VA ECMO: Managing Complications, Integration of MCS Devices, De-Escalation of Care

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Objectives

1. ECMO Weaning
2. ECMO Complications
3. MCS Device Integration in Conjunction with VA ECMO
    1. LAVA ECMO

Disclosures

- No disclosures

UKHC ECMO Program

- Member of ELSO since 1994
- Designated Center of Excellence since 2012
- Currently providing ECLS support for
  - Neonatal
  - Pediatric
  - Adult

2020 Award Recipient

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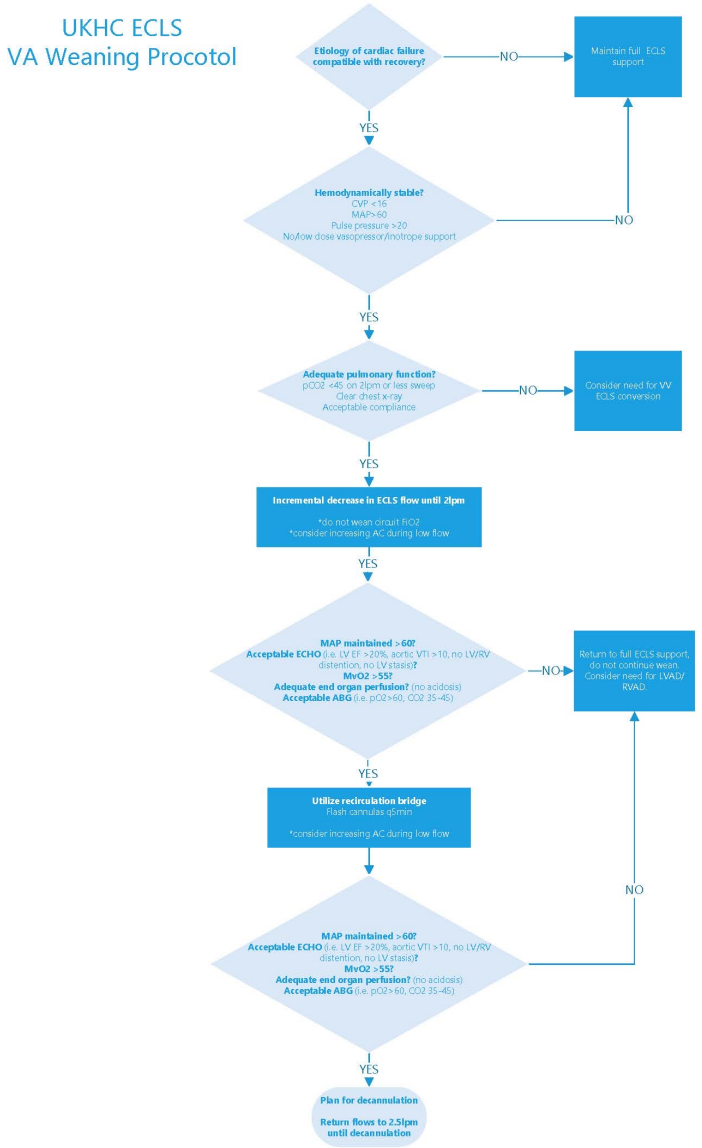
Weaning

- Gradual reduction in ECMO flows over several hours/ days
- Consider increasing anticoagulation regimen due to low circuit flow
- Strict observance of hemodynamic changes
- Inotropic support if needed
- TTE or TEE study for real time evaluation of myocardial recovery
- Trial off by placing a shunt into the ECMO circuit
- Decannulation by percutaneous closure of the artery or by direct cutdown and closure.

