# Syllabus for ECMO Education Day 1

1. Introduction to ECMO 08:00-08:30 Dr. Tyler VanDyck

a. History

b. Types of ECMO

c. Current Status

d. Future applications

e. Research- Key Trials- overall ECMO Survival

f. Registry

g. AGH’s history of ECMO

2. Criteria for ECMO 08:30-08:45 Dr. Tyler VanDyck

a. Patient selection criteria

b. Pre ECMO evaluation

c. Contraindications

d. Mortality Risk Score

3. Preparing the Patient for ECMO 08:45-09:00 SICU Nurse

a. Family support

b. Explanation of plan of care

c. Consent

d. Preparation of patient for insertion and nurses responsibility to assist with insertion

e. Standing orders set for ECMO

f. ECMO flow sheet

4. ECMO Cart 09:00-09:45 SICU Nurse

a. Cart Equipment

b. Cannulas for VA and for V V ECMO (Including reperfusion cannulas)

5. Equipment and Circuit Components 09:45-10:15 Cheryl Sowers CCP, LP

a. ECMO circuit components

b. Circuit design

c. Oxygenator function and blood gas control

d. Membrane gas exchange physics and physiology

e. Oxygen content, delivery and consumption

f. Shunt physiology

Break 10:15-10:30

6. Pathophysiology of Respiratory Failure 10:30-11:15 Dr. Tyler VanDyck

a. Pneumonia

b. ARDS

c. Pulmonary embolism

d. Hypercapnia

e. Pump lung post op CABG / Valve surgery

f. Toxins/ Burns

g. Sepsis

h. SIRS

I. Pulmonary Hypertension

j. Trauma

7. Management of V V ECMO 11:15-12:00 Dr. Tyler VanDyck

a. Lung protective management

1. Different ventilator management modes used and reasons for use

b. Medications specific for treatments

c. Cannulas used and placement (different types of cannulation- Fem –Fem, V A V , etc.)

d. CPR

1. continue V V ECMO at low flows and bag with 100% and turn blender up to 100%.

Rationale – In V V ECMO cardiac output is entirely dependent on native cardiac function. In an arrest situation CPR is required to produce cardiac output for organ perfusion . The absence of cardiac output means venous return is similarly affected, causing access insufficiency on the ECMO circuit and impairing V V ECMO flow. Good quality CPR increases cardiac output and continuing V V ECMO flows at a low flow with blender at 100% and bagging with 100% fio2 until rosc is obtained. Check for underlying cause of arrest:

Hypoxemia – Ensure O2 is flowing to the Oxygenator ( tank Empty?, disconnected ?, etc)

Check for color changes across the Oxygenator ( bright red blood in the return line)

Tension Pneumo- Consider if difficult to ventilate .

Tracheal shift to the unaffected side

Breath sounds decreased or absent on the affected side

Unequal chest expansion ( decreased on the affected side)

Can occur if an intercostal catheter is blocked or displaced

Thrombus- Consider new myocardial ischemia or pulmonary embolism

Arrhythmia

Progression of underlying disease process

Hemorrhage- Check H &H

Air Embolus - Clamp the circuit on the return line. Position the patient head down and start CPR per ALS. Physician may consider aspiration of the right atrium and/or the right ventricle.

Electrolyte Imbalance cause of arrhythmias

Cardiac Tamponade

Acute pulmonary edema

E. Case Presentations

F. Treatment

G. Advantages/ Disadvantages / What we learned

Lunch 12:00-12:30 lunch with lecture.

