CUTTING EDGE TREATMENTS FOR VENTRICULAR FIBRILLATION: E-CPR

TREATING A CAUSE OR A SYMPTOM?

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Objectives

- Discuss the concepts of e-CPR for recurrent ventricular fibrillation cardiac arrest
- Discuss optimal candidates for e-CPR
- Describe the evidence for mechanical CPR

A 54 year old patient in vfib…

Shocked 4 times - Defibrillating every 2 minutes – repeating 360 joules

$EtCO_2$ remains in the high 20s to 30s

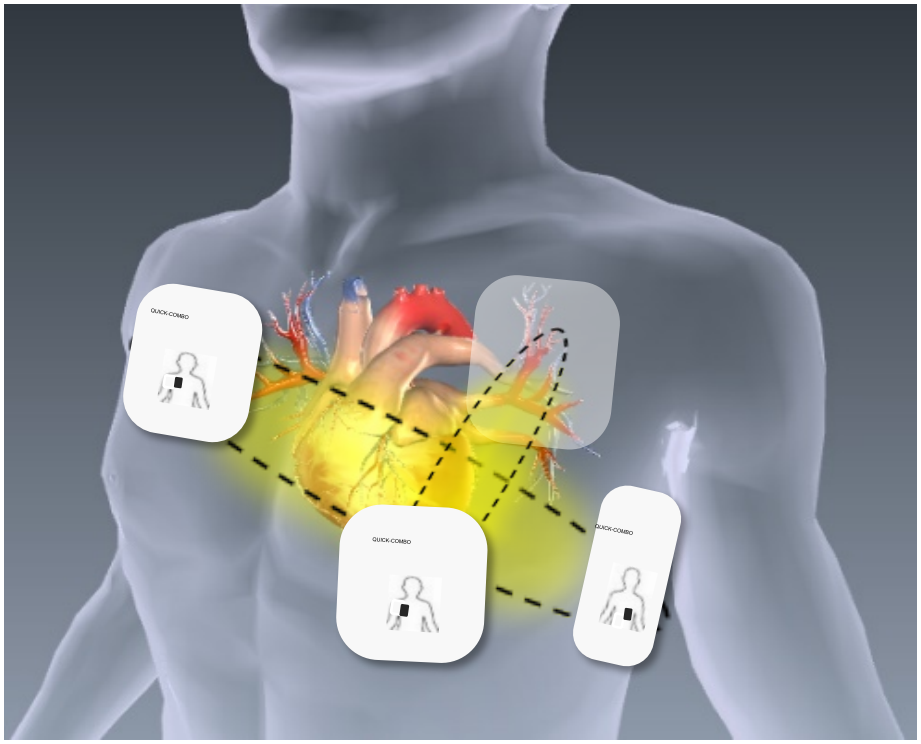
Ongoing chest compressions

Airway placed

Now what?!

Other defibrillation ideas?

- Reposition the pads
- Change the vector (or direction) the energy is delivered



OK, so now what?

Why do people experience ventricular fibrillation?

- Long QT interval
- Drugs (cocaine)
- Hypertrophic Obstructive Cardiomyopathy
- Lesion in a coronary artery! – **REVERSIBLE!!!**

Should the patient go to the cath lab?

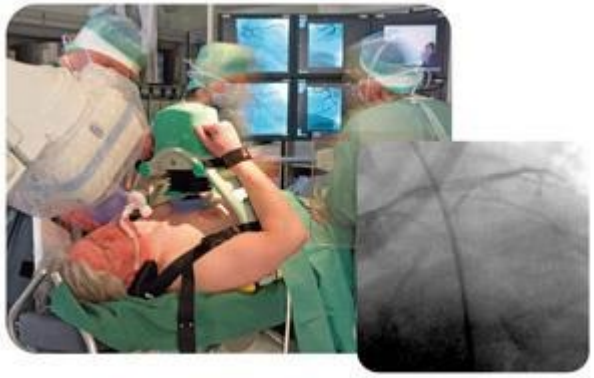
What is E-CPR?

Extracorporeal Cardiopulmonary Resuscitation:

