# E-CPR
## National Trends & Local Plans

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## Objectives

- **What** is E-CPR?
- **Why** would one do it? **Evidence** behind E-CPR?
- **Who** might be candidates, & who are not?
- **How** does this work?
  - Our **EDRU** initiatives
  - ACLS improvements
  - 3 stages

# E-CPR

- The Rapid deployment of arterio-venous ECMO in patients with cardiac arrest, during CPR before ROSC.

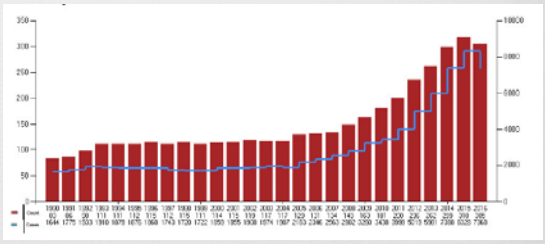
**N (2012-2015)= 1,337**

**N (2016)= 710**

**Survival to discharge ~ 30%**

*OHCA ~8%

*IHCA ~ 11%



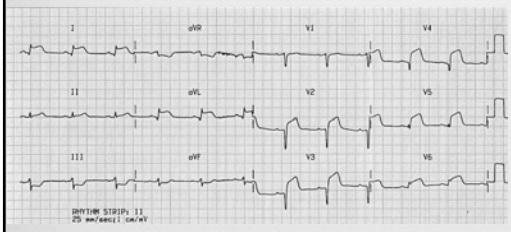
ELSO International Summary, 2016.

# E-CPR

- **E-CPR: ECMO assisted CPR**
  - Achieve ROC when we can't achieve ROSC
  - To facilitate treating a discreet & reversible cause of arrest…

# Case: LAD occlusion

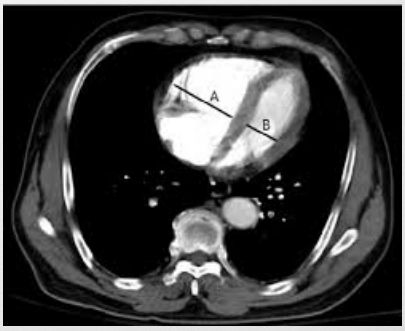
- 55 male, s/p witnessed cardiac arrest. Wife started CPR, EMS arrives in 10 minutes. V-fib shocked successfully.




- During transport & in ED, patient continues to lose ROSC with V-fib… shocked 4 times. Gets amiodarone, epi, good CPR… but refractory.
- After a total of 40 minutes, patient placed on bypass, goes to cath lab; LAD stenting
- Spends 2-5 days on ECMO
- Decannulated, Dc'd home

# Case: Massive PE

- 36 male presents to ED with PE



# ECMO is a Bridge

- Bridge to revascularization
- Bridge to thrombectomy (PE)
- Bridge to recovery (overdose, hypothermia, myocarditis)
- Bridge to transfer; transplant, VAD etc..)
- Treat underlying etiology
- Rest heart
- Rest lungs
- Optimize DO2 to organs
- Allow healing

UNM EDU

# Why Not do E-CPR?….

- No RCT demonstrating benefit
  - What are ideal patients
  - Ideal thresholds criteria
- Increase hemodynamic saves without neurologic function
- Resource intensive/ Cost for folks with poor outomes

# Evidence: IHCA

**Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis**

- Prospective, observational, propensity matched, comparing E-CPR vs S-CPR for IHCA
- N = 172, ECPR: 59, conventional CPR: 113
- Inclusion: Age 18-75, CPR > 10 min, suspected cardiac origin, no trauma/ bleeding, terminal malignancy, neuro disability
- Survival to discharge with good neurologic outcome CPC 1-2

Chen Y, et al. Lancet, 2008

# Evidence: IHCA

| CPC Scale | |
|---|---|
| 1 | Conscious, normal or minimal disability |
| 2 | Conscious, moderate disability |
| 3 | Conscious, severe debility |
| 4 | Comatose, vegetative |
| 5 | Brain dead |

- **E-CPR: 28% survival/ control:12% survival** (CPC 1-2)
- **w/case matching: ECPR: 32.6% vs 17.4%**

