

## ECMOjo Circuit Check

Patient Monitor: Baseline (Baseline.tnd)

- |                                                                                                                                                                                        |                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> Flashlight                                                                                                                                                    | <input type="checkbox"/> Heater                                                                                                                                                                                            |
| <input type="checkbox"/> Venous Cannula <ul style="list-style-type: none"><li>• Bleeding</li><li>• Position/landmarks</li><li>• Clots/fibrin</li></ul>                                 | <input type="checkbox"/> Heater <ul style="list-style-type: none"><li>• Water bath temperature</li><li>• Patient temperature</li><li>• Water level</li></ul>                                                               |
| <input type="checkbox"/> Bridge <ul style="list-style-type: none"><li>• Stopcocks off to circuit or line clamped</li><li>• Flush per policy</li></ul>                                  | <input type="checkbox"/> Gas Flowmeter <ul style="list-style-type: none"><li>• Tubing connections to flowmeter and oxygenator</li><li>• Gas source connections to wall outlets</li><li>• Sweep and FiO2 settings</li></ul> |
| <input type="checkbox"/> Connectors <ul style="list-style-type: none"><li>• Cracks</li><li>• Tubing security</li><li>• Clots/fibrin</li></ul>                                          | <input type="checkbox"/> Blood Flowmeter <ul style="list-style-type: none"><li>• Correct direction of blood flow</li></ul>                                                                                                 |
| <input type="checkbox"/> Stopcocks <ul style="list-style-type: none"><li>• Off to circuit and capped</li><li>• Tight connection to luer lock</li></ul>                                 | <input type="checkbox"/> Arterial Cannula <ul style="list-style-type: none"><li>• Bleeding</li><li>• Position/landmarks</li><li>• Clots/fibrin</li></ul>                                                                   |
| <input type="checkbox"/> Bladder <ul style="list-style-type: none"><li>• Volume</li><li>• Air</li><li>• Clots</li></ul>                                                                | <input type="checkbox"/> Clamps available at bedside                                                                                                                                                                       |
| <input type="checkbox"/> <b>Roller Pump</b> <ul style="list-style-type: none"><li>• Tubing integrity</li><li>• Air</li><li>• Blood flow setting – (<i>occlusion setting</i>)</li></ul> | <input type="checkbox"/> Hospital generator electrical outlets/UPS utilized                                                                                                                                                |
| <input type="checkbox"/> <b>Centrifugal Pump</b> <ul style="list-style-type: none"><li>• Air</li><li>• Blood flow/RPM setting</li><li>• Gel</li></ul>                                  | Emergencies                                                                                                                                                                                                                |
| <input type="checkbox"/> Oxygenator <ul style="list-style-type: none"><li>• Clots</li><li>• Leaks</li><li>• Vent port open</li><li>• Sigh</li></ul>                                    | <input type="checkbox"/> Clamp patient off circuit <ul style="list-style-type: none"><li>• VBA or AVB</li></ul>                                                                                                            |
| <input type="checkbox"/>                                                                                                                                                               | <input type="checkbox"/> Call for help <ul style="list-style-type: none"><li>• RN</li><li>• RT</li><li>• MD</li><li>• Perfusionist</li><li>• Surgeon</li></ul>                                                             |
|                                                                                                                                                                                        | <input type="checkbox"/> Emergency ventilator settings                                                                                                                                                                     |
|                                                                                                                                                                                        | <input type="checkbox"/> Code drugs                                                                                                                                                                                        |
|                                                                                                                                                                                        | <input type="checkbox"/> Blood bank                                                                                                                                                                                        |

## Scenario 1

### Wet lab Scenario – Gas Failure

Initial Set-Up for Student (t=0)

VS Trend: Baseline: 30 seconds. Scenario: 31+ seconds  
Action: Before start - Gas line is disconnected at the blender or oxygenator or connect gas line to exhaust port  
Trigger: Alarms

History: ECMO has just been initiated for this infant with meconium aspiration and everyone is starting to clean up after the cannulation. You are just starting to catch up with your charting. The second set of gases have returned.