- Mechanical Chest Compression device

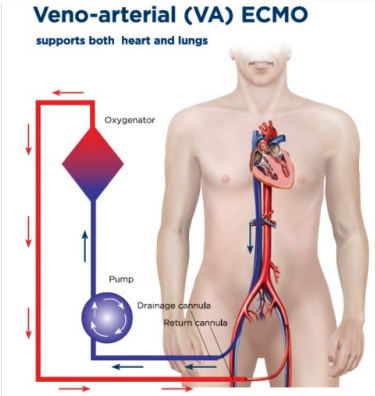
- PCI

Percutaneous Coronary Intervention



- ECMO

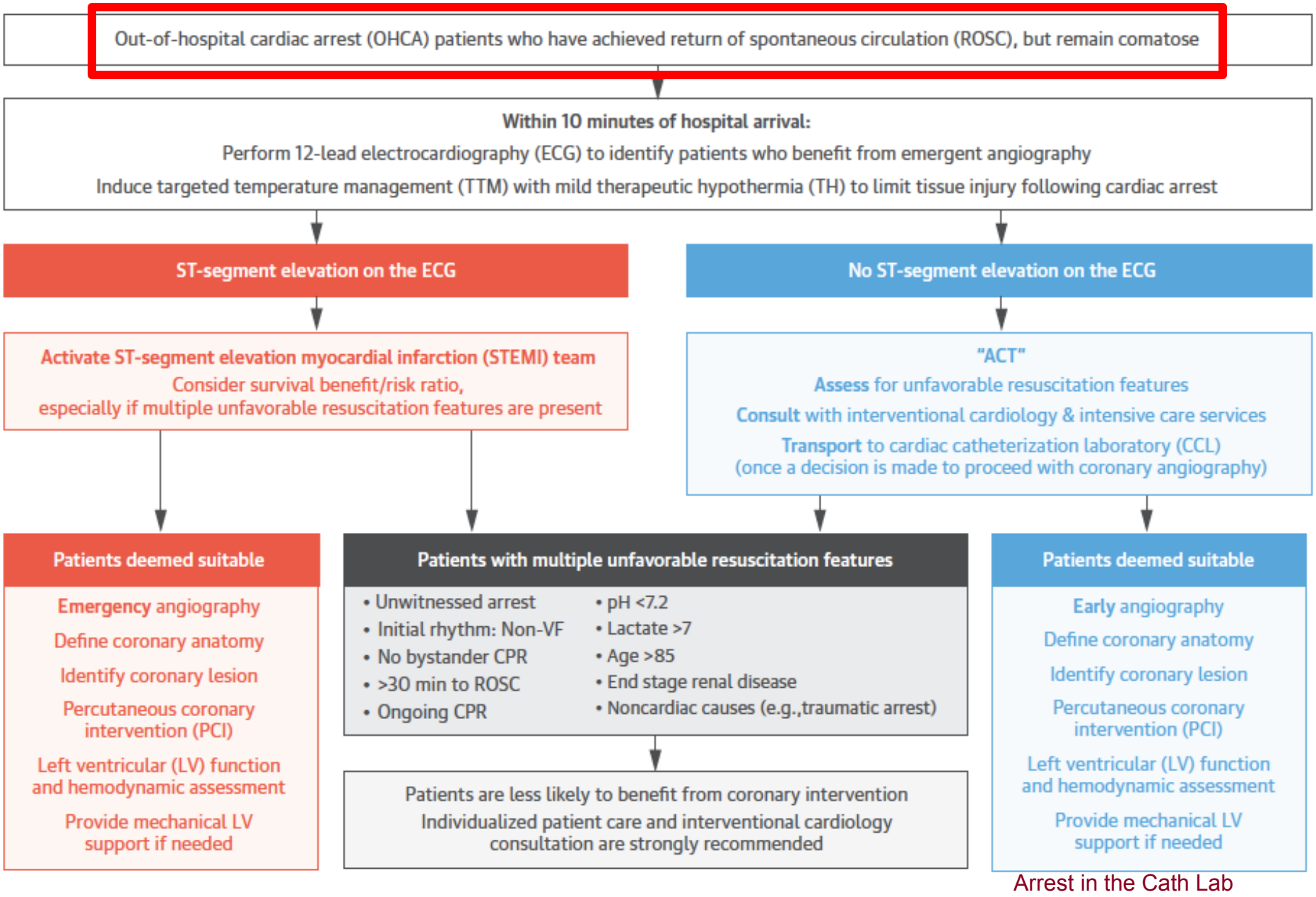
Extracorporeal Membrane Oxygenation



Should the patient go to the cath lab?

- Get a 12 Lead ECG post arrest
  - Class I, LOE B
- PCI should be performed emergently in OHCA with STEMI
  - Class I, LOE B-NR
- Reasonable to perform PCI regardless of awake or comatose
  - Class IIa, C-LD
- Case series –
  - PCI was needed in 95% of all post arrest patients with STEMI
  - PCI was needed in 58% of patients post arrest who didn't have ST elevation!
    - Dumas et al (2010) Circ Cardiovasc Interv.;3:200–207

CENTRAL ILLUSTRATION **Algorithm for Risk Stratification of Comatose Cardiac Arrest Patients**



Arrest in the Cath Lab

Rab, T. et al. J Am Coll Cardiol. 2015; 66(1):62-73.

When is CPR challenging?

- Prolonged codes
- Back of a moving ambulance
- Cardiac Cath Lab
- In a hospital bed
- When you don't have enough staff/limited resources
- On a morbidly obese patient

Should we rethink the way we provide chest compressions?

nical CPR

Table 2. Primary and Secondary Outcomes

Outcomes	No. (%) of Participants: Mechanical CPR (n = 1300)	No. (%) of Participants: Manual CPR (n = 1289)	P Value	Treatment Difference, % (95% CI)
4-Hour survival[a]	307 (23.6)	305 (23.7)	>.99	−0.05 (−3.3 to 3.2)
ROSC[b]	460 (35.4)	446 (34.6)	.68	0.78 (−2.9 to 4.5)
Arrival at emergency department with palpable pulse	366 (28.2)	357 (27.7)	.83	0.46 (−3.0 to 3.9)
Survival to discharge from ICU with CPC 1-2[c]	98 (7.5)	82 (6.4)	.25	1.18 (−0.8 to 3.1)
Survival to hospital discharge with CPC 1-2[c]	108 (8.3)	100 (7.8)	.61	0.55 (−1.5 to 2.6)
1-Month survival with CPC 1-2[d]	105 (8.1)	94 (7.3)	.46	0.78 (−1.3 to 2.8)
6-Month survival with CPC 1-2[d]	110 (8.5)	98 (7.6)	.43	0.86 (−1.2 to 3.0)
Survival to discharge from ICU[e]	158 (12.2)	153 (11.9)	.86	0.28 (−2.2 to 2.8)
With CPC 1	54(4.2)	34(2.6)	.04	1.52 (0.1 to 2.9)
With CPC 2	44 (3.4)	48 (3.7)		
With CPC 3	34 (2.6)	40 (3.1)		
With CPC 4	26 (2.0)	29 (2.2)		
Survival to discharge from hospital[e]	117 (9.0)	118 (9.2)	.89	−0.15 (−2.4 to 2.1)
With CPC 1	89 (6.8)	67 (5.2)	.08	1.65 (−0.2 to 3.5)
With CPC 2	19 (1.5)	33 (2.6)		
With CPC 3	9 (0.7)	15 (1.2)		
With CPC 4	0	1 (0.1)		
1-Month survival[f]	112 (8.6)	109 (8.5)	.89	0.16 (−2.0 to 2.3)
With CPC 1	92 (7.1)	74 (5.7)	.17	1.34 (−0.6 to 3.2)
With CPC 2	13 (1.0)	20 (1.6)		
With CPC 3	7 (0.5)	13 (1.0)		
With CPC 4	0	1 (0.1)		
6-Month survival[g]	111 (8.5)	1048.1)	.67	0.47 (−1.7 to 2.6)
With CPC 1	103 (7.9)	88 (6.8)	.29	1.10 (−0.9 to 3.1)
With CPC 2	7 (0.5)	10 (0.8)		
With CPC 3	1 (0.1)	6 (0.5)		
With CPC 4	0	0		

9 patients

edish, 1 Dutch, 1

h EMS system

s n = 1300

ual CPR n = 1289

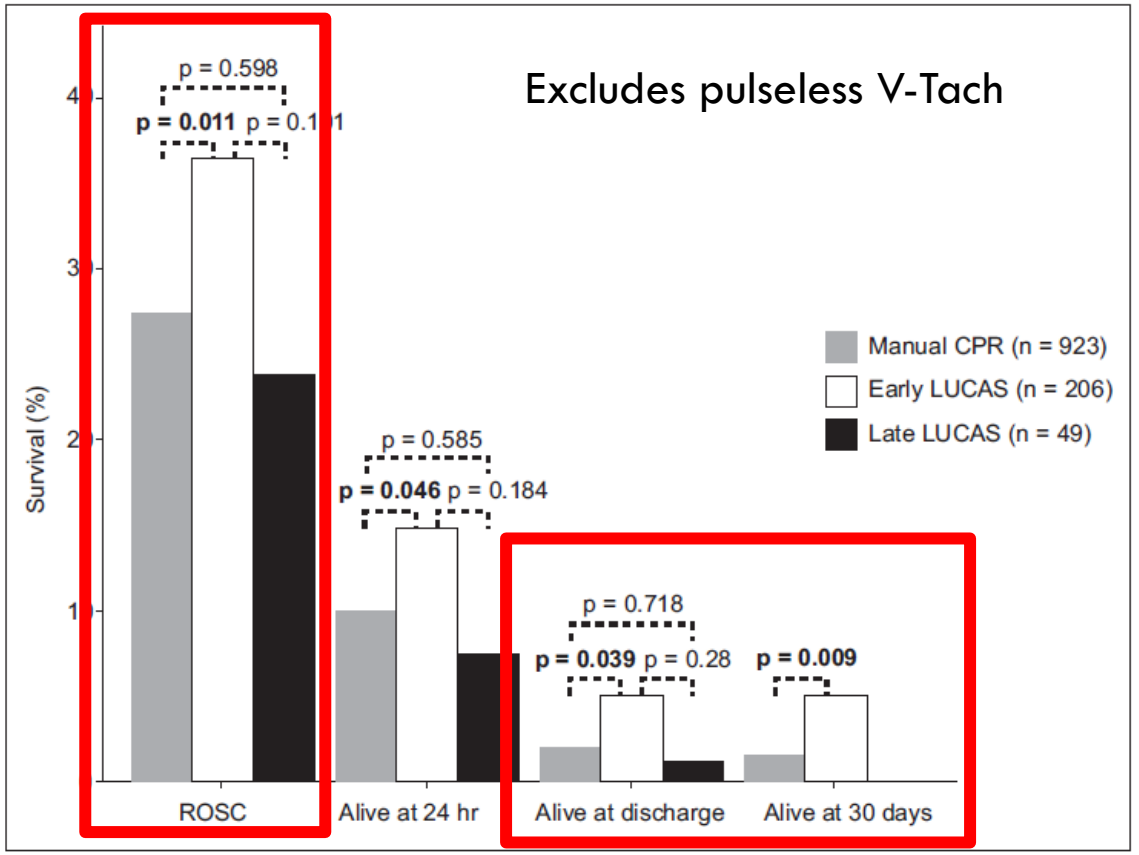
ur survival

w up 6 months

Rubertsson, Lingren, Smekal et al (2013) JAMA

Does Mechanical CPR applied early make a difference?