Chen Y, et al. Lancet, 2008

# Evidence: SAVE J

Extracorporeal cardiopulmonary resuscitation versus conventional cardiopulmonary resuscitation in adults with out-of-hospital cardiac arrest: A prospective observational study☆

- Prospective, multi-center (46): S-CPR (20) vs E-CPR centers (26)
  - ECPR centers: added balloon pumps & hypothermia
- N= 454 OHCA/ E-CPR 260, S-CPR 194
- Inclusion: VT/ VF, suspected cardiac origin, 45 minutes to reach hospital, No ROSC for 15 min at ED, Age 20-75, no neuro-debilitation, informed consent
- **Survival (6 mo) with CPC 1-2: 11% vs. 2.5%**

Sakamoto T, et al. Resuscitation, 2014

# Evidence: CHEER Trial

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)☆

- Prospective observational study of bundled resuscitative therapies
  - Mechnical CPR, Hypothermia, ECMO, Early Revascularization
- Survival with Good Neurologic Outcome: CPC 1-2
- N= 26, 15 IHCA, 11 OHCA… 24 underwent ECMO
  - Cath lab; 11 patients (42%)/ Median age: 52/
    time to ECMO initiation 56 min (40-85)/ ECMO duration 1-5 days
- 25 achieved ROSC, 13 (54%) weaned off ECMO
- **STHD with CPC-1: 14/26, 54%**

Stub D et al. Resuscitation, 2014

# Evidence: CHEER Trial

Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion (the CHEER trial)☆

- **STHD with CPC-1: 14/26, 54%**
  - **Included IHCA (60%) & OHCA (45%)**
  - **Bundled Therapies**
  - **Inclusion Criterion**
    - **Age 18-65**
    - **Arrest due to suspected cardiac etiology**
    - **V-fib arrest rhythm (OHCA)**
    - **IHCA patients included at MD discretion (selection bias?)**
    - **Smaller cannulae (17 & 15 Fr)**

Stub D et al. Resuscitation, 2014

# Evidence; OHCA Meta-analysis

Prognostic factors for extracorporeal cardiopulmonary resuscitation recipients following out-of-hospital refractory cardiac arrest. A systematic review and meta-analysis☆

- Meta-analysis of studies (15) 2000-2016 w/ primary outcomes of…
  - survival (N=5) or survival with good neuro-outcome (N=10)
  - Evaluate for prognostic outcome predictors
- **15% favorable outcomes** (125/841)
- **Predictors of favorable outcomes: shockable rhythm, shorter low flow duration, higher admission pH, lower lactates**
- No difference with age, gender, bystander CPR

Guillaume D et al. Resuscitation, 2017.

# Key Variables

- Witnessed arrest/ Bystander CPR
- Initial Rhythm
- Low flow time (IHCA vs. OHCA)
- Shock Markers (pH, lactate)
- Age
- Arrest etiology
- Other interventions (automated CPR, hypothermia, assist devices, revascularization)
- Presence of a Protocol

# E-CPR Key Variables

| Inclusion | Exclusion |
|---|---|
| Witnessed arrest/ Bystander CPR | Age >60/ Asystole |
| Age ≤ 60 | Pre-existing neuro impairment |
| Time to cannulate ≤ 60 min | organ failures (ESLD/ ESRD) |
| Failed CPR/ ACLS > 20 min | Active malignancy |
| Presumed reversible cause | Un-witnessed arrest |
| VF/ VT/ PEA… | Severe LE vascular disease |
| | Aortic dissection/ AI |

## Emergency physician-initiated extracorporeal cardiopulmonary resuscitation☆

Joseph M. Bellezzo[a,*], Zack Shinar[a,b], Daniel P. Davis[c], Brian E. Jaski[b], Suzanne Chillcott[b], Marcia Stahovich[b], Christopher Walker[b], Sam Baradarian[b], Walter Dembitsky[b]

[a] Sharp Memorial Hospital, Emergency Department, 7901 Frost Street, San Diego, CA 92123, United States

- Can EPs successfully incorporate E-CPR into practice?
- Prospective case series using a 3 stage algorithm for E-CPR delivery
- N= 8 over 1st year (42 arrests, 18 met inclusion, 8 made it to stage 3)
- STHD neurologically intact 5/8 (63%)
- **Sharpe Memorial Cardiac Arrest STHD**
  - **2010: 13%**
  - **2014: 28%**

Bellezzo JM et al. Resuscitation, 2012.