8. Pathophysiology of post op cardiogenic shock 12:15-12:45 Dr. Candace Lee/ Theresa Weber PA-C

a. Post- cardiotomy cardiogenic shock

b. ECMO to VAD or bridge to transplant

9. Cardiac Arrest and other conditions that may warrant ECMO support 12:30- 13:00 Dr. Karthikeyan Ranganathan

a. ECPR

b. Acute MI cardiogenic shock

c. Cardiomyopathy

d. Myocarditis

e. Decompensated heart failure with worsening cardio renal syndrome

f. High Acuity PCI supported by ECMO

g. VT Storm

h. Valvular Heart Disease Shock

10. Management of V A ECMO 13:00-13:45 Dr. Crouch

a. treatment strategies for specific conditions

b. Pump Flows

c. Cannulas and placement

d. vasopressors

e. IABP, Impella, CVVHD

f. CPR

1. Check ECMO circuit and blood pressure -- if you have flow, you have time to think, no CPR yet

If arterial waveform showed pulsatile flow and now no longer shows a pulsatile wave- check to make sure your pump and circuit are working with adequate flows. Check to see if art line is positional and dampened. If not, it could be progression of disease with worsening or no native cardiac function, but if still adequate flow and pump function, organ perfusion and cardiac output is present. If pump failure and BP mean dropped initially clamp the circuit and change pump to manual and crank to adequate cardiac output. Call for help to get perfusion to change the circuit or machine if necessary. Check power supply.

2. Hypoxemia- Turn both vent and blender to 100%

Ensure O2 is flowing to the Oxygenator

Check for color changes across the Oxygenator

3. Hypovolemia- consider giving fluid boluses

Check H&H. If low give Blood- check for bleeding-? Retroperitoneal from cannula insertion.

4. High K+. Consider hemolysis

5. Hypothermia- Check body temperature and check heater function. Cooling occurs rapidly if the ECMO heater unit is not functioning .

6. Tamponade- Tamponade physiology is complex in VA ECMO but can cause insufficiency

7. Tension Pneumothorax is uncommon in VA ECMO

8. Thrombus- Consider new or ongoing myocardial ischemia or pulmonary embolism

9. Toxins- eg: drug overdose of ca channel blockers will require specific antidotal management.

Even a relatively low dose of beta blockers or sedatives can cause loss of pulsatility in patients on VA ECMO

With cardiogenic shock.

10. Air embolism- clamp the circuit on the return line. Position the patient’s head down and start ACLS.

11. Fulminant circuit or pump head thrombosis. Clamp the circuit and start ACLS.

12. Accidental decannulation or circuit rupture-clamp the circuit, turn off the pump to prevent further air embolism or exsanguination. Apply pressure to any bleeding sites. Manage per ACLS until emergent recannulation can be established.

What will the patient look like in a VA ECMO arrest. No pulsatility on arterial waveform but make sure patient had native cardiac function prior to this. Mean arterial pressure will drop depending on the amount of ECMO support and the patient’s total peripheral resistance.

Shockable VT/VF on the monitor. Defibrillate, give amiodarone, titrate pressors to increase MAP.

g. Advantages/ Disadvantages/ What we learned

h. Case Presentations

11. 5 Stages of Cardiogenic Shock 13:45-14:15 Dr. Manreet Kanwar

Water Drills SIMS LAB with Case Scenarios 14:15-16:30 Dr. Collins, Dr. VanDyck, Dr. Matteson

Day 2 of ECMO Education

12. Physiology of Coagulation 08:00-08:30 Chelsea Konopka, Pharm D

a. Coagulation cascade

b. ACT

c. DIC

d. Blood products and interaction

e. Blood product management of the bleeding patient

1. low fibrinogen- replace Cryo

2. High PT/ INR – give FFP

f. HIT

g. Blood surface interactions and coatings

h. Laboratory anticoagulation monitoring studies

I. Amicar, Protamine, recombinant clotting factors

j. Case presentations

13. Medications and Specific Considerations Related to ECMO 08:30-08:45 Chelsea Konopka, Pharm D

a. Anticoagulation (heparin, bivalirudin)

b. Antibiotic therapy

c. Antiarrhythmics

d. Specific considerations related to decreased renal and or liver function

e. Dosing and peaks and troughs

f. Hydrophilic and lipophilic properties

g. Sedation and pain control

h. Neuromuscular blockade

14. Nutritional Support in ECMO Patients 08:45-09:15 Donna Demor RD/ Mary Jo Winkler RD

a. Initiate feedings within 24-48 hrs with time to goal as soon as possible

1. Start trickle feeds

b. TPN if enteral feeding is not possible within 5-7 days, but enteral remains the goal

c. Feeding intolerance managed with prokinetic drugs

d. Evaluation of nutrition management by weekly pre-albumin levels

e. research related to nutritional status in critical patients and relation to mortality and outcomes