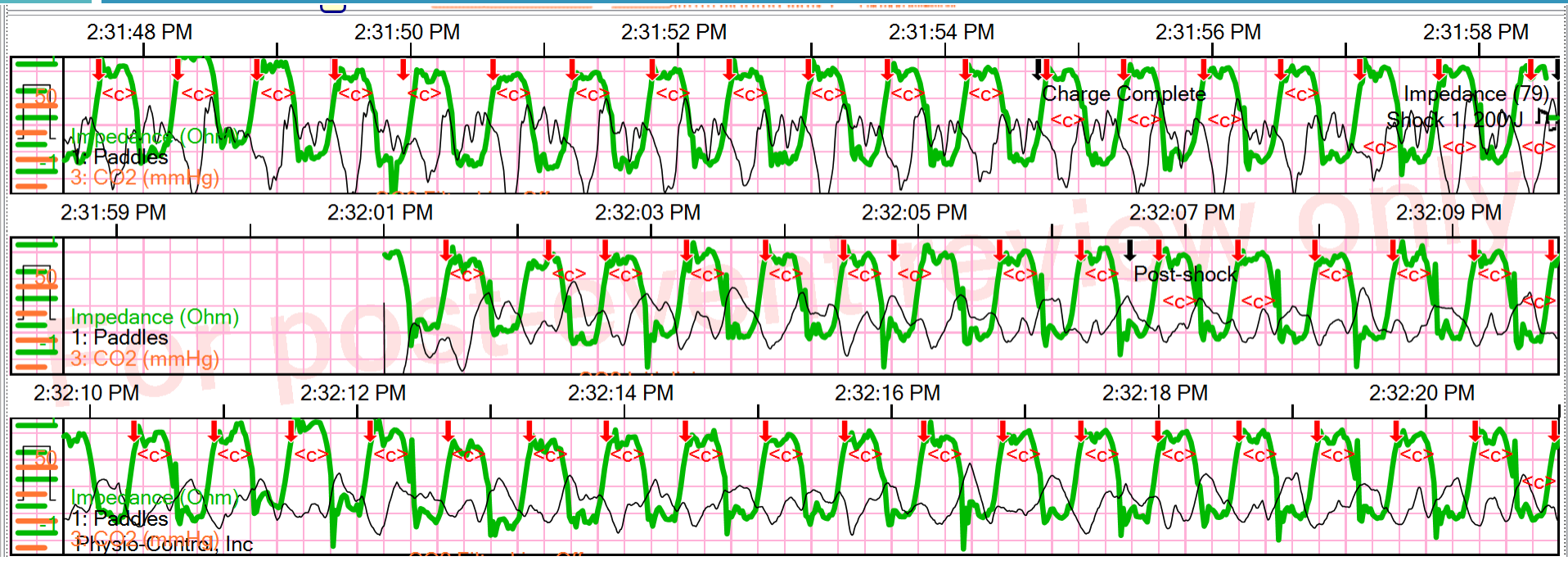
- Seems to!
- RCT Lucas 2 vs. manual CC
- Lucas applied onsite vs. ambulance



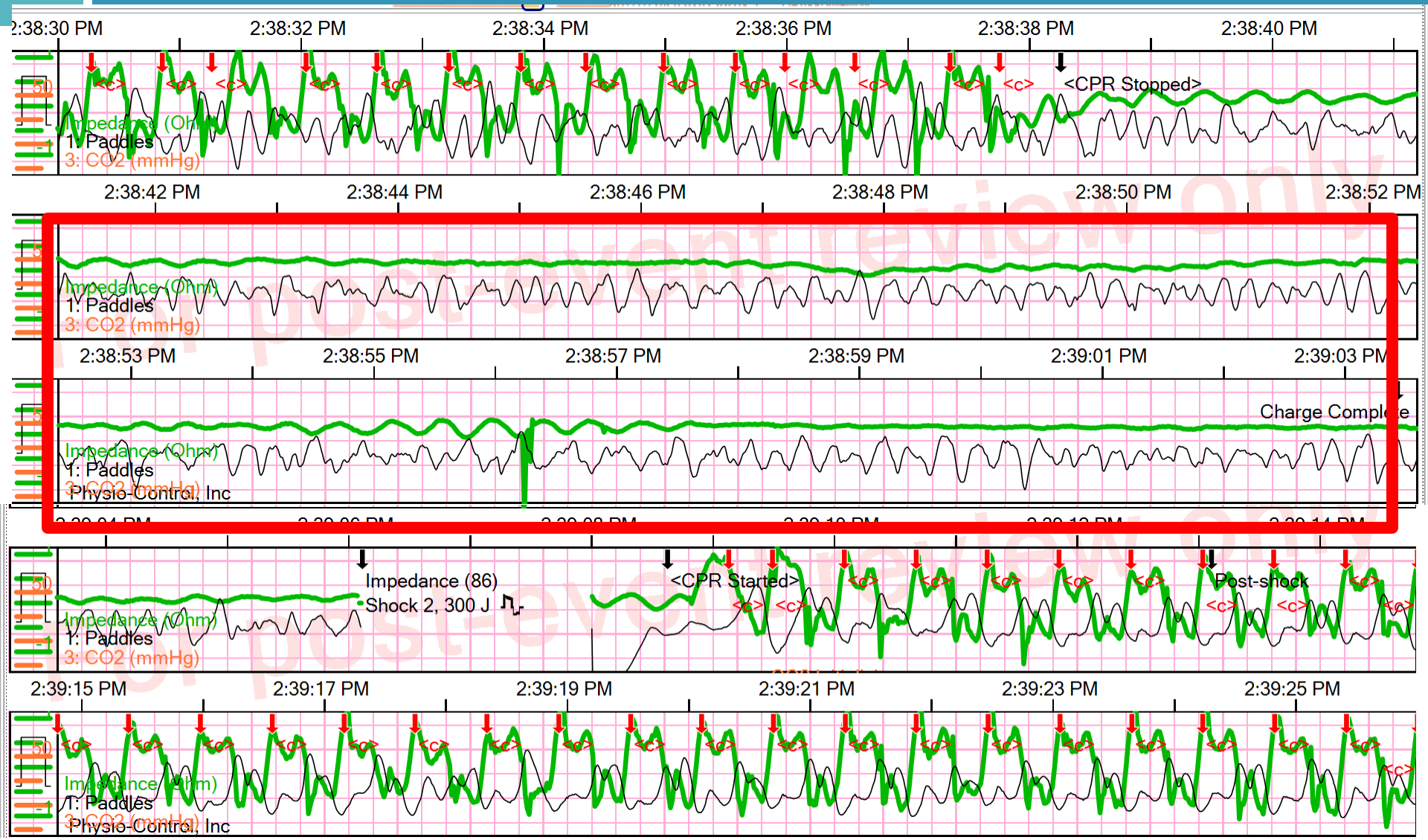
MECCA Trial – **ME**chanical **C**ardiopulmonary Resuscitation vs. Standard Manual **C**PR in OHCA by Emergency **A**mbulance Crew