# Fundamental ACLS improvements

- Roles based team approach
  - Nurse run ACLS (optimize good CPR & defibrillation)
  - Resuscitation Doc role (reduced cognitive load)
- Automated CPR
- Patient centered resuscitation
  - ETCO2, DBP, ECHO feedback
- Intra-arrest lines/ line Doc

# How it works: 3 stage approach

- **Stage 1:** Optimize ACLS/ place femoral arterial & venous sheaths / gather all patient data (E-CPR criteria)
- **Time Out**
- **Stage 2:** Place 25 Fr venous & 17 Fr arterial cannulae
- **Time Out**
- **Stage 3:** Place on pump/ optimize post arrest care

# Prep for E-CPR initiative

- Already introduced roles based resuscitation
  - Communication skills/ team leadership
- Vascular access initiative
- RUSH/ basic Echo initiative
- Multi-disciplinary & Multi-professional partnerships; nursing/ techs, critical care, cardiology, CT/ vascular surgery

# "ERECT" ED-ECMO

(Extracorporeal Resuscitation ConsorTium)

# E-CPR future

# Objectives

- History of ECMO
- Physiology of ECMO
- UNM Current Protocols
- ECPR Cannulation DEMO!!!

# ECMO in 1973
# Truly Experimental

# ECLS in 2005
# It works… But…

- Complex
- Specialist Required
- System Failures
- Thrombogenic
- Vascular Access Can be difficult
- Smart people done understand all the physiology
- (why are they still blue

# ECLS in 2017

- More data to direct indications and contraindications
- Specialist and non specialist systems
- Reliable machines
- Anticoagulated Circuits/Cannulae
- Streamlined Cannulae and insertion procedures
- Physiology better understood and managed

# Notable History of ECMO in New Mexico

- 1977 Bartlett et al. publishes on ECMO
  - One of their five survivors was a 17 year old female with Pulmonary Hemorrhage from Good-Pastures Syndrome.
  - Transported from Albuquerque to Orange County
- 1993 HANTAVIRUS

**Medical machine can be lifesaver for hantavirus victims**

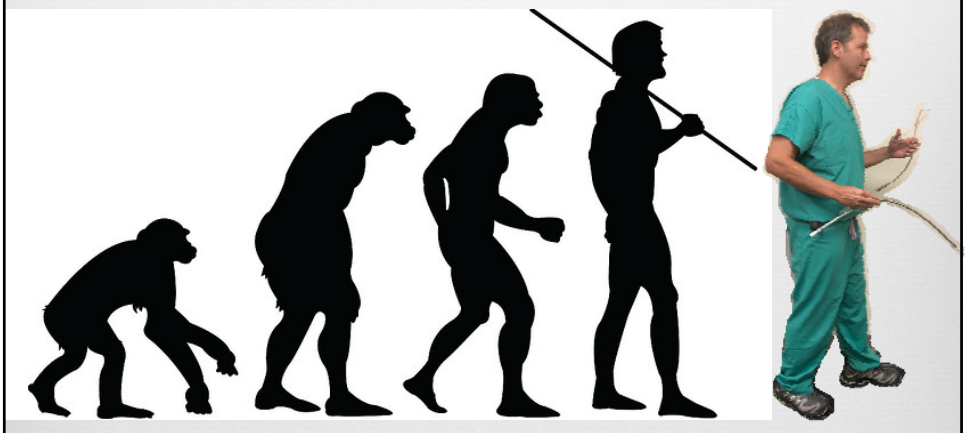
CNN Article August 25, 1998

- "We do believe the ECMO can save critically ill patients with heart and lung failure from hantavirus," said the hospital's Dr. Mark Crowley.
- The university hospital is the only center in the United States using ECMO, or extra-corporeal membrane oxygenation, to treat hantavirus.