ECMO Mode: VA or VV

Patient: (GF1 SvO2.tnd)

|            |            |           |    |
|------------|------------|-----------|----|
| Temp       | 37         |           |    |
| HR         | 140        | 100       | 66 |
| BP         | 60/40 (47) | 36/6 (23) |    |
| CVP        | 4          |           |    |
| Saturation | 93%        | 69%       |    |
| SvO2       | 79%        | 51%       |    |

(if SvO2 function is used on Sim monitor)

CDI 7.27 / 75 / 39 / 18 / BD 4  
H/H 39% / 13  
SvO2 51%

Blood gas - Baby Boy Rap

Patient: 7.28 / 71 / 47 / 16 / BD 5  
Pre Memb: 7.23 / 79 / 32 / 14 / BD 7  
Post Memb: 7.29 / 67 / 41 / 18 / BD 4

Pressures: Venous 0 Pre-memb 149 Post-memb 145

Available data

- Physical Exam: Quiet. No spontaneous movements. Mottled. Dusky. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill delayed. Extremities cool
- Color blood in circuit tubing – same color
- CXR: Ordered, but tech is busy in the ER with :
- Chem: Previous labs normal. Sample sent to lab
- Heme: Previous labs normal. Sample sent to lab
- ACT: 180 sec

Participant # \_\_\_\_\_

## Scenario 1

### Wet lab Scenario – Gas Failure

Scoring

Time to accomplish: 120 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Recognize increased CO<sub>2</sub>
- ☐ Increases sweep gas
- ☐ Evaluates CDI (if applicable)
- ☐ Call for help
- ☐ Initiates emergency ventilator settings
- ☐ Circuit check
- ☐ Checks oxygenator for clots
- ☐ Checks gas line for disconnection at source
- ☐ Checks gas line for kinks
- ☐ Reconnect gas tubing

Discouraged interventions

- ☐ Come off ECMO

**COMMENTS**

## Scenario 2

### Wet lab Scenario – Heater Failure

Initial Set-Up for Student (t=0)

VS Trend: Baseline - 30 seconds. Scenario – 31+ seconds

Action: Before start - Turn off heater. Unplug.

Trigger: Monitor

History: 2 month old former premature infant with RSV pneumonia.  
You are getting back from a break and no events occurred while you were gone.

ECMO Mode: VA or VV

Patient: (HF1 SvO2.tnd)

|            |            |            |
|------------|------------|------------|
| Temp       | 35.9       | 34         |
| HR         | 120        | 81         |
| BP         | 71/42 (52) | 75/46 (56) |
| CVP        | 5          |            |
| Saturation | 94%        |            |
| SvO2       | 75%        | 69%        |

*(if SvO2 function is used on Sim monitor)*

CDI 7.43 / 39 / 309 / 23 / BE 2  
H/H 39% / 13  
SvO2 69%

Blood gas – ordered and results pending.

Pressures Venous -9 Pre-memb 130 Post-memb 120

Available data

- Physical Exam: Quiet. Pale. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill delayed. Extremities cool
- Color blood in circuit tubing – color differentiation seen
- CXR: Ordered, but tech is busy in the ER with a code
- Chem: Morning lab sample sent to lab. Results pending.
- Heme: Morning lab results. CBC normal.  
PT slightly elevated to 22. PTT increased from 82 to 101
- ACT: Increased from 179 to 193 sec

**Scenario 2**  
**Wet lab Scenario – Heater Failure**

Scoring

Time to accomplish: 180 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Recognize hypothermia
- ☐ Recognize hypothermia induced bradycardia
- ☐ Maintain normothermia
  - Blankets or warmer blanket or thermo-gel blankets
  - Over bed warmer
- ☐ Circuit check
- ☐ Call for help
- ☐ Go to heater
- ☐ Check heater switch
- ☐ Check heater plug
- ☐ Check heater temperature set point
- ☐ Check heater hose valves

Discouraged interventions

- ☐ Come off ECMO

**COMMENTS**

### Scenario 3

#### Wet lab Scenario – Pump Failure

Initial Set-Up for Student (t=0)

VS Trend: Baseline: 30 seconds. Scenario: 31+ seconds  
Trigger: At 0:25 distract student, have mole turn off pump

History: 1 month old with H1N1 pneumonia and myocarditis.  
There are heavy rain and winds due to a storm. Multiple power surges have been disrupting your shift. A brief black out has just occurred.