Anantharaman, Ng, Ang et al (2017) Singapore Med 58(7):424-31

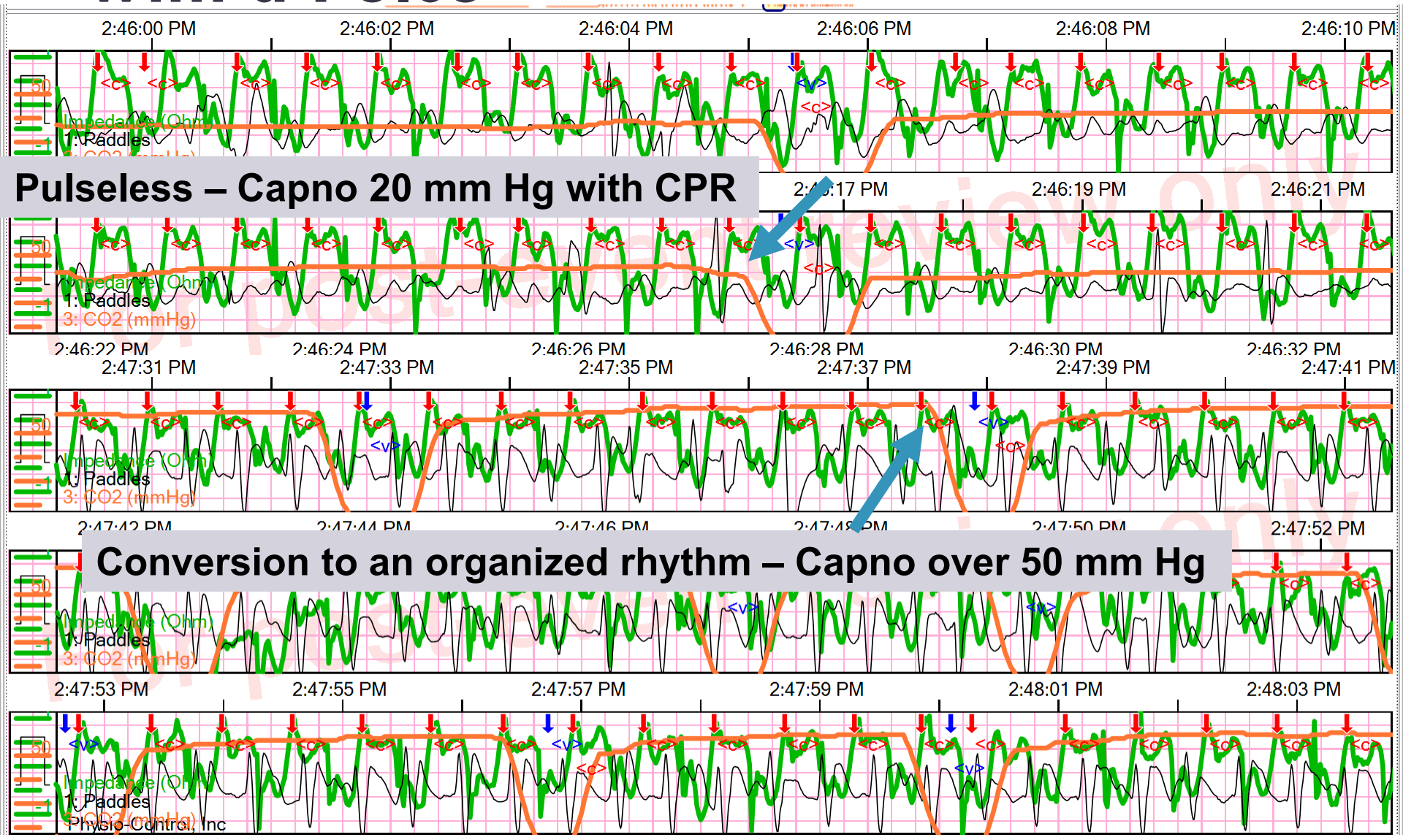
Mechanical CPR with a Shock - #1



Pre-Shock Pause w/ Mechanical CPR-#2

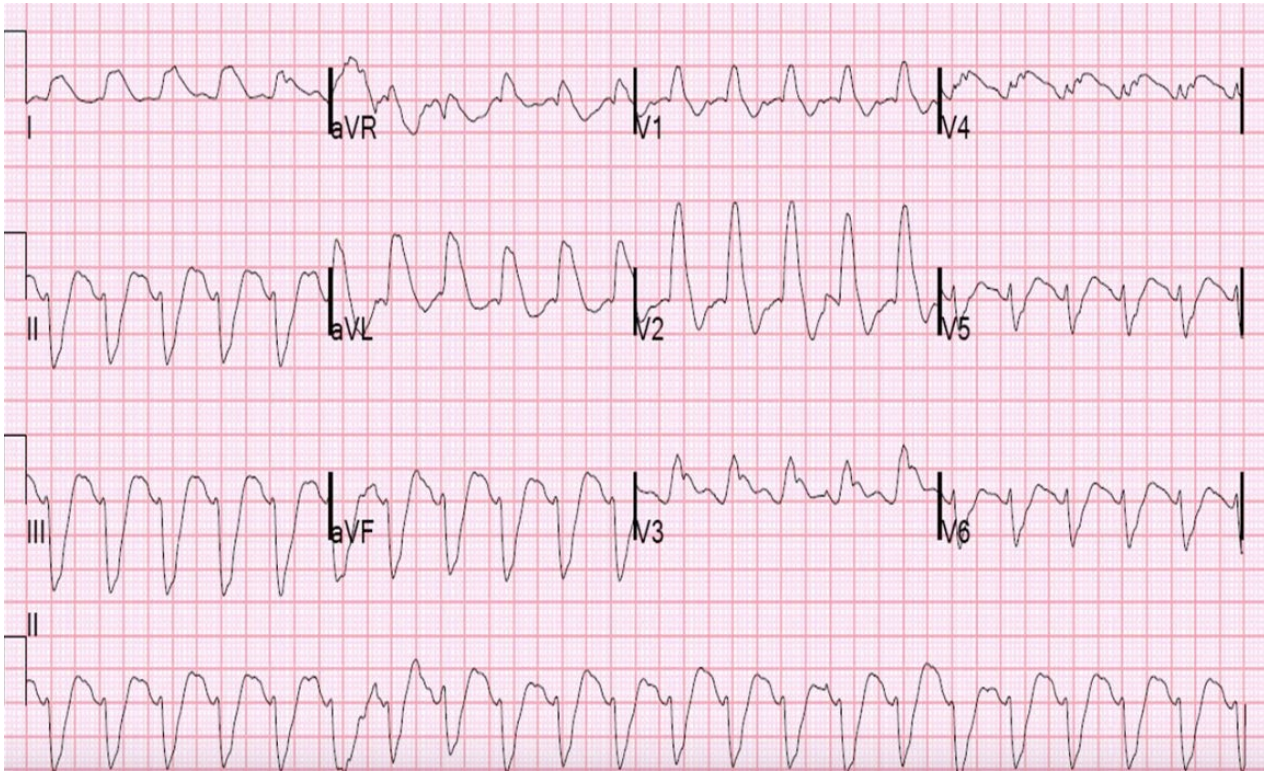


mCPR & Capnography without, then with a Pulse



