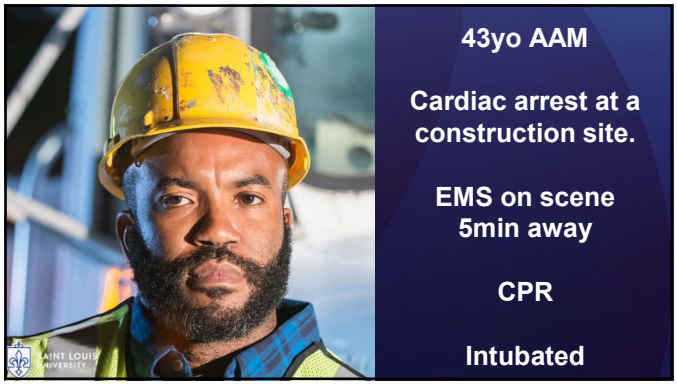

43yo AAM
Cardiac arrest at a construction site.
EMS on scene 5min away
CPR
Intubated

1


Updates in Post-Cardiac Arrest Care
ACOEP Spring Seminar 2023
Kene Chukwuanu, M.D.
Assistant Clinical Professor - Emergency Medicine & Critical Care Medicine
Associate Program Director, Emergency Medicine Residency
Director of Emergency Ultrasound
Saint Louis University School of Medicine
April 2, 2023
SAINT LOUIS UNIVERSITY
ACOEP

2

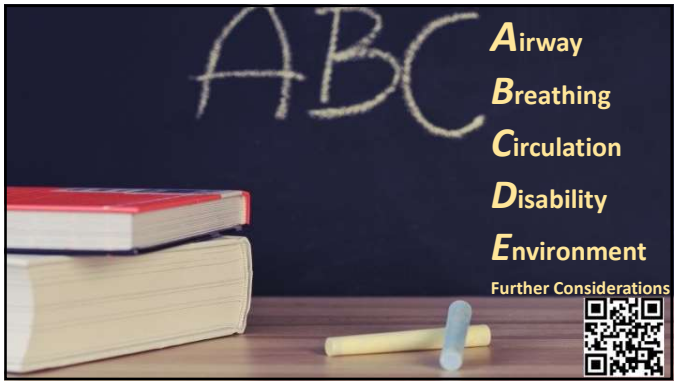

Disclosures
SSMHealth Saint Louis University Hospital
SLUCare Physician Group
I have NO financial disclosures, or other conflicts of interests in the content presented in this presentation.

3

Objectives

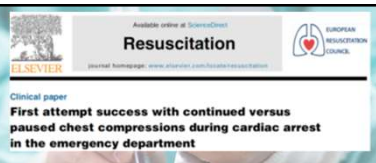
1. Review the recent literature and guidelines regarding out-of-hospital cardiac arrest management and post-cardiac arrest care.
2. Discuss the optimal hemodynamic targets in the management of post cardiac arrest patients in the emergency department.
3. Discuss the optimal management of post-resuscitation shock.
4. Examine the recent evidence for non-traditional advanced therapies for cardiac arrest including double sequential external defibrillation and ECMO/ECPR.
5. Examine the evidence regarding the utility of therapeutic hypothermia versus targeted temperature management.

4



5

Airway

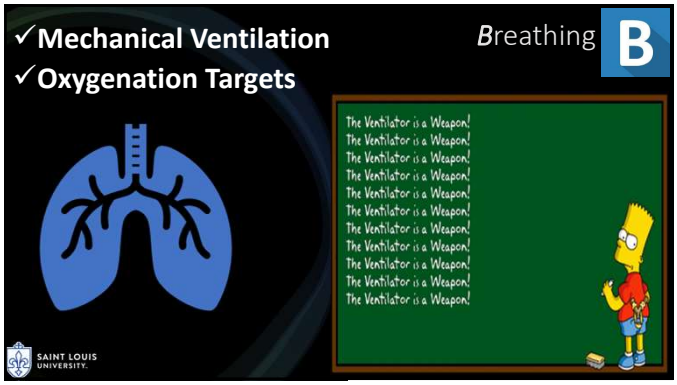


- Q: First attempt intubation success with continuous vs paused CPR?
- Hennepin ED
- Intubations mostly by senior EM residents ~ 85%.
- >90% intubations with C-Mac + standard blade + bougie.
- Successful placement confirmed by waveform capnography.