UK VA ECMO Weaning Protocol



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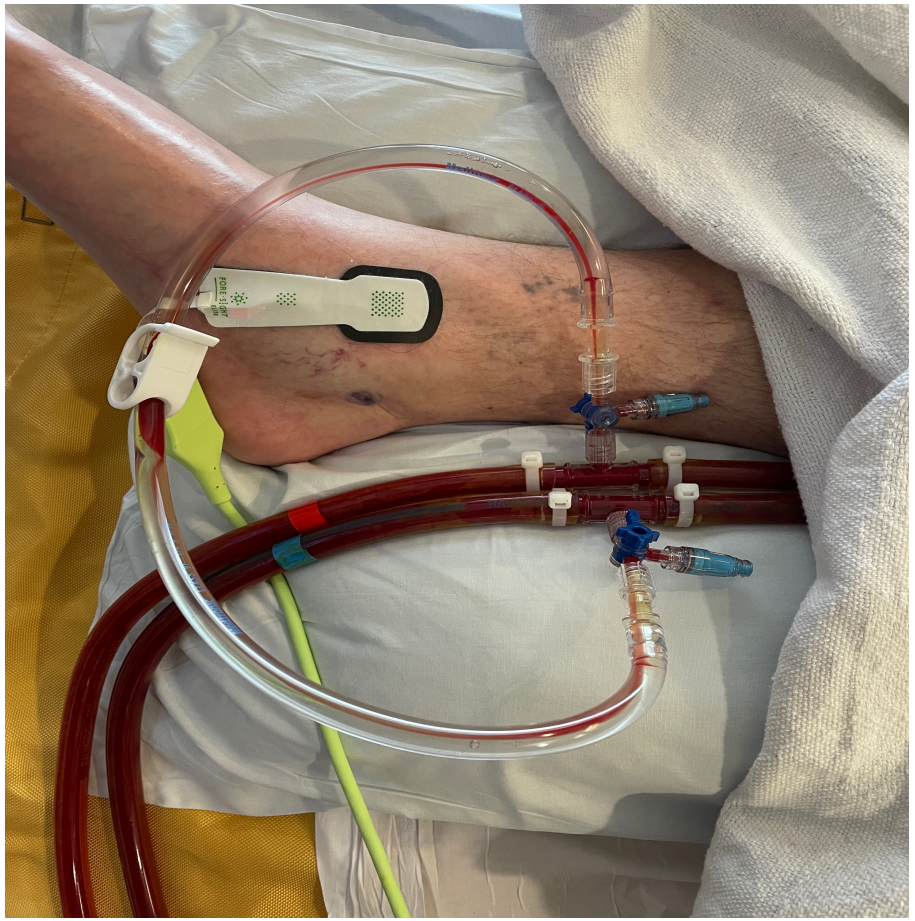
ECMO Trial Off Bridge



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ECMO Complications

Circuit Concerns

- Mechanical Failures
- Thrombus in circuit
- Incorrect cannula positioning
- Oxygenator failure
- Pump malfunction
- Air in circuit
- Tubing rupture

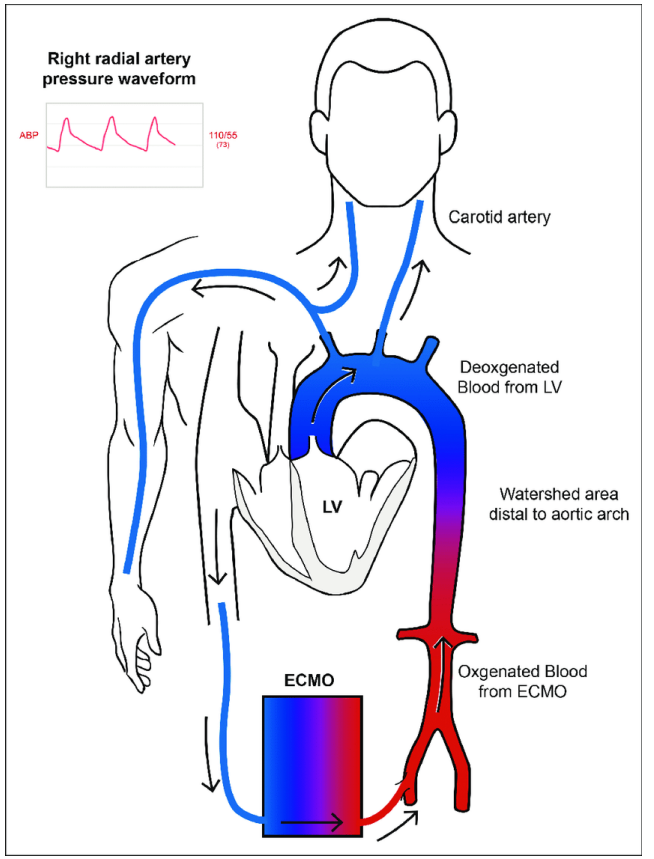
Patient Concerns

- Bleeding
- Limb Ischemia
- Harlequin Syndrome
- MSOF
- Infection
- Exposure to Blood product transfusions
- Delirium
- Pain
- Arrythmias and Cardiac Arrest

North-South Syndrome

- Also known as Harlequin Syndrome
- Cardiac Output vs. ECMO Flow and the mixing cloud
- Indication of patient improvement?
- VA – hybrid conversion

https://www.vanityfair.com/hollywood/2016/08/harley-quinn-suicide-squad-margot-robbie-domestic-violence



https://www.researchgate.net/figure/North-south-Harlequin-syndrome-a-common-consideration-with-femoral-artery-cannulation_fig4_327723526