56 year old with OHCA

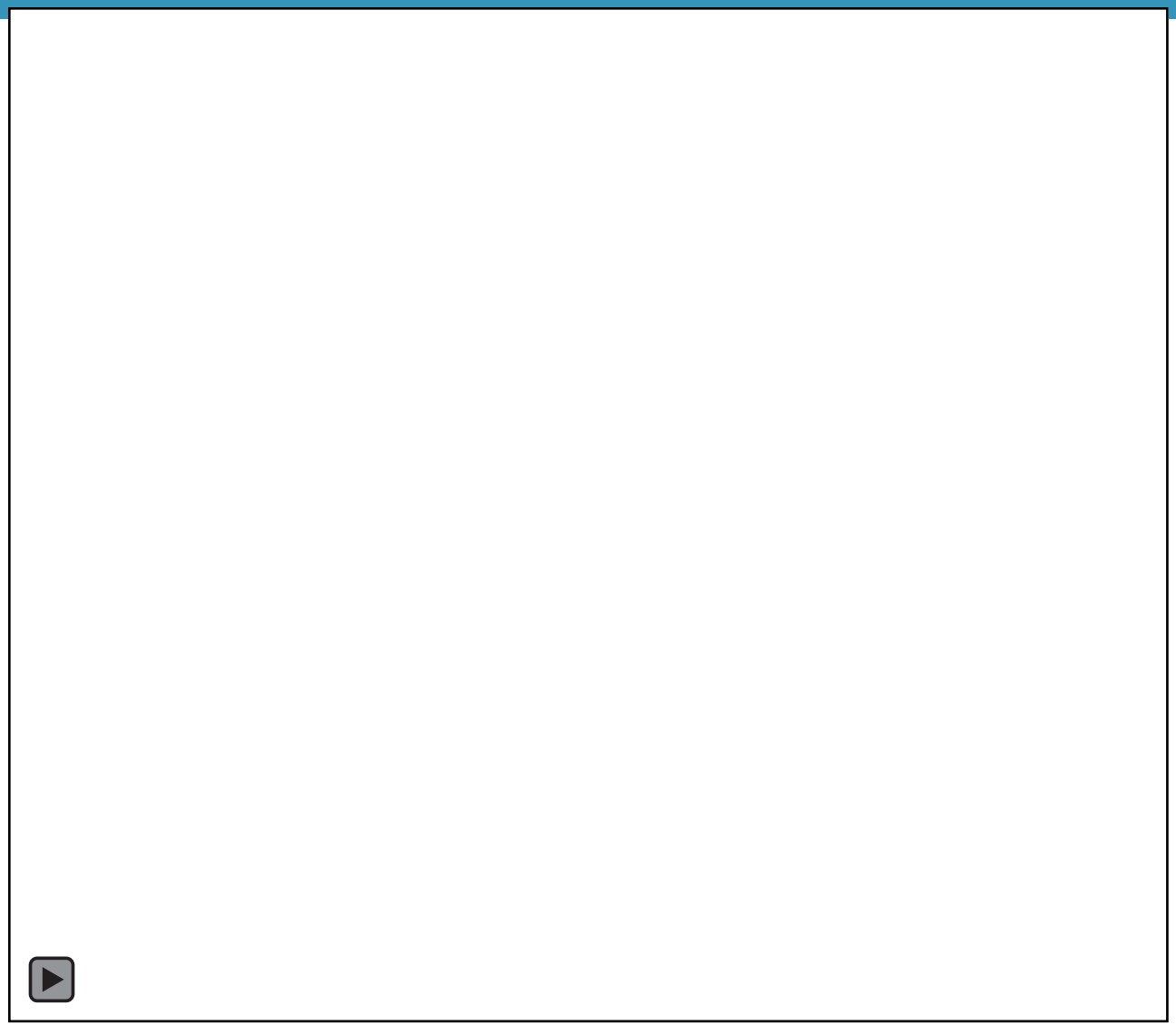
- Transient ROSC
- 4 mg of Epi, but continues loss of pulse
- Unclear if STEs on ECG
- What to do next?



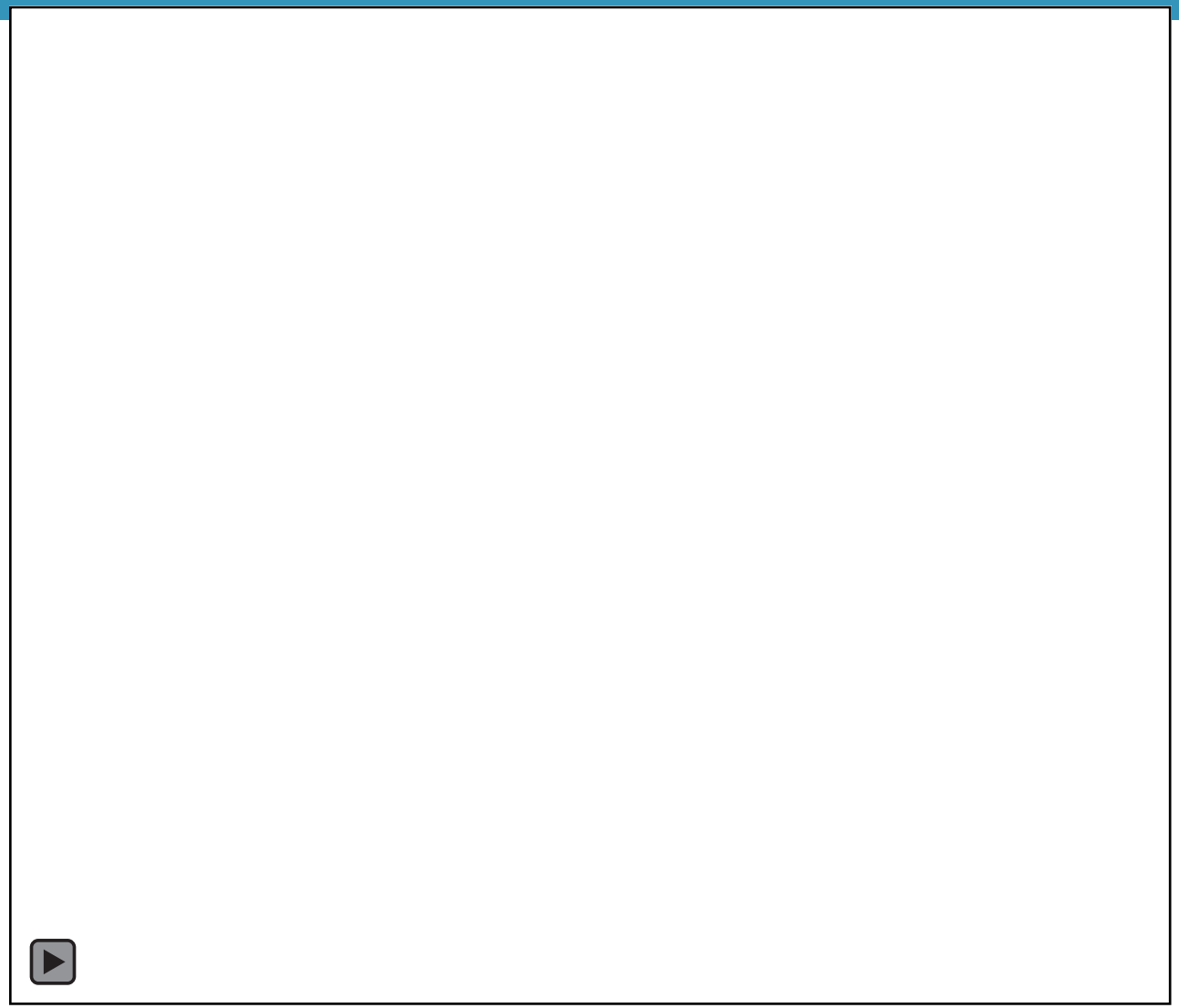
Would anyone take this patient to the cath lab?