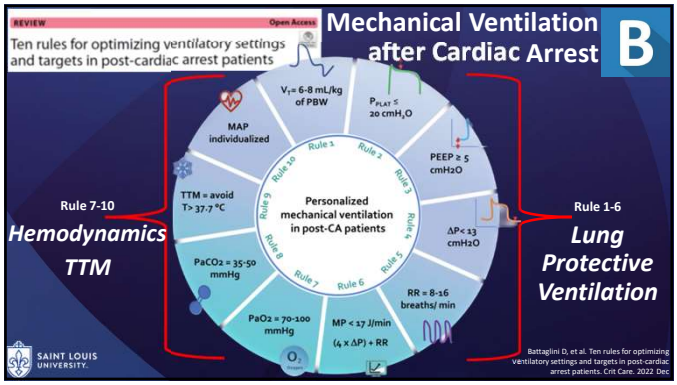
✓***First attempt success -- higher in continued CPR group (87%) vs interrupted CPR group (65%), + 22%.***

Robinson AE, et al. First attempt success with continued versus paused chest compressions during cardiac arrest in the emergency department. Resuscitation. 2023 Feb.

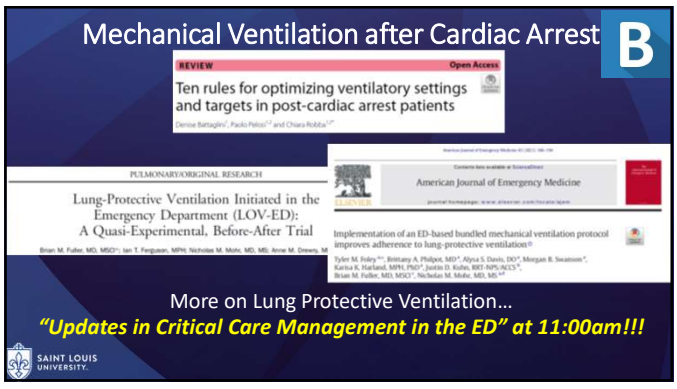
6


✓Mechanical Ventilation
✓Oxygenation Targets
Breathing
B
The Ventilator is a Weapon!
SAINT LOUIS UNIVERSITY.

7


REVIEW
Open Access
Ten rules for optimizing ventilatory settings and targets in post-cardiac arrest patients
Mechanical Ventilation after Cardiac Arrest
B
Personalized mechanical ventilation in post-CA patients
Rule 7-10
Hemodynamics
TTM
Rule 1-6
Lung Protective Ventilation
MAP individualized
TTM = avoid T> 37.7 °C
PaCO2 = 35-50 mmHg
PaO2 = 70-100 mmHg
PEEP ≥ 5 cmH2O
ΔP< 13 cmH2O
RR = 8-16 breaths/ min
MP < 17 J/min
(4 x ΔP) + RR
SAINT LOUIS UNIVERSITY.
Battaglini D, et al. Ten rules for optimizing ventilatory settings and targets in post-cardiac arrest patients. Crit Care. 2022 Dec