15. Physical Therapy for the ECMO Patient 09:15-09:30 Michele D’Ambrosio PT/ Lisa McGlynn OT

a. Passive ROM

1. q 2 hr

b. Position side to side q 2 hr

c. Reverse Trendelenberg position

d. PT/OT to evaluate for splints or boots to prevent weakness or atrophy

e. Out of bed as soon as patient can tolerate. Team approach to protect cannulas

f. Research on ambulation of ECMO patients and outcomes

Break 09:30- 09:45

16. Supportive Care for the ECMO patient. 09:45-10:15 Palliative Care CRNP/MD

a. Family and patient support

b. Staff support and debriefing

17. Nursing Care and Assessment of the ECMO Patient 10:15-10:45 Cheryl Graper BSN, RN, CCRN

a. systems assessment- neuro, mental, cardiac, respiratory, GI, renal, Musculoskeletal, integumentary, nutritional.

b. Assess for infection

c. Assess for bleeding/ vascular checks

d. evaluation of sedation and pain control

e. Fluid, electrolyte and lab result monitoring with replacement

f. Blood product infusion per policy

g. Hemofiltration setup and management per written orders

h. Circuit checks, pressure monitoring and pump/gas flow charted hourly and also when any changes are made on the ECMO flow sheet

i. Management of anticoagulation per protocol or specific orders written/ follow blood work per protocol

j. Maintain aseptic technique with dressing changes

k. Frequent oral care and good hygiene.

l. When to notify MD of significant changes

18. “Nursing - Did I really sign up for this job? Identifying burnout early.” 10:45- 11:15 Morgan Krumeich, Psy.D.

Clinical Psychologist

19. Nursing Considerations (what do these numbers I’m recording mean? When do I worry and when do I let the doctor know?) 11:15-11:30 Dr. Collins

a. Pump and gas flow, circuit checks (what am I looking for?)

b. Plasmaphoresis- indicated for what use?

c. When is a drainage tube inserted and why? Reperfusion catheter?

d. Why does my patient also need an Impella if ECMO is on full support?

e. Why is an IABP indicated?

20. Medical Problems 11:30-12:00 Dr. Collins

a. Intracranial bleed and other hemorrhages

b. Pneumothorax or pneumoparicardium

c. Cardiac arrest

d. Arrhythmias

e. Hypotension

f. Hypovolemia

g. Hypertension

h. Sever coagulopathy

i. Seizures

j. Hemothorax, hemopericardium

k. Electrolyte imbalance

l. Renal failure

m. Limb ischemia/ loss of limb

n. Case scenarios

21. Mechanical Complications 12:00-12:30 Dr. Collins

a. Circuit disruption

b. Raceway rupture

c. Cavitation

d. System or component alarm and failure (pump compliance chamber, venous return monitor, oxygenator, heater, flow sensor)

e. Air embolism

f. Inadvertent decannulation

g. Clots

h. Case presentations

LUNCH 12:00-12:30 lunch during talk on mechanical complications

22. Weaning from ECMO 12:30-13:00 Dr. Collins

a. Clinical indications of cardiac and pulmonary recovery

b. Pump and gas flow weaning techniques

c. Ventilator changes during weaning

d. Trial off

c. Decannulation from low flow

d. Possible Medications needed after decannulation (vasopressors/inotropes)

e. Case presentations

23. Decannulation 13:00-13:15 Dr. Collins

a. Personnel needed

b. Medications required

c. potential complications

d. Vessel ligation

e. Withdraw of ECMO support, CMO, family support

24. Issues Related to Flight and Transport 13:15-14:00 Dr. Collins

a. Lung protective vent management

b. Troubleshooting for low flow, low sat’s

c. Vasopressors/ inotropes/sedation

d. Standing orders

e. Case scenarios

14:00-16:15 SIMS LAB with Case Scenarios Dr. Collins, Dr. VanDyck, Dr. Matteson

16:15-16:30 Test, Evaluation and Certificate of attendance