Mechanical Chest Compression Devices

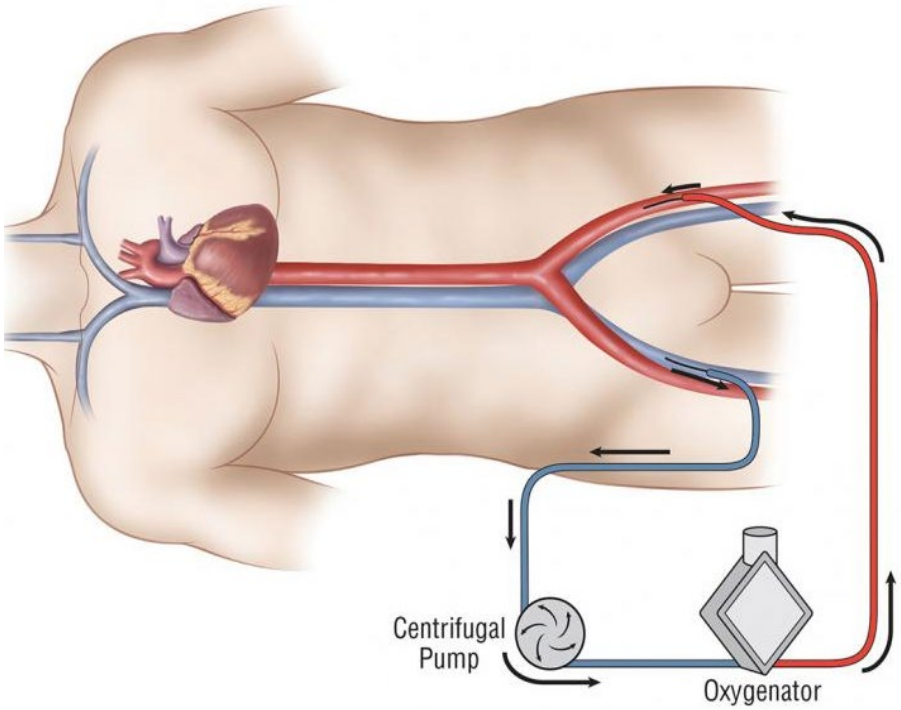
Case continued…OHCA, RBBB

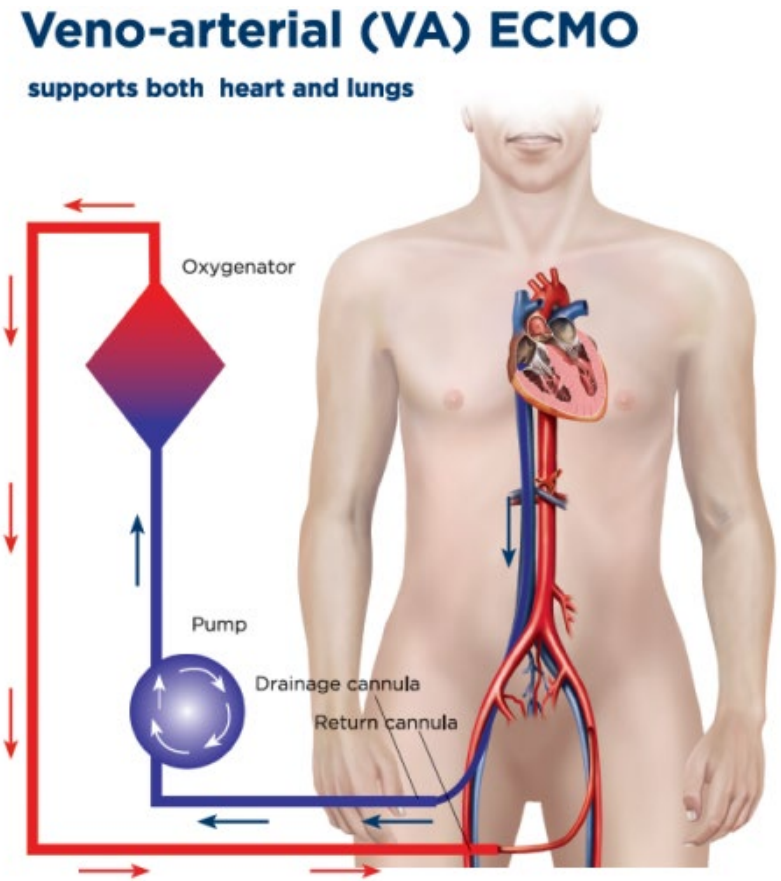


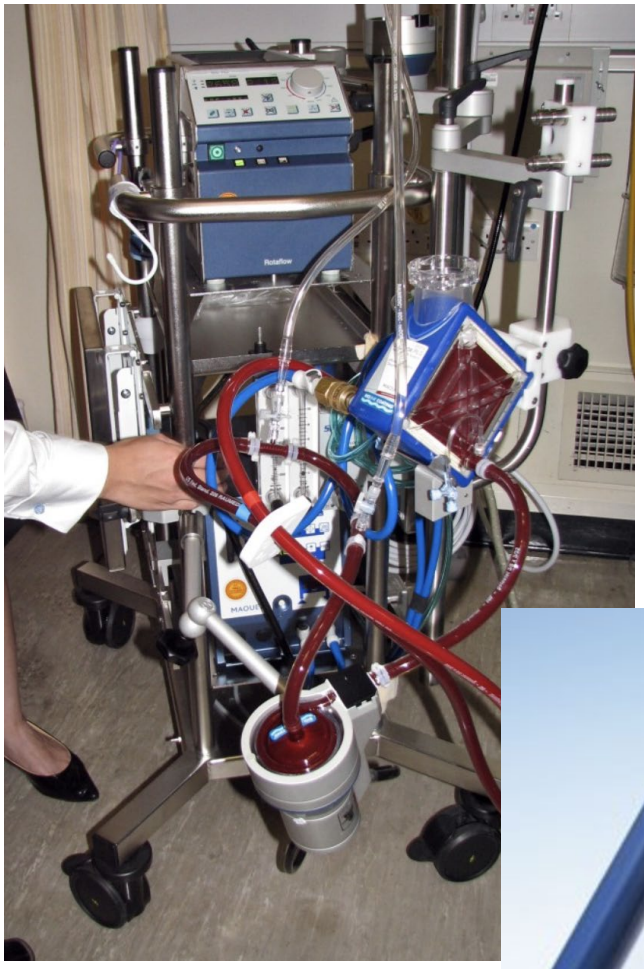
Stent placed to the LAD



ECMO


Centrifugal
Pump
Oxygenator


Veno-arterial (VA) ECMO
supports both heart and lungs
Oxygenator
Pump
Drainage cannula
Return cannula