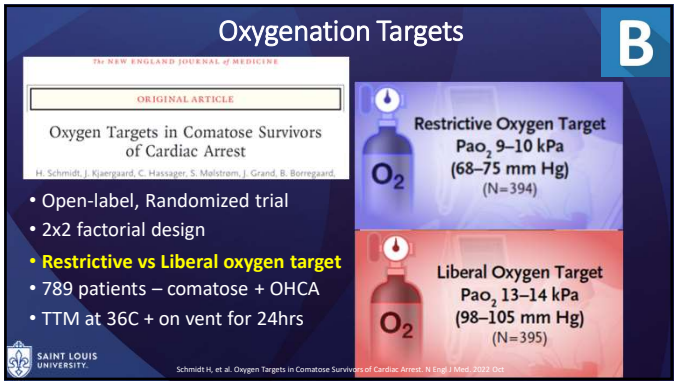
8


Mechanical Ventilation after Cardiac Arrest
B
REVIEW
Open Access
Ten rules for optimizing ventilatory settings and targets in post-cardiac arrest patients
PULMONARY/ORIGINAL RESEARCH
Lung-Protective Ventilation Initiated in the Emergency Department (LOV-ED): A Quasi-Experimental, Before-After Trial
American Journal of Emergency Medicine
Implementation of an ED-based bundled mechanical ventilation protocol improves adherence to lung-protective ventilation
More on Lung Protective Ventilation…
"Updates in Critical Care Management in the ED" at 11:00am!!!
SAINT LOUIS UNIVERSITY.

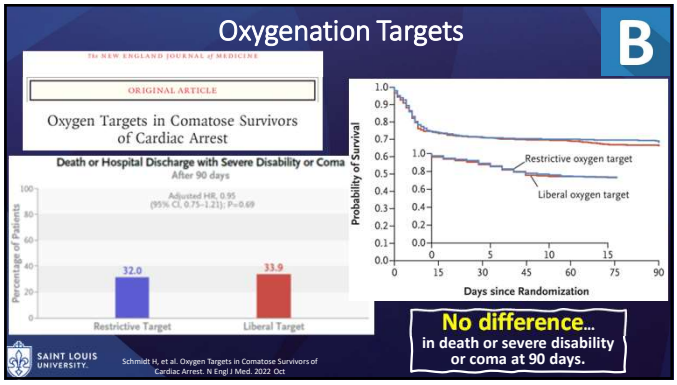
9


Oxygenation Targets
B
The BOX Trial
Schmidt H, et al. Oxygen Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct
O_2
RESTRICTIVE? vs LIBERAL?
SAINT LOUIS UNIVERSITY.

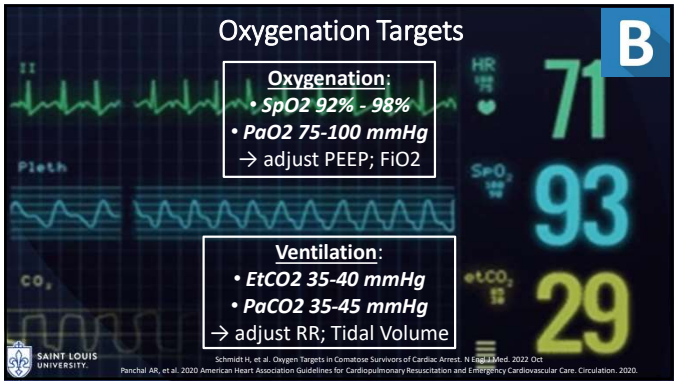
10


Oxygenation Targets
B
The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Oxygen Targets in Comatose Survivors of Cardiac Arrest
H. Schmidt, J. Kjaergaard, C. Hassager, S. Molstrom, J. Grand, B. Borregaard,
• Open-label, Randomized trial
• 2x2 factorial design
• Restrictive vs Liberal oxygen target
• 789 patients – comatose + OHCA
• TTM at 36C + on vent for 24hrs
Restrictive Oxygen Target
Pao_2 9–10 kPa
(68–75 mm Hg)
(N=394)
Liberal Oxygen Target
Pao_2 13–14 kPa
(98–105 mm Hg)
(N=395)
O_2
SAINT LOUIS UNIVERSITY.
Schmidt H, et al. Oxygen Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct

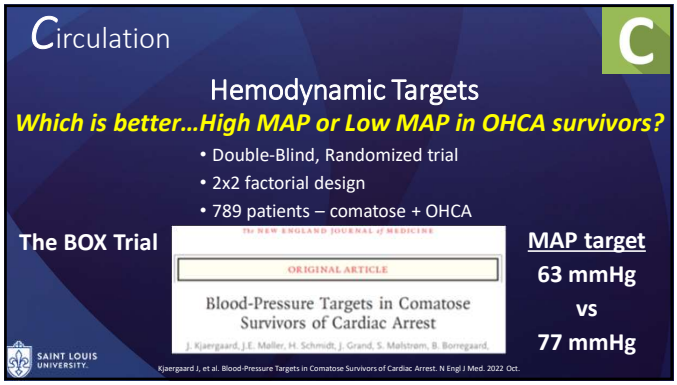
11


Oxygenation Targets
B
The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Oxygen Targets in Comatose Survivors of Cardiac Arrest
Death or Hospital Discharge with Severe Disability or Coma
After 90 days
Adjusted HR, 0.95
(95% CI, 0.75–1.21); P=0.69
Percentage of Patients
32.0
33.9
Restrictive Target
Liberal Target
Probability of Survival
Restrictive oxygen target
Liberal oxygen target
Days since Randomization
No difference...
in death or severe disability or coma at 90 days.
SAINT LOUIS UNIVERSITY.
Schmidt H, et al. Oxygen Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct

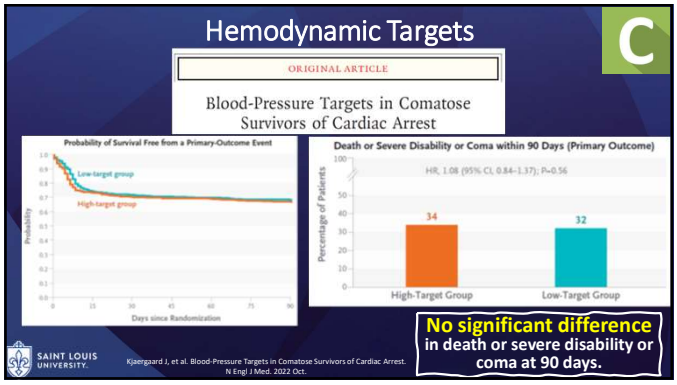
12


Oxygenation Targets
B
Oxygenation:
• SpO2 92% - 98%
• PaO2 75-100 mmHg
→ adjust PEEP; FiO2
Ventilation:
• EtCO2 35-40 mmHg
• PaCO2 35-45 mmHg
→ adjust RR; Tidal Volume
HR
71
SpO2
93
etCO2
29
Pleth
CO2
SAINT LOUIS UNIVERSITY.
Schmidt H, et al. Oxygen Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct
Panchal AR, et al. 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. Circulation. 2020.

13


Circulation
C
Hemodynamic Targets
Which is better…High MAP or Low MAP in OHCA survivors?
• Double-Blind, Randomized trial
• 2x2 factorial design
• 789 patients – comatose + OHCA
The BOX Trial
ORIGINAL ARTICLE
Blood-Pressure Targets in Comatose Survivors of Cardiac Arrest
MAP target
63 mmHg
vs
77 mmHg
SAINT LOUIS UNIVERSITY.
Kjaergaard J, et al. Blood-Pressure Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct.

14


Hemodynamic Targets
C
ORIGINAL ARTICLE
Blood-Pressure Targets in Comatose Survivors of Cardiac Arrest
Probability of Survival Free from a Primary-Outcome Event
Low-target group
High-target group
Probability
Days since Randomization
Death or Severe Disability or Coma within 90 Days (Primary Outcome)
HR, 1.08 (95% CI, 0.84–1.37); P=0.56
Percentage of Patients
34
32
High-Target Group
Low-Target Group
No significant difference
in death or severe disability or coma at 90 days.
SAINT LOUIS UNIVERSITY.
Kjaergaard J, et al. Blood-Pressure Targets in Comatose Survivors of Cardiac Arrest. N Engl J Med. 2022 Oct.

15

Refractory V Fib/V Tach after ACLS?