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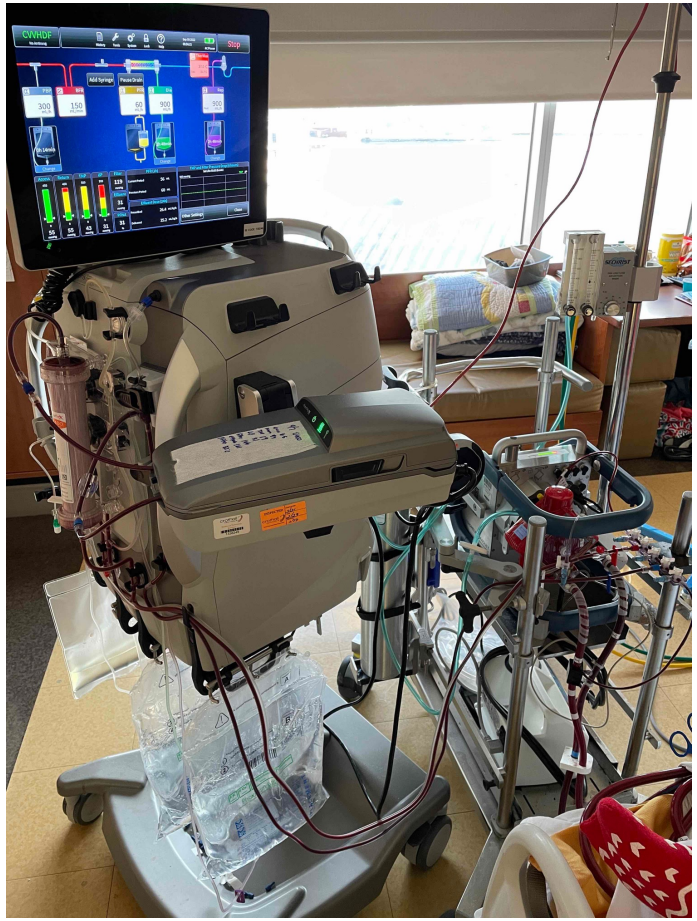
Center Specific Complications

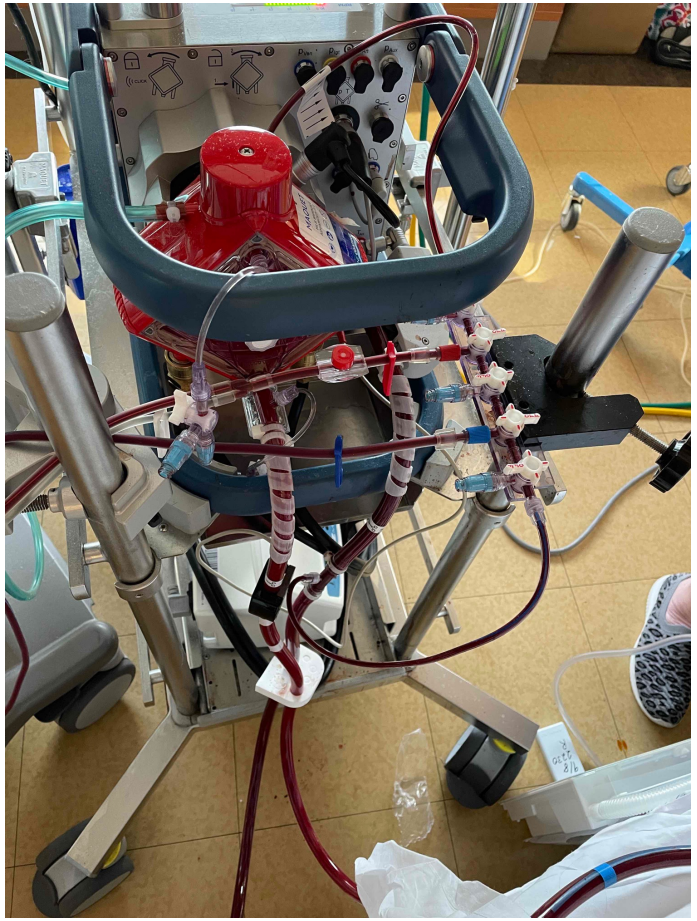
- Most common:
  - Oxygenator Failure
  - Circuit Change
  - CRRT use and increased creatinine
- Largest effect on Survival
  - Limb Ischemia
  - Surgical Site bleeding
  - Cardiac Arrythmia