MAQUET
CARDIOHELP

E-CPR/ECMO Cannulation for Cardiac Arrest

ECMO Cannulation for e-CPR

Credit: University of Pennsylvania
https://www.youtube.com/watch?v=UK0yBWypCrg

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical Paper

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

Table 3: Results with new "scoop and treat on the way" approach for refractory out-of-hospital v fib cardiac arrest[20,23]

	The CHEER trial	Minnesota Research Consortium	Summary
Number of patients	11	62	73
Survival to discharge	5 (45%)	28 (45%)	33 (45%)
Favorable neurology among survivors	5 (100%)	26 (93%)	31 (94%)

Minnesota Resuscitation Consortium's Advanced Perfusion and Reperfusion Cardiac Life Support Strategy for Out-of-Hospital Refractory Ventricular Fibrillation

Demetris Yannopoulos, Jason A. Bartos, Cindy Martin, Ganesh Raveendran, Emil Missov, Marc Conterato, R. J. Frascone, Alexander Trembley, Kevin Sipprell, Ranjit John, Stephen George, Kathleen Carlson, Melissa E. Brunsvold, Santiago Garcia, Tom P. Aufderheide

The Paris experience

Safety and feasibility of prehospital extra corporeal life support implementation by non-surgeons for out-of-hospital refractory cardiac arrest☆

Lionel Lamhaut[a,b,*], Romain Jouffroy[a], Michaela Soldan[a], Pascal Phillipe[a], Thibaut Deluze[a], Murielle Jaffry[a], Christelle Dagron[a], Benoit Vivien[a], Christian Spaulding[b,c], Kim An[a], Pierre Carli[a,b]

[a] D.A.R. and SAMU de Paris, Hôpital Necker, Assistance Publique Hôpitaux de Paris, Paris Descartes University, Paris, France
[b] Inserm UMR-S970, Paris Cardiovascular Research Centre, Paris Descartes University, Paris, France
[c] Cardiology Department, Hôpital Européen Georges Pompidou, Assistance Publique, Hôpitaux de Paris, Paris Descartes University, Paris, France

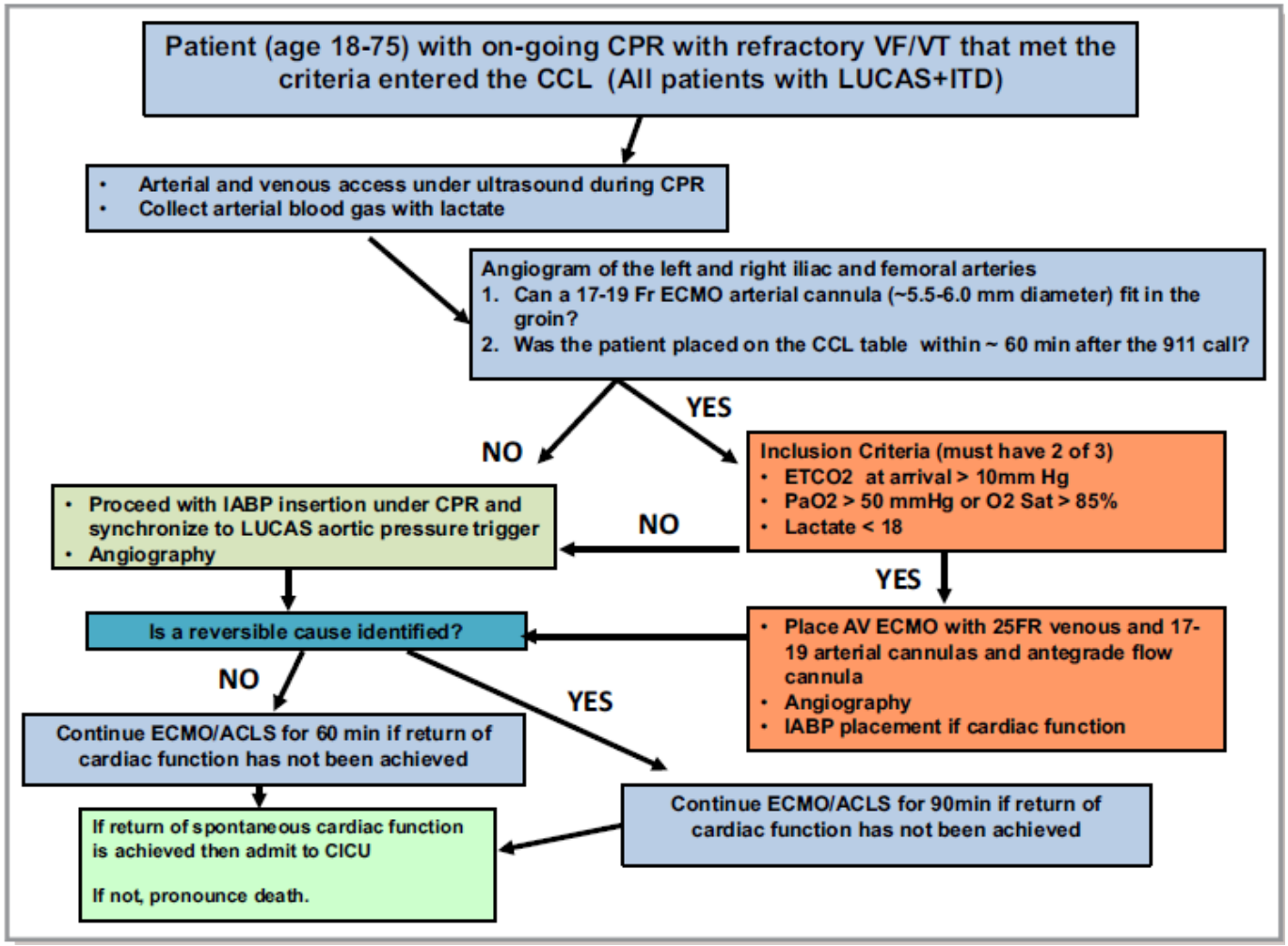
2013

Mechanical CPR as a bridge? The "Art" of E-CPR!

Pre-hospital E-CPR in the Louvre Museum, Paris

ECMO comes to you?

Minnesota experience with eCPR



Yannopoulos, Bartos, Martin et al (2016); Journal of Am Heart Assoc.