ECMO Mode: VA

Patient: (NoFlow SvO2.tnd)

|            |            |           |    |
|------------|------------|-----------|----|
| Temp       | 37         |           |    |
| HR         | 130        | 60        | 50 |
| BP         | 68/38 (48) | 36/6 (16) |    |
| CVP        | 6          | 0         |    |
| Saturation | 96%        | 44%       |    |
| SvO2       | 79%        | 69%       |    |

(if SvO2 function is used on Sim monitor)

CDI 7.45 / 37 / 318 / 24 / BE 2  
H/H 39% / 13  
SvO2 69%

Blood gases – Baby Girl Hula

Patient: 7.26 / 78 / 41 / 14 / BD 6  
Pre Memb: 7.19 / 81 / 30 / 11 / BD 8  
Post Memb: 7.45 / 38 / 314 / 22 / BE 1

Pressures Venous -9 Pre-memb 130 Post-memb 120

Available data

- Physical Exam: Quiet. No spontaneous movements. Mottled. Cyanotic. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill delayed. Extremities cool
- Color blood in circuit tubing – equal
- CXR: ask for reason. Results: normal
- Chem: Previous labs normal. Sample sent to lab. Results pending.
- Heme: Previous labs normal. Sample sent to lab. Results pending.
- ACT: 180 sec

**Scenario 3**  
**Wet lab Scenario – Pump Failure**

Scoring

Time to accomplish: 90 seconds

Dies at 90 sec

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Orders CXR is to look for pneumothorax or pneumomediastium
- ☐ Circuit check
- ☐ Recognizes pump failure
- ☐ Call for help
- ☐ Clamp off circuit
- ☐ Emergency vent settings
- ☐ Check pump switch
- ☐ Check plug
- ☐ Get hand crank
- ☐ Verbalizes with hand crank that the SvO2 is used to monitor = adequate flow?

Discouraged interventions

- ☐ Does not come off circuit
- ☐ Attempts to hand crank without coming off circuit

**COMMENTS**

## Scenario 4

### Wet lab Scenario – Circuit Failure / DIC

#### Initial Set-Up for Student (t=0)

VS Trend: Continuous

Action: Draw clots

Set sweep at 4 liters and FiO<sub>2</sub> at 0.70

Blood at cannula site

Trigger: Give Children's Hospital of ECMOjo ABG & HEME results for Baby Boy Hip to student

History: 2 month old with a viral myocarditis. Day 5 of the run. You have just started your shift and some of the morning lab results are now available.

ECMO Mode: VA

Patient: (no trend)

Temp 37

HR 130

BP 68/38 (48)

CVP 5

Saturation 97%

SvO<sub>2</sub> 65% (if SvO<sub>2</sub> function is used on Sim monitor)

CDI 7.45 / 37 / 318 / 24 / BE 2

H/H 39% / 13

SvO<sub>2</sub> 71%

#### Available data

Physical Exam:

Quiet. Pink. Blood oozing from cannula site. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill 3 sec. Extremities warm to wrist and ankles.

Blood gas – Baby Boy Hip

Pressures Venous -12

Pre-memb 194

Post-memb 189

Color blood in circuit tubing – color differentiation seen

CXR: Ordered. Still waiting for the tech.

Chem: Sent. Results pending.

Heme: Results reported.