Adult Cardiac Complications from 2017 to Present

	No Reported	% Reported	Survived	% Survived
Mechanical: Oxygenator failure	7	2.7%	1	14%
Mechanical: Cannula problems	3	1.2%	1	33%
Mechanical: Circuit change	14	5.4%	4	29%
Mechanical: Thrombosis/Clots: circuit component	6	2.3%	2	33%
Hemorrhagic: GI hemorrhage	7	2.7%	1	14%
Hemorrhagic: Cannulation site bleeding	1	0.4%	0	0%
Hemorrhagic: Surgical site bleeding	15	5.8%	6	40%
Hemorrhagic: Peripheral cannulation site bleeding	4	1.6%	0	0%
Neurologic: Brain death	1	0.4%	0	0%
Neurologic: Seizures Confirmed by EEG	1	0.4%	1	100%
Neurologic: CNS Infarction (US or CT or MRI)	12	4.7%	1	8%
Neurologic: CNS diffuse ischemia (CT/MRI)	2	0.8%	0	0%
Renal: Creatinine 1.5 - 3.0	81	31.4%	28	35%
Renal: Creatinine > 3.0	41	15.9%	11	27%
Renal: Renal Replacement Therapy Required	76	29.5%	14	18%
Cardiovascular: Inotropes on ECLS	19	7.4%	6	32%
Cardiovascular: CPR required	5	1.9%	1	20%
Cardiovascular: Cardiac arrhythmia	23	8.9%	4	17%
Cardiovascular: Tamponade (blood)	3	1.2%	1	33%
Pulmonary: Pulmonary hemorrhage	1	0.4%	0	0%
Infectious: Culture proven infection (see Infections)	1	0.4%	0	0%
Infectious: WBC < 1,500	11	4.3%	2	18%
Metabolic: pH < 7.20	1	0.4%	0	0%
Metabolic: Hyperbilirubinemia	18	7%	5	28%
Metabolic: Moderate hemolysis	7	2.7%	2	29%
Metabolic: Severe hemolysis	2	0.8%	1	50%
Limb: Ischemia	4	1.6%	1	25%
Limb: Compartment Syndrome	4	1.6%	0	0%
Limb: Fasciotomy	9	3.5%	0	0%
Limb: Amputation	2	0.8%	0	0%

