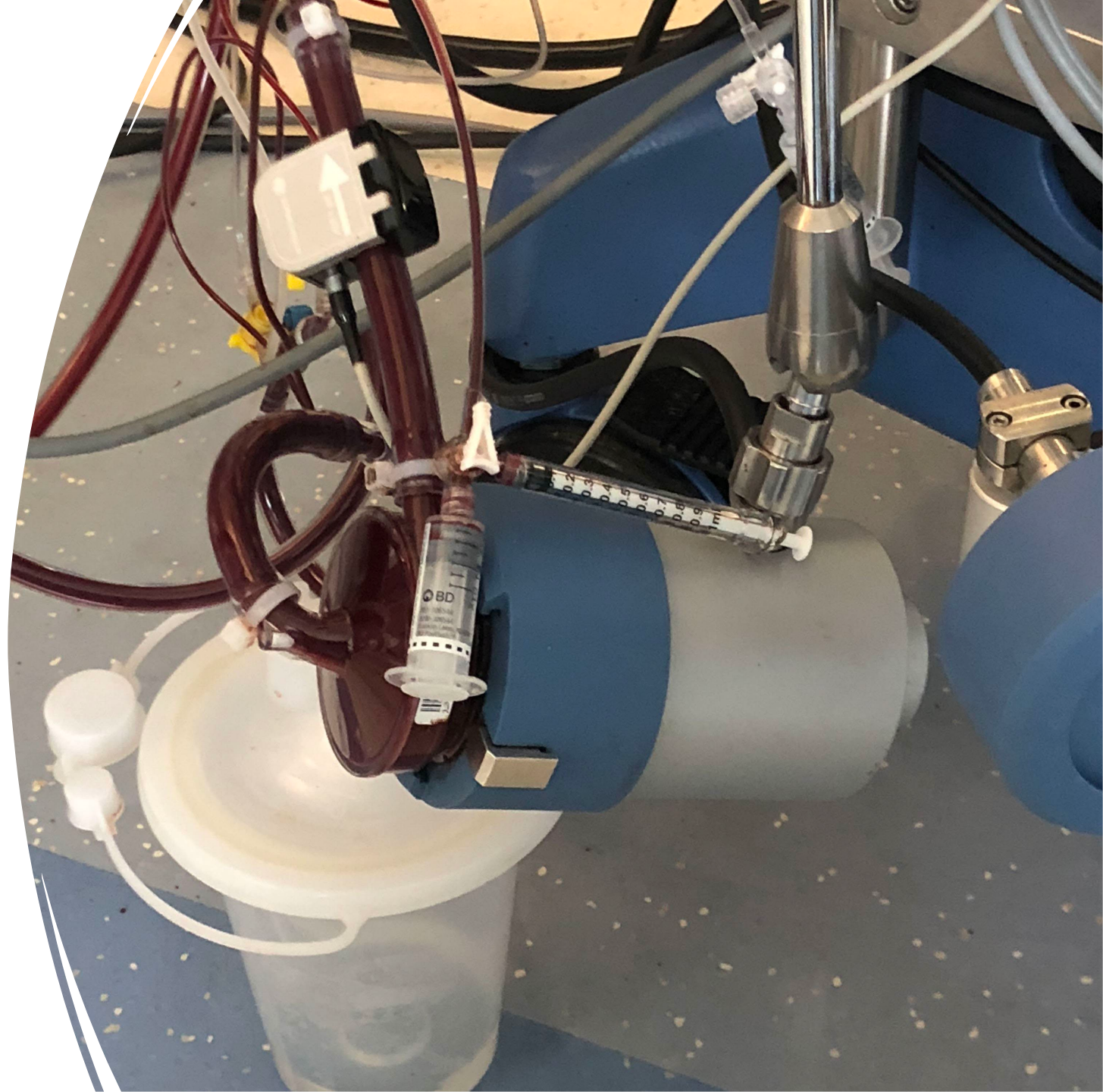
- advocacy
- maintain ECMO pump
- monitor labs
- manage anticoagulation
- infuse blood products
- monitor vitals
- monitor I's & O's
- ECMO rounds
- OWN and maintain cannulae and circuit







Centrifugal Pump



Oxygenator



Blender



Hemofilter



Heater Cooler



- **CRRT -- Continuous Renal Replacement Therapy**



Ventilation Strategies pre, during, post ECMO



Ventilation Pre ECMO

Conventional: AC or SIMV 100%/60/30/10 NO 20ppm

HFOV: 100%/24/55/6 NO 20 ppm

Inotropes, Steroids, Paralytics, etc.