ACT: 171 to 188 sec

Participant # \_\_\_\_\_

#### Scenario 4

#### Wet lab Scenario – Circuit Failure / DIC

##### Scoring

Time to accomplish: 300 seconds

**Stop assessment when instructor gives verbal cues to the participant**

##### Appropriate interventions

- ☐ Recognize abnormal labs
- ☐ Recognize trend
- ☐ Give platelets
- ☐ Give FFP or cryo
- ☐ Order additional labs after blood products
- ☐ Gives additional blood products
- ☐ Circuit check
- ☐ Check for clots
- ☐ Check oxygenator
- ☐ Change circuit.

##### Discouraged interventions

- ☐ Come off ECMO

#### COMMENTS

## Scenario 5

### Wet lab Scenario – Oxygenator Failure

#### Initial Set-Up for Student (t=0)

VS Trend: Continuous  
Action: Draw clots  
Adjust sweep gas to 2.5 lpm and FiO<sub>2</sub> to 0.70  
Adjust pre membrane pressure zero calibration to have a large delta P across membrane  
Trigger: Give Children's Hospital of ECMOjo ABG & HEME results for Baby Girl Disco to student

History: 2 month old with a viral myocarditis. Day 5 of the run. You have just started your shift. No mechanical problems have been encountered with the circuit, but the off going ECMO specialist was very tired and mentioned that there were some new clots in the oxygenator. Some of the morning lab results are now available.

ECMO Mode: VA

Patient: (OF1 SvO<sub>2</sub>.tnd)  
Temp 37  
HR 130  
BP 72/38 (49)  
CVP 5  
Saturation 97%  
SvO<sub>2</sub> 66% *(if SvO<sub>2</sub> function is used on Sim monitor)*

CDI 7.33 / 52 / 121 / 21 / BE 2  
H/H 36% / 12  
SvO<sub>2</sub> 66%

Blood gas – Baby Girl Disco

Pressures Venous -9 Pre-memb 281 Post-memb 149

#### Available data

- Physical Exam: Quiet. Pink. Blood oozing from cannula site. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill 3 sec. Distal extremities cool.
- Color blood in circuit tubing – color differentiation seen
- Oxygenator – clots seen
- Sweep gas – 2.5 lpm, FiO<sub>2</sub> = 0.7
- CXR: ordered, but tech is busy in the CVICU with a code
- Chem: Sent. Results pending.
- Heme: Report results from Baby Girl Disco
- ACT: Report results from Baby Girl Disco

**Scenario 5**  
**Wet lab Scenario – Oxygenator Failure**

Scoring

Time to accomplish: 300 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Recognize abnormal labs
- ☐ Recognize trend in post membrane ABG PCO<sub>2</sub> and PO<sub>2</sub>
- ☐ Adjust sweep gases
- ☐ Calls for help
- ☐ Circuit check
- ☐ Check oxygenator for clots
- ☐ Recognize abnormal trans-membrane gradient
- ☐ Adjusts heparin rate (lower)
- ☐ Gives blood products (platelets, FFP, cryo)
- ☐ Identify oxygenator failure

Discouraged interventions

- ☐ Come off ECMO
- ☐ Increase heparin rate

**COMMENTS**

## Scenario 6

### Wet lab Scenario – Venous Air

Initial Set-Up for Student (t=0)

VS Trend: Continuous

Trigger: (at any time) Inject air into reservoir or  
Place punctured cap on stopcock or pigtail. Withdraw  
volume to make venous pressures more negative

History: Day 3 for a newborn infant with Group B sepsis. Everything has been going well and it's been 94% boredom. The patient is awake and responsive to environment stimulation. It is time for your hourly circuit check.