CRRT in tandem with ECMO

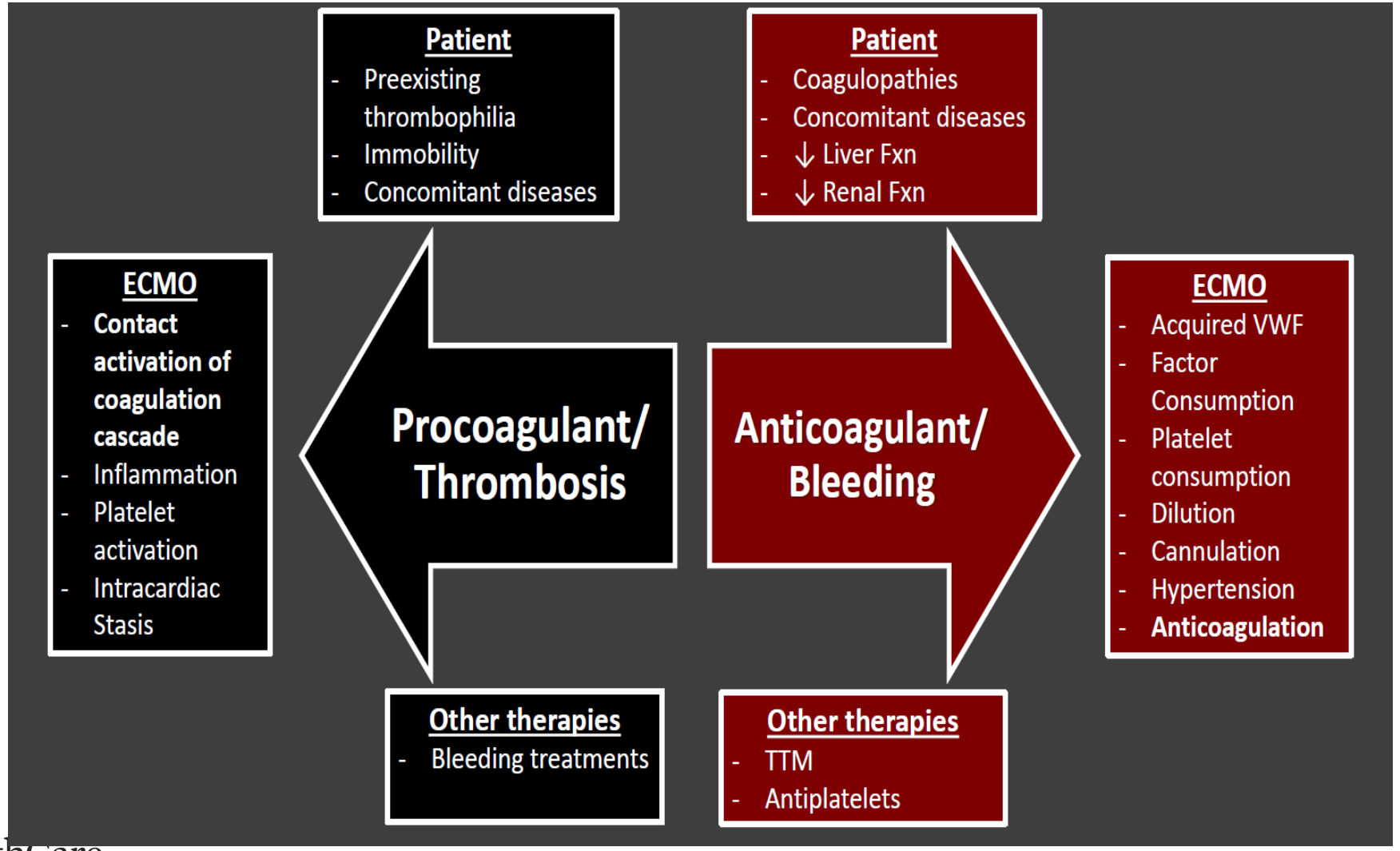




Bleeding

- Concerns of internal vs. external bleeding
  - Surgical incisions
  - Cannulation site bleeding
  - Retroperitoneal Bleeding
  - Stroke
- Use of Anticoagulation during and post cannulation
  - Heparin vs Bivalrudin
  - Bolus strategies
  - No AC strategy

Hemostasis in the ECLS Patient



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Clots!

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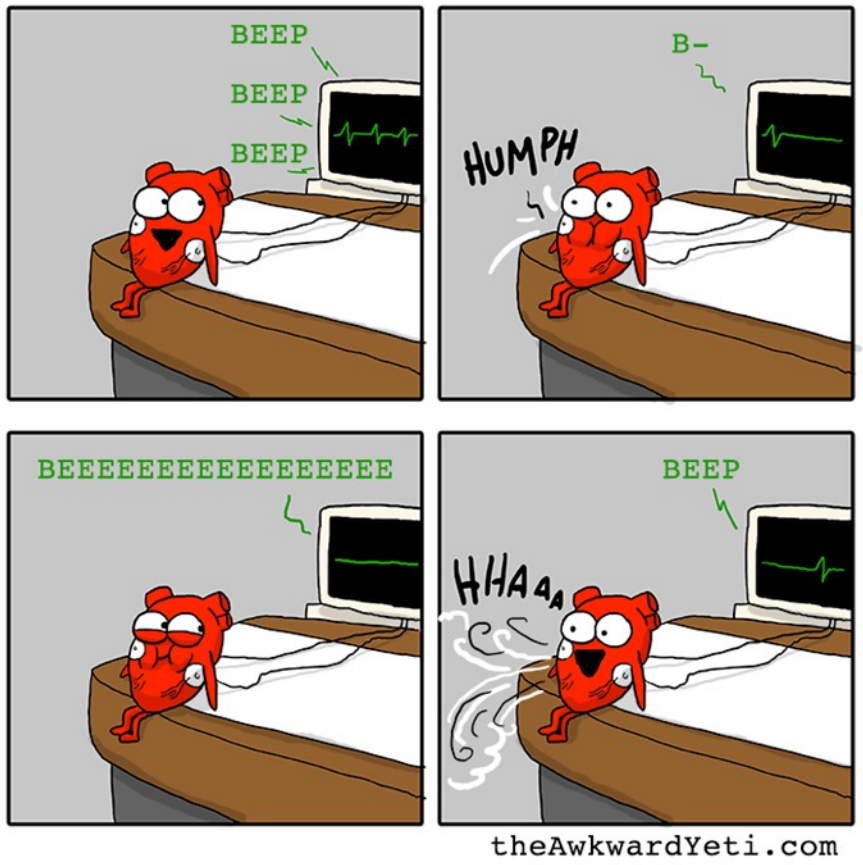
Cardiac Arrest



VA ECLS

- No Chest compressions if flows are maintained
- Chemically code only
- Cardioversion only

VV ECLS

- Full Code status
- Compressions: Native Cardiac output is required.