Earlier ECMO Activation

Decreased Barotrauma

ECMO Ventilation: Rest Settings

SIMV/PC: 40%/20/20/5/10

Lung rest

Avoid Barotrauma

Atelectatic

Pulmonary Toilet

Post ECMO Ventilation

Post ECMO ventilator settings should not be the same or greater than pre ECMO settings. If so, stay on ECMO.

SIMV PC
60%/30/22/6/10 NO
20PPM

ECMO Length of Therapy

Each patient is unique

Hours or weeks or
months

ECMO does not heal,
but allows the body to
rest while overcoming
the illness

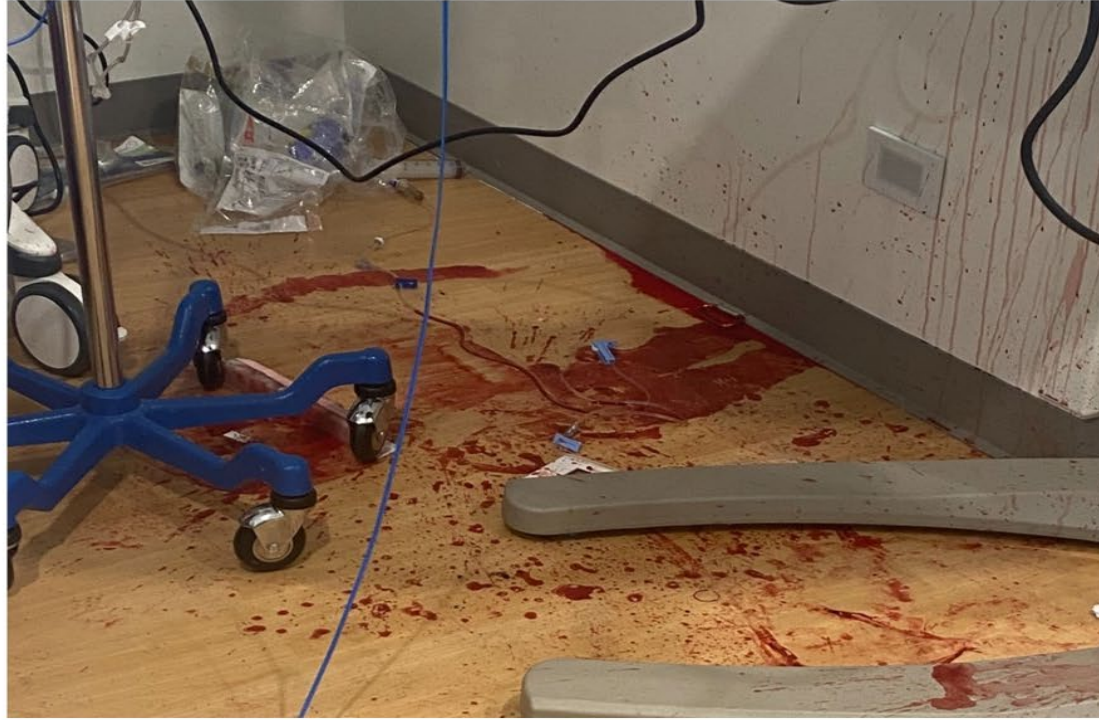
SAFETY
FIRST!