ECMO Mode: VA or VV

Patient: (no trend)

Temp 37.1

HR 140

BP 72/38 (48)

CVP 4

Saturation 96%

SvO<sub>2</sub> 71% *(if SvO<sub>2</sub> function is used on Sim monitor)*

CDI 7.46 / 38 / 312 / 24 / BE 4

H/H 36% / 12

SvO<sub>2</sub> 71%

Blood gas – Sent and results are pending

Pressures: Venous -25 Pre-memb 130 Post-memb 120

Available data

- Physical Exam: Quiet. Pink. Blood oozing from cannula site. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill 3 sec. Extremities warm to wrist and ankles.
- Color blood in circuit tubing – color differentiation seen
- Oxygenator – no clots seen
- CXR: Ordered, but tech is busy in the CVICU with a code
- Chem: Sent. Results pending.
- Heme: Sent. Results pending.
- ACT: 176 sec (stable)

**Scenario 6**

**Wet lab Scenario – Venous Air**

Scoring

Time to accomplish: 300 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Circuit check
- ☐ Calls for help
- ☐ Recognizes air in venous circuit
- ☐ Checks arterial side of circuit
- ☐ Determines if emergency or not an emergency
- ☐ Check catheters
- ☐ Check stopcocks and other connectors
- ☐ Check medications infusing into central catheters to circuit
- ☐ Check medications infusing into central catheters to patient
- ☐ Verbalizes: Need to remove air

Discouraged interventions

- ☐ Come off ECMO

**COMMENTS**

## Scenario 7

### Wet lab Scenario – Bubble Detector Alarm

Initial Set-Up for Student (t=0)

Baseline: 30 seconds. Coupled PVC start at 0:45

Action: Inject air into system post oxygenator at 0:28 minutes

History: 1 month old with aspiration pneumonia and ARDS. Today is day 7 of the ECMO run. The circuit was change 1 hour ago due to circuit failure.

ECMO Mode: VV

Patient: (NoFlow SvO2.tnd)

(NoFlow SvO2 NoBub.tnd - no bubble dectector – 30 sec delay in physiologic parameter changes)

Temp 37

HR 150 80 (with coupled PVC)

BP 68/38 (48) 47/17 (27)

CVP 4 5

Saturation 93% 53%

SvO2 75% 45%

*(if SvO2 function is used on Sim monitor)*

CDI 7.45 / 37 / 318 / 24 / BE 2

H/H 39% / 13

SvO2 72%

Blood gases Baby Girl Tango

Pressures: Venous 5 Pre-memb 54 Post-memb 51

Available data

- Physical Exam: Quiet. No spontaneous movements. Mottled. Cyanotic. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill delayed. Extremities cool
- Color blood in circuit tubing – color differentiation seen
- CXR: ordered, but tech is busy and not answering their page
- Chem: Previous labs normal. Sample sent to lab. Results pending.
- Heme: Previous labs normal. Sample sent to lab. Results pending.
- ACT: 180 sec

**Scenario 7**

**Wet lab Scenario – Bubble Detector Alarm**

Scoring

Time to accomplish: 60 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Recognizes pump is off
- ☐ Recognized arterial bubble detector alarm
- ☐ Clamps off circuit
- ☐ Emergency vent settings
- ☐ Calls for help
- ☐ Circuit check
- ☐ Checks oxygenator
- ☐ Checks all connections on arterial side
- ☐ Checks for air at arterial side clamp
- ☐ Checks venous side
- ☐ CPR (Late addition - do not include in grading, but teaching point)

Discouraged interventions

- ☐ Attempts to hand crank

**COMMENTS**

## Scenario 8

### Wet lab Scenario – Accidental Arterial Decannulation (Hypovolemia)

Initial Set-Up for Student (t=0)

VS Trend: Baseline - 30 seconds; Trend 30+ seconds  
Action: Gauze with blood at cannulation site. Push blood.  
Take fluid out of bladder to create a more negative venous pressure

History: Day 1 for a 2 month old who had a witnessed arrest on the floor.  
Visitor with many dangling pieces of jewelry just left the bedside after giving the patient a kiss

ECMO Mode: VA

Patient: (Hypovolemia2 SvO2.tnd)

|            |            |            |
|------------|------------|------------|
| Temp       | 37         |            |
| HR         | 140        | 50         |
| BP         | 68/44 (52) | 44/20 (28) |
| CVP        | 4          | 0          |
| Saturation | 96%        | 59%        |
| SvO2       | 79%        | 43%        |

(if SvO2 function is used on Sim monitor)

CDI 7.45 / 37 / 318 / 24 / BE 2  
H/H 39% / 13  
SvO2 52%-

Blood gases: Blood gas machine in calibration mode. Results pending.