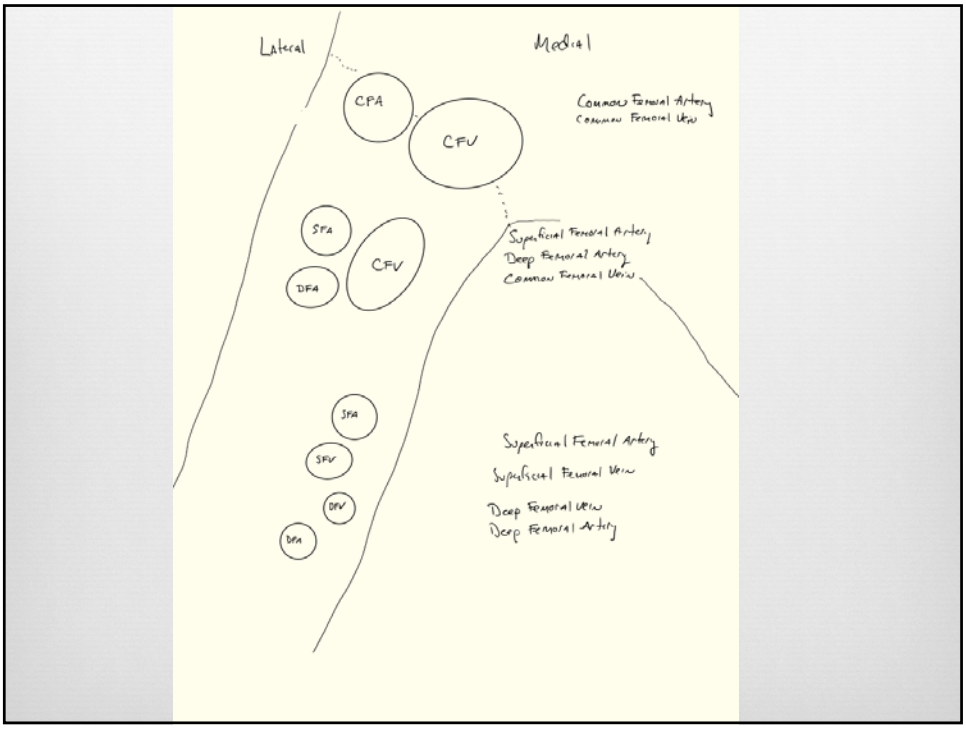
# History of ED ECMO at UNM

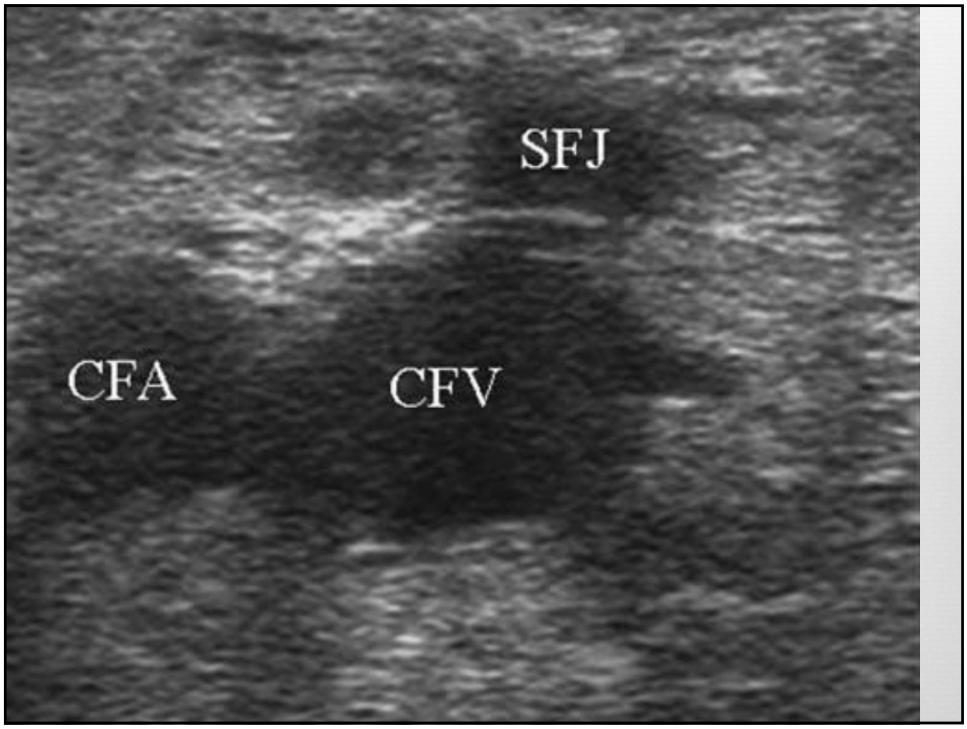
- 3000 BC until February 2017 AD
  - 1 ED Initiated Case
- February 2017 to Current
  - 5 ED initiated Cases