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ECMO Emergencies
Air Embolism

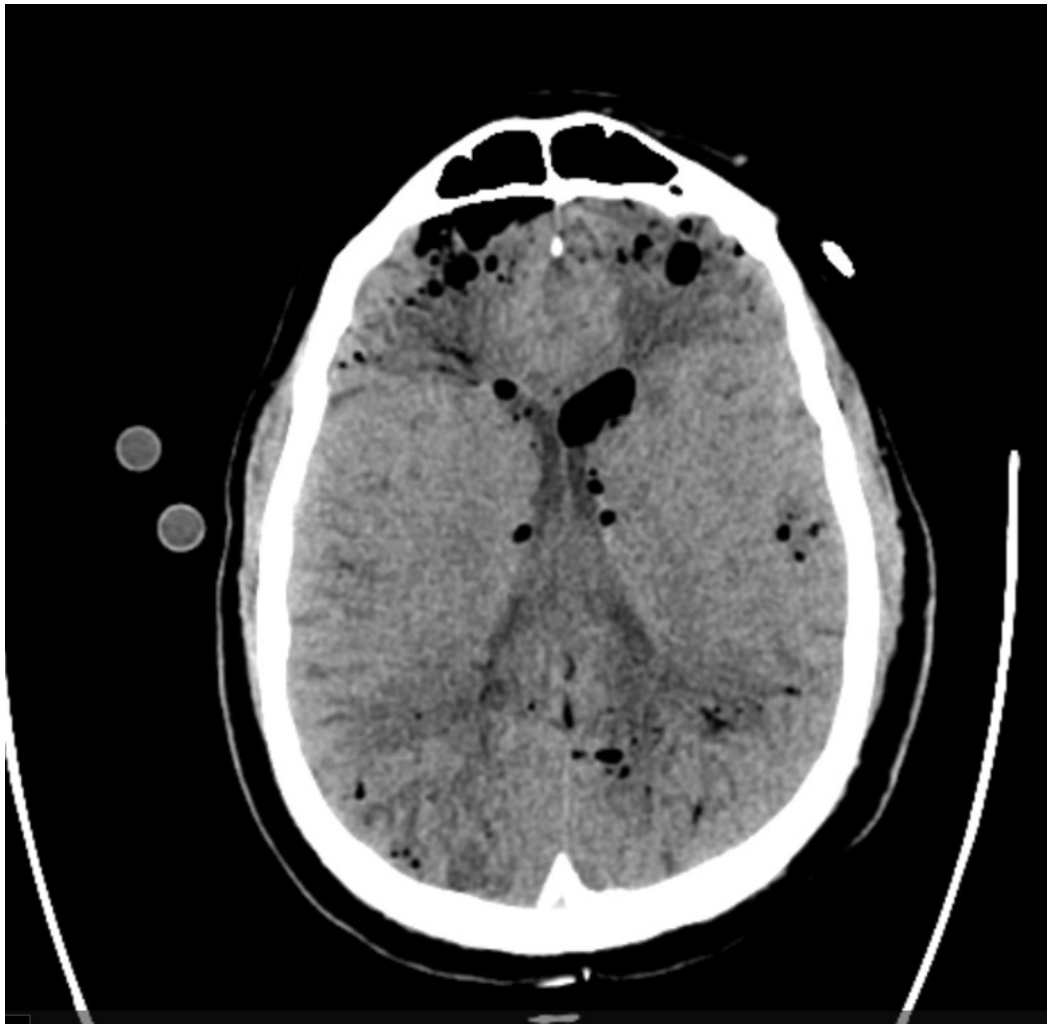
Potential Causes

- Open Stockcocks
- Cracks in connectors or tubing
- Oxygenator Gas leak

Interventions

- Clamp circuit immediately
- Place Patient in Trendelenburg position
- Maximize Ventilator support
- Use inotropic/vasopressor support
- Get the air OUT! ASAP