Pressures: Venous -15 Pre-memb 160 to 100 Post-memb 154 to 95

Flow Decreases (depends on amount of volume removed & servo-reg)

Available data

- Physical Exam: Quiet. No spontaneous movements. Mottled. Cyanotic. BS equal. Heart sounds normal. Abdomen soft. Peripheral refill delayed. Extremities cool
- Color blood in circuit tubing – color differentiation seen
- CXR: ordered, but tech is busy and not answering their page
- Chem: Previous labs normal. Sample sent to lab. Results pending.
- Heme: Previous labs normal. Sample sent to lab. Results pending.
- ACT: 180 sec

**Scenario 8**

**Wet lab Scenario – Accidental Arterial Decannulation (Hypovolemia)**

Scoring

Time to accomplish: 60 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Give volume
- ☐ Circuit check
- ☐ Recognizes bleeding at cannulation site
- ☐ Verbalizes arterial versus venous decannulation
- ☐ Apply pressure to site
- ☐ Call for help
- ☐ Clamp off circuit
- ☐ Emergency vent settings
- ☐ Resuscitation of patient
- ☐ Call surgeon

Discouraged interventions

- ☐ Attempts to hand crank

**COMMENTS**

## Scenario 9

### Wet lab Scenario – High Post membrane pressure

#### Initial Set-Up for Student (t=0)

VS Trend: Baseline 30 seconds. Trend 30+ seconds.  
Prep: Hoffman clamp on arterial tubing and  
Adjust pressure zero calibration point higher on post  
membrane, just below alarm limit  
Action: Add volume at 0:28 seconds raise membrane pressures, and  
to make alarm sound

History: Day 3 for a 2 month old who presented with V-tach unresponsive  
to medical intervention. Found to have TAPVC. He is awake, but  
sedated, calm and quiet. The nurse has just completed his assessment with  
a diaper change.

ECMO Mode: VA

Patient: (ArtCanKink1 SvO2.tnd)

|            |            |            |
|------------|------------|------------|
| Temp       | 37.2       |            |
| HR         | 130        | 160        |
| BP         | 70/42 (51) | 48/20 (29) |
| CVP        | 5          |            |
| Saturation | 95%        | 83%        |
| SvO2       | 75%        | 60%        |

(if SvO2 function is used on Sim monitor)

CDI 7.45 / 37 / 318 / 24 / BE 2  
H/H 35% / 12  
SvO2 52%-

Blood gases: Sample sent. Results still pending

Pressures: Venous -2 Pre-memb 130 to 338 Post-memb 120 to 359

Flow Decreases (depends on amount of volume added & servo-reg)

#### Available data

- Physical Exam: Sedated. Quiet. Mottled. Dusky. BS equal but course. Heart sounds normal. Abdomen soft. Peripheral refill 4 to 5 sec. Extremities cool.
- Color blood in circuit tubing – color differentiation seen
- CXR: Taken. Radiologist calls back and says that shorter catheter appears bent.
- Chem: Previous labs normal. Sample sent to lab. Results pending.
- Heme: Previous labs normal. Sample sent to lab. Results pending.
- ACT: 176 sec

**Scenario 9**

**Wet lab Scenario – High Post membrane pressure**

Scoring

Time to accomplish: 60 seconds

**Stop assessment when instructor gives verbal cues to the participant**

Appropriate interventions

- ☐ Gives volume
- ☐ Orders chest X-ray
- ☐ Recognizes problem is downstream to the oxygenator
- ☐ Circuit check
- ☐ Calls for help
- ☐ Checks oxygenator
- ☐ Checks catheters
- ☐ Adjusts arterial cannula
- ☐ Assess activity level
- ☐ Calls surgeon

Discouraged interventions

- ☐ Comes off ECMO
- ☐ Attempts to hand crank

**COMMENTS**