WE ARE MAKING PROGRESS



# Vascular Access is Key
# Common Femoral vessels only

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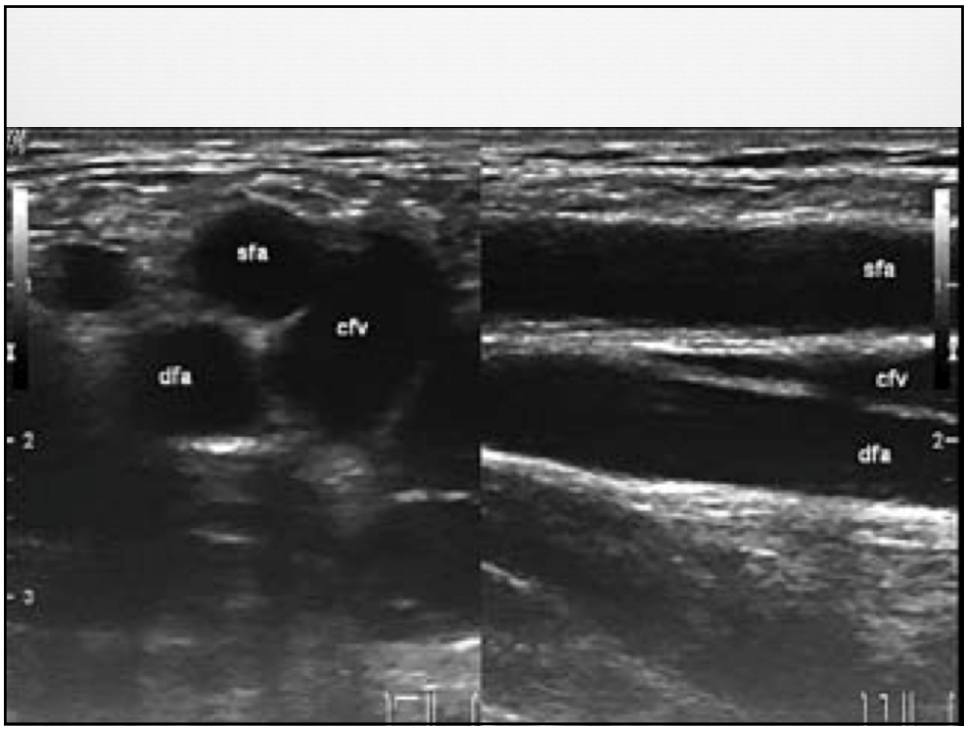
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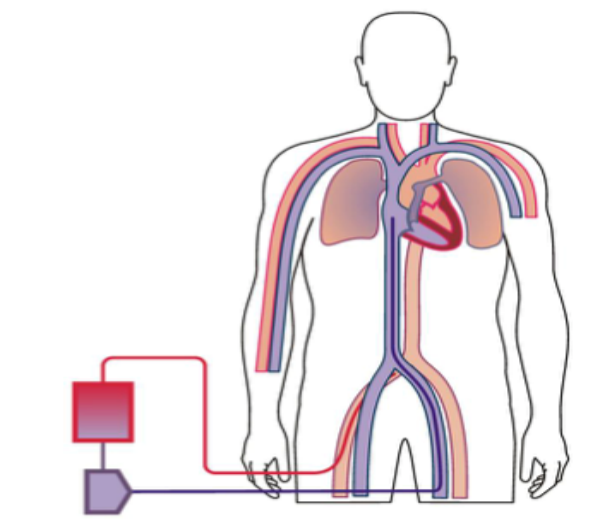
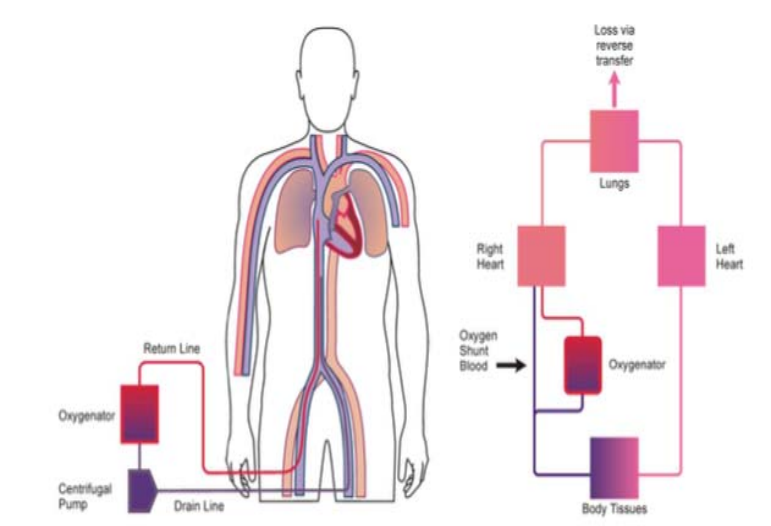
# How does ECMO work?