2018 E-CPR Data from Minnesota

A

118 Patients Transported by EMS

18/118 (15%) Excluded Not Meeting EMS Transport Criteria
- 5 – Misclassified presenting rhythm
- 3 – Pulseless electrical activity
- 2 – Asystole
- 5 – Time from 911 call to CCL arrival > 90 min
- 3 – DNR/DNI
- 3 – Manual CPR only
- 2 – Terminal Cancer

100 Patients Meeting Transport Criteria

8/100 (8%) Excluded Not Meeting Resuscitation Criteria
- 7 – ABG paO2 < 50
- 1 – Lactic Acid > 18

92/100 (92%) Patients Received Full CCL Treatment:

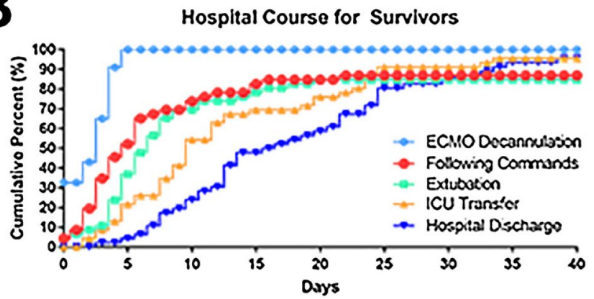
9/100 (9%) Declared Dead with Failure to Achieve Sustained Organized Cardiac Rhythm after 90 Minutes

83/100 (83%) Patients Admitted to CICU

37/100 (37%) Died Prior to Discharge	
Recurrent VF Cardiac Arrest	3/37 (8.1%)
Brain Death	14/37 (38%)
Anoxic Brain Injury	12/37 (32%)
Acute Hemorrhagic Shock Due to Intra-Abdominal Bleeding	2/37 (5.4%)
Refractory Shock	4/37 (11%)
Bowel Infarction	1/37 (2.7%)
Chronic Aspiration and Severe Pneumonia	1/37 (2.7%)

46/100 (46%) Survived to Hospital Discharge	
Survival to Discharge with CPC 1 or 2	40/100 (40%)
Survival to Discharge with CPC 3 or 4	6/100 (6%)
Survival to 3 month clinic follow-up	40/100 (40%)

B



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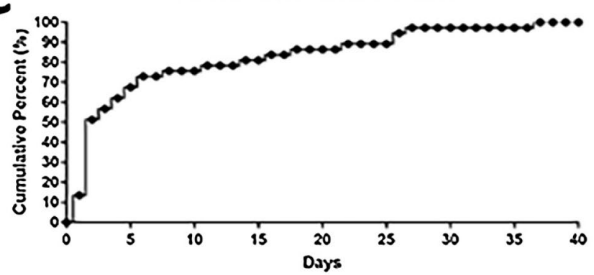

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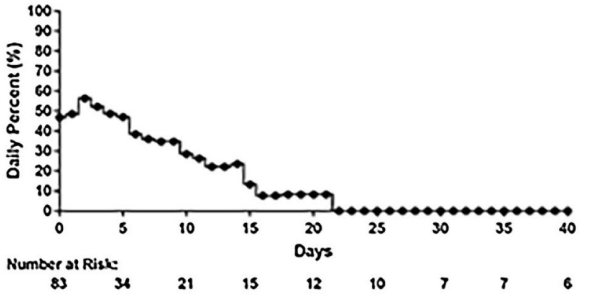
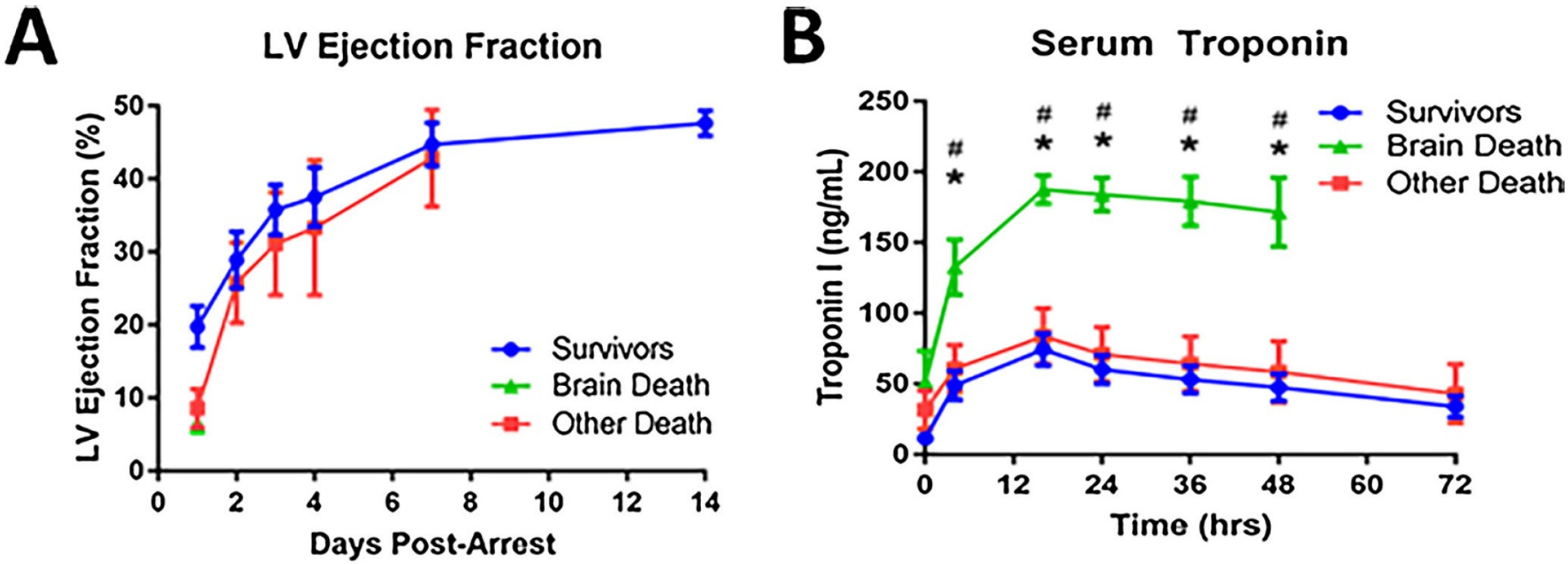


Bartos et al (2018) Resuscitation; 132:47-55

2018 data from Minnesota



Bartos et al (2018) Resuscitation; 132:47-55

Best chance of survival?

Refractory VF/VT Patients	Survivors With CPC 1&2 (9)	Deaths and Survivors With CPC >2 (9)	*P* Value
Age, y	57±11	56±9	0.2
911 call to first response arrival	3.8±2.5 min	8±3 min	0.004*
Bystander CPR	8/9	4/9	0.13
911 call to CCL entry	54±7.6	66±10.5	0.019
CCL entry—on ECMO	6±2	5.4±4	0.2
$ETCO_2$ on arrival	32±12	35±8	0.5
pH on ECMO opening ABG	7.05±0.1	7.07±0.3	0.4
Lactate at CCL arrival	9.9±2.8	14.6±5.5	0.041*
Presence of CAD	9/9	4/9	0.029*
Witnessed arrest	5/9	6/9	0.6
Intermittent ROSC before ECMO	6/9	1/9	0.049*

- Rapid EMS response time
- Bystander CPR
- Evidence of coronary disease

Yannopoulos, Bartos, Martin et al (2016); Journal of Am Heart Assoc.

2015 ILCOR/AHA Mechanical Devices

Recommendation	Class	LOE
Using feedback devices to guide compression quality	IIb	B-R
The use of **mechanical compression devices** may be a reasonable for use by properly trained personnel.		
The use of **mechanical compression devices** may be considered in specific settings where the delivery of high quality manual compressions may be challenging or dangerous to the provider.	IIb	C-EO
ECPR – Venous/Arterial ECMO may be considered for refractory cardiac arrest when the cause is likely reversible	IIb	C-LD

Neumar et al (2015). Circulation;132[suppl 2]:S315-S367

Vfib arrest is survivable!

Stay in touch!

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