Air Embolism



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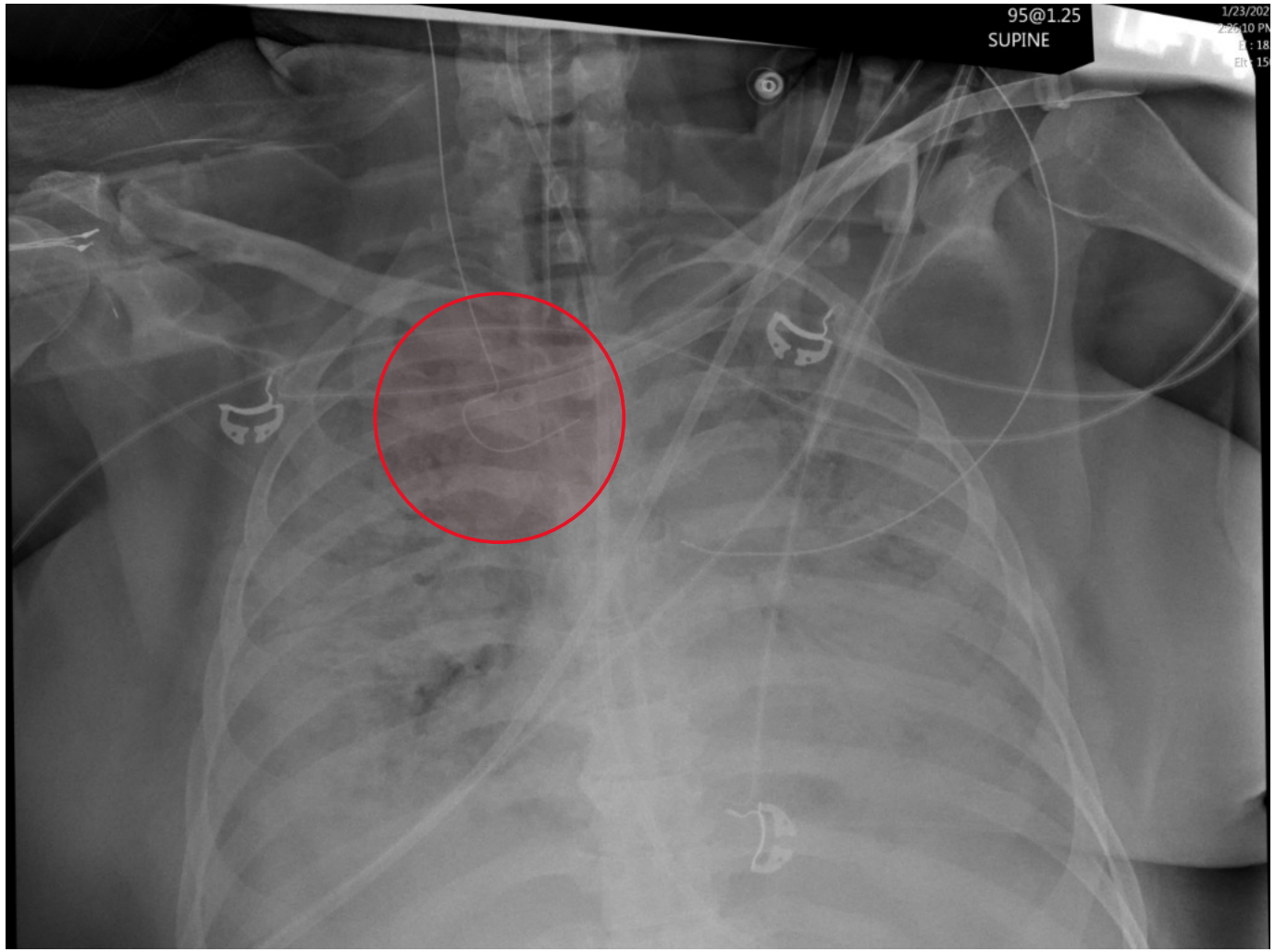
Watch out for the wires



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ECMO Emergencies
Accidental De-cannulation

- Clamp circuit
  - VBA (Venous-Bridge-Arterial)
- Establish Rescue Vent Settings
- Apply Direct pressure
  - Prepare for Mass transfusion
- Notify ECMO Attending for Surgical intervention