- ESSENTIALLY
  - Blood Goes out of body into ECMO circuit enters a pump where it is pressurized and pushed into an Oxygenator where it Gets Oxygenated and Carbon Dioxide is removed then it is returned to the ascending aorta at the ilio-aortic bifurcation at a pressure of about 180-280mmHg

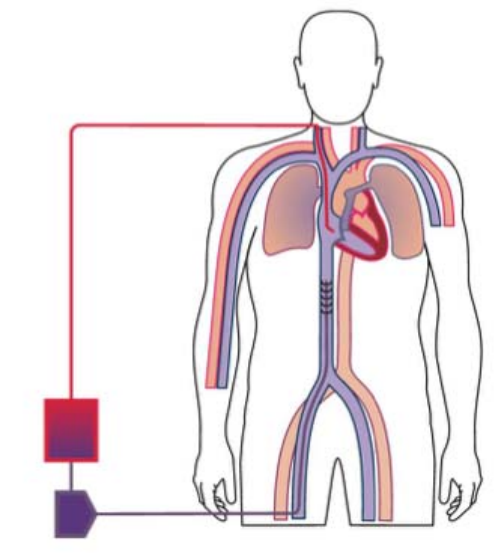
# VA ECMO

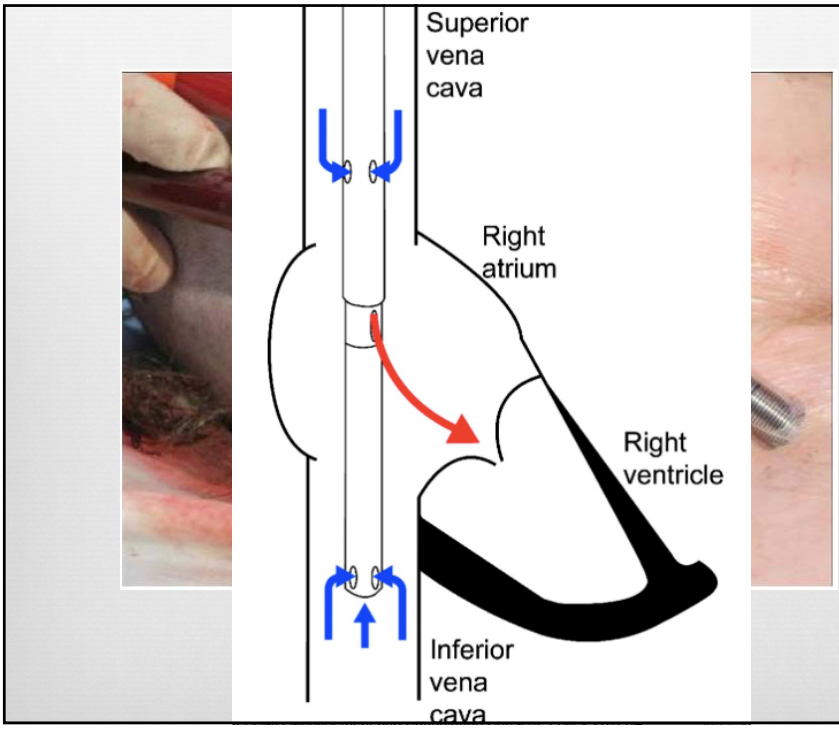


# VV ECMO Fem-Fem

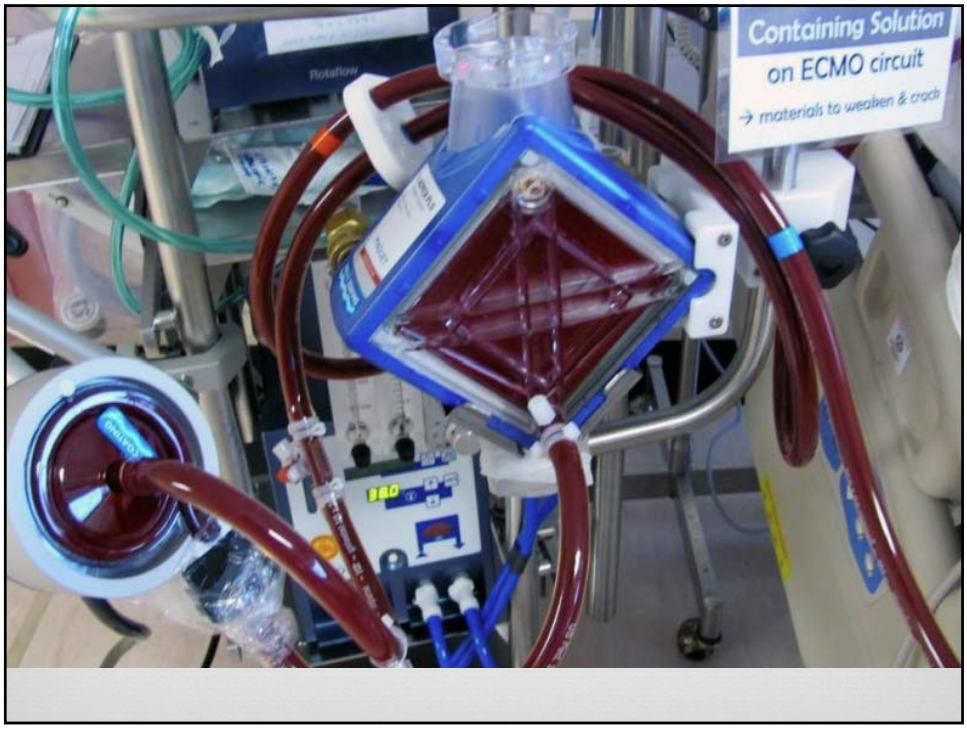


# VV ECMO Fem-IJ





# How the Cannulae Work




# VA and VV ECMO Indications/Contraindications

## ADULT VA ECMO CONSULT INDICATIONS

- Failure to wean from CPB
- Cath Lab- per Cath Lab ECMO Protocol
- Acute Reversible Right Heart Failure (Massive PE, RCA MI)
- Intractable Arrhythmia (medication/ablation)
- Acute CV collapse unknown origin
- Toxicologic Overdose
- Potentially Reversible Cardiomyopathy- Viral or otherwise
- Hypothermia

## ADULT VV ECMO CONSULT CRITERIA

- Failed ARDS Protocol
  - Pressure-limited ventilation at 30 cm H2O
  - PEEP and/ or FiO2 titrated to optimum SaO2 >85%
  - Diuresis to dry weight
  - Prone positioning per UNMH Protocol
  - If patient not responding to this protocol within 12 h (FiO2>90% needed to maintain SaO2>85%, respiratory or metabolic acidosis <7.2) or was hemodynamically unstable, cannulation and ECMO
- Ventilator Days ≤14 days
- Reversible Cause of Lung Disease

## ECMO ABSOLUTE CONTRAINDICATIONS

- Uncontrolled Coagulopathy
- Severe Multi-organ dysfunction
- Age ≥ 75 years
- Aortic Insufficiency ≥ Moderate
- Major intracranial hemorrhage
- Irreversible Process (active malignancy, ESRD,ESLD, ESLungDx)

# E-CPR SIMULATION!!!!

45 Year Old Male Playing Tennis
Cardiac Arrests and has immediate CPR started, EMS activated
Patient initially found in V-Fib Arrest
Transported to UNMH ED with CPR – No Stay and Play—Scoop and Run!!
LETS CANNULATE!!

# 3 Phases

- Sheaths
  - Time out
- Cannulae
  - Time out
- On Pump
  - Cath Lab!!
    - V Fib/ V Tach and ST Elevation MI