C

- ✓ACLS
- ✓Magnesium, Amiodarone
- ✓Lidocaine
- ✓Esmolol/Beta-Blockers
- ***…Double Simultaneous/Dual Sequence Defibrillation??***

DOUBLE SIMULTANEOUS DEFIBRILLATORS FOR REFRACTORY VENTRICULAR FIBRILLATION

Benjamin W. Leacock, MD

Emergency Physicians of St. Louis, St. Louis, Missouri

Reprint Address: Benjamin W. Leacock, MD, Emergency Physicians of St. Louis, 10010 Kennerly Rd., St. Louis, MO 63128

J Emerg Med. 2014 Apr

SAINT LOUIS UNIVERSITY.

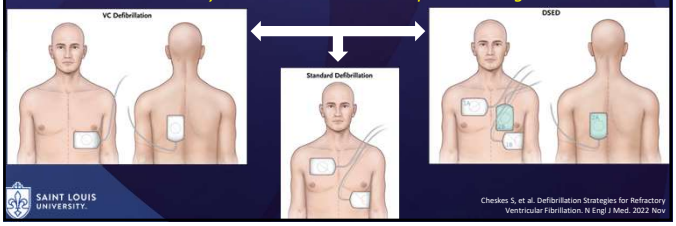
16

The DOSE-VF Trial

Defibrillation Strategies for Refractory Ventricular Fibrillation

C

- 3-group, cluster-randomized, controlled trial with crossover
- 405 adults in OHCA; 6 Canadian paramedic services
- *Primary outcome: Survival to Hospital discharge*



SAINT LOUIS UNIVERSITY.

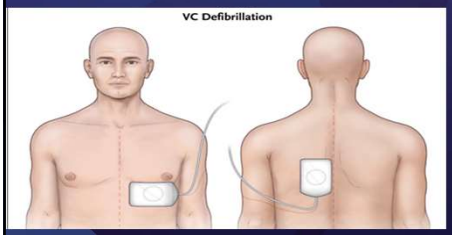
Cheskes S, et al. Defibrillation Strategies for Refractory Ventricular Fibrillation. N Engl J Med. 2022 Nov

17

The DOSE-VF Trial

Defibrillation Strategies for Refractory Ventricular Fibrillation

C



*"…**Survival to hospital discharge occurred more frequently with DSED or VC defibrillation*** than with standard defibrillation."

- Major limitation - Trial Stopped due to COVID-19.

SAINT LOUIS UNIVERSITY.

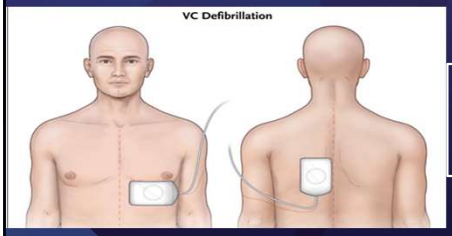
Cheskes S, et al. Defibrillation Strategies for Refractory Ventricular Fibrillation. N Engl J Med. 2022 Nov

18

The DOSE-VF Trial

Defibrillation Strategies for Refractory Ventricular Fibrillation

C



VECTOR CHANGE
Anterior-Posterior > Anterolateral

- Major limitation - Trial Stopped due to COVID-19.

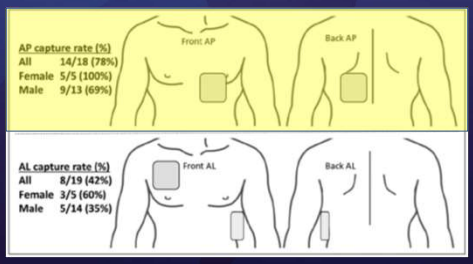
SAINT LOUIS UNIVERSITY.

Cheskes S, et al. Defibrillation Strategies for Refractory Ventricular Fibrillation. N Engl J Med. 2022 Nov

19

Pacer Pad Position

C



Anteroposterior Pacer Pad Position Is More Likely to Capture Than Anterolateral for Transcutaneous Cardiac Pacing

SAINT LOUIS UNIVERSITY.