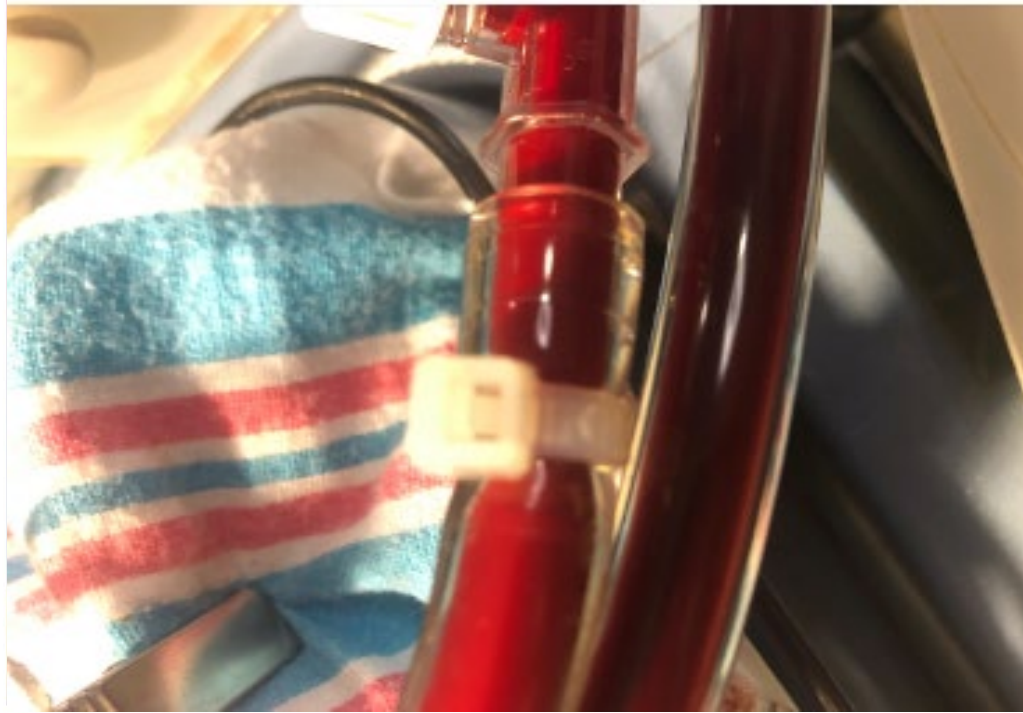


Oooops!

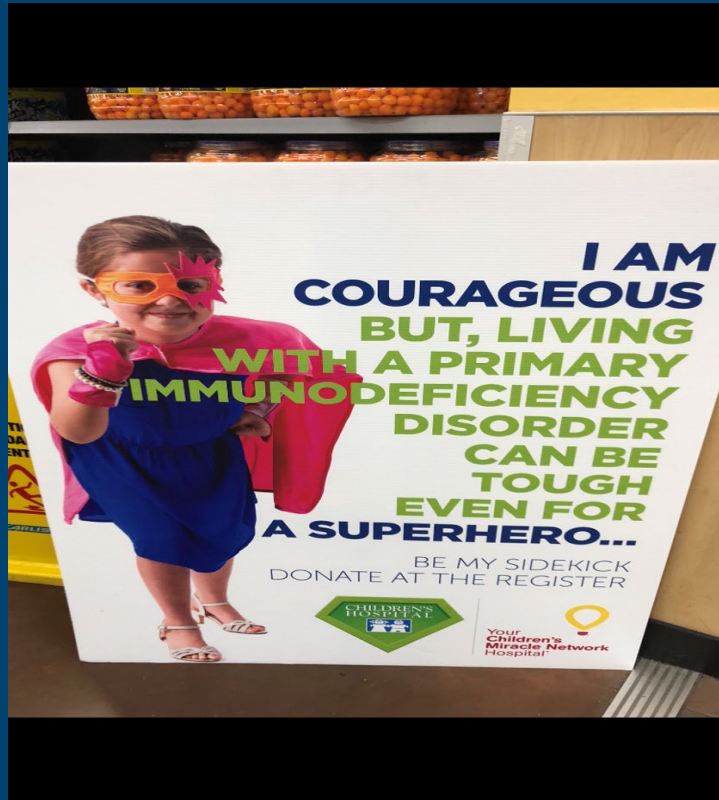








Post ECMO Management





ELSO guidelines suggest a cadence of structured, multifaceted care from discharge through adolescence.

Complications such as neurodevelopmental delay, sensory deficits, or new onset medical issues from late impact complications may require coordinated clinical evaluation, testing for development status, and strong family support.

Attaching a letter to the EMR for pediatricians to explain the condition leading to ECMO support, detailed aspects of the ECMO run, and aspects to watch for during the cadence of visits.

Thank You!!

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