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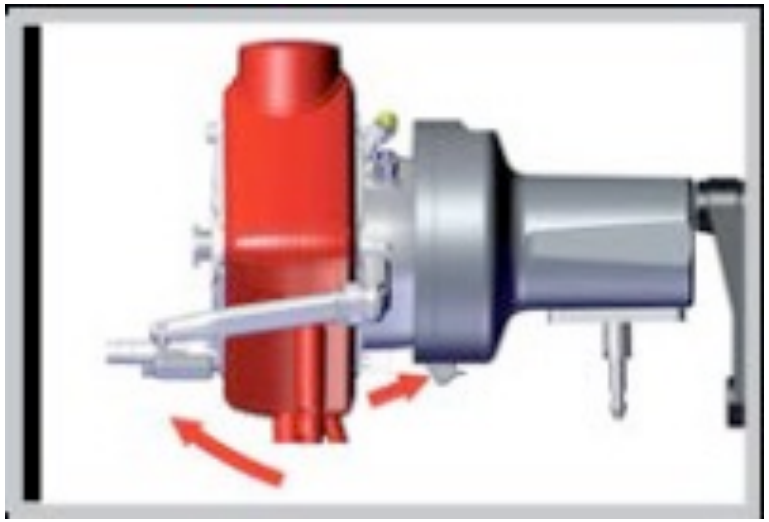
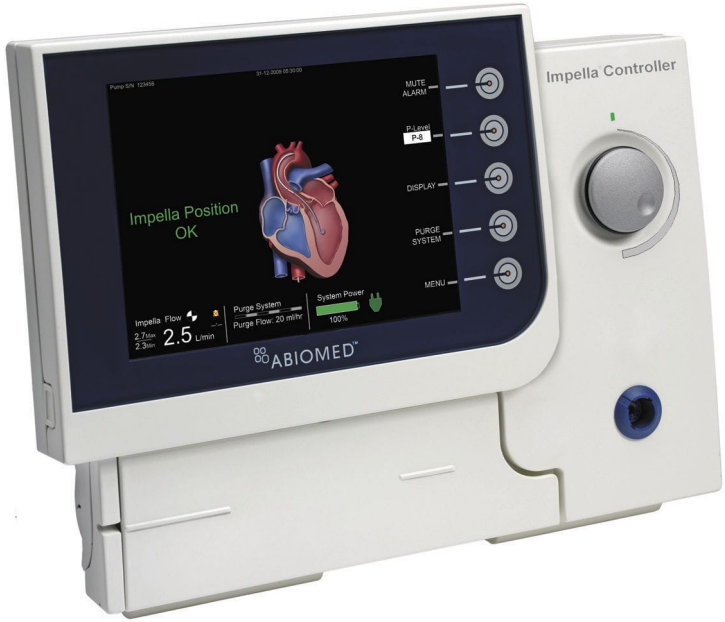
Emergency Backup

- ***Only for console Power failure***
- Turn Handcrank in Clockwise position
- Maximum speed is controlled by operator
- Monitor LED speed while performing manual propulsions
- Clamp lines while not actively handcranking to avoid retrograde Flow
  - **Note:** If CRRT is running in tandem with the ECLS Circuit, You ***MUST*** Clamp the Manifold / shunt Off prior to Handcranking



LV Unloading Strategies

- LV Vent
- IABP
- Impella
  - CP
  - 2.5



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Considerations with Impella vs IABP

Impella

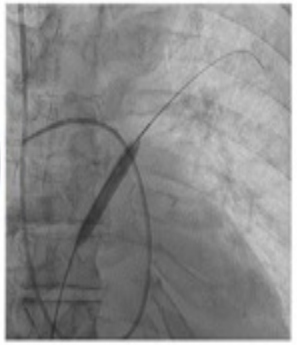
- P-level considerations
- Weaning ECMO and Increasing Impella Support
- Which do you remove first?

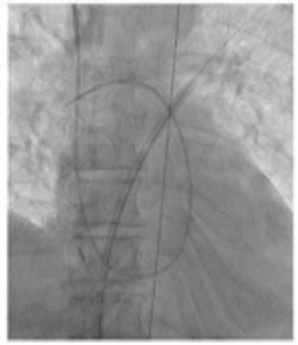
IABP

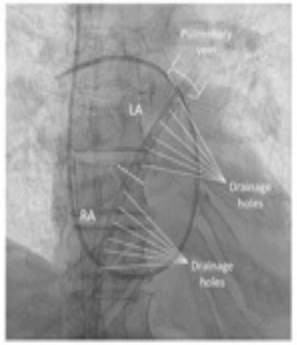
- Auto vs. Semi-Auto
- Cardiac Stun patients

LAVA ECMO

- LV Unloading with VA ECMO
- Prevents complications of
  - Lung Edema
  - LV Thrombosis
  - Eventual RV failure or Biventricular failure
- Drainage of the LA, RA, and LSPV
  - Transeptal Puncture
- Similar to VA ECMO + Impella support







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Any Questions?

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