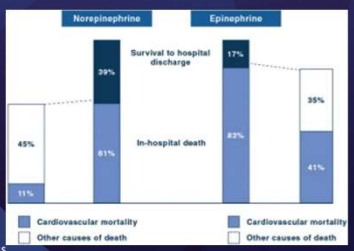
Moayedi S, et al. Circulation. 2022 Oct.

20

Post-Resuscitation Shock

C

What is the best vasoactive agent to institute post-ROSC for shock?

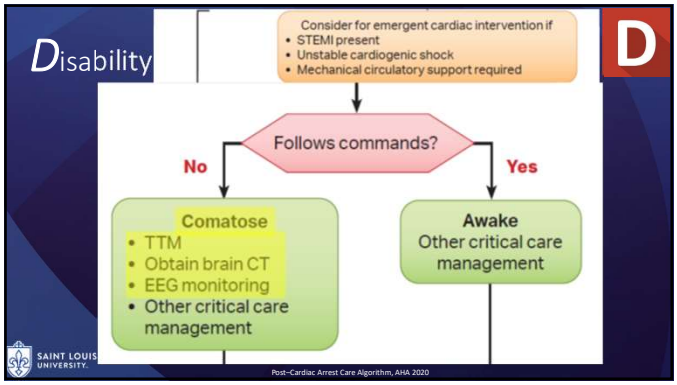


Epinephrine infusion associated with higher mortality (vs. norepinephrine).

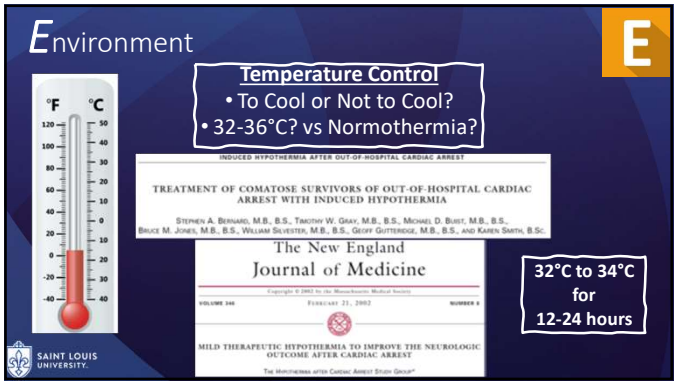
SAINT LOUIS UNIVERSITY.

Bougouin W, et al. Sudden Death Expertise Center Investigators. Epinephrine versus norepinephrine in cardiac arrest patients with post-resuscitation shock. Intensive Care Med. 2022 Mar

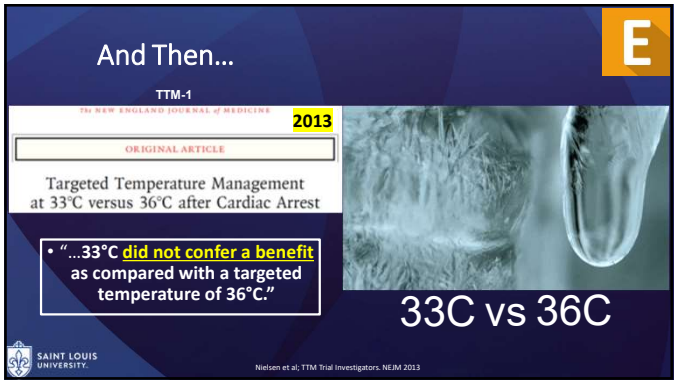
21


Disability
D
Consider for emergent cardiac intervention if
• STEMI present
• Unstable cardiogenic shock
• Mechanical circulatory support required
Follows commands?
No
Yes
Comatose
• TTM
• Obtain brain CT
• EEG monitoring
• Other critical care management
Awake
Other critical care management
SAINT LOUIS UNIVERSITY.
Post–Cardiac Arrest Care Algorithm, AHA 2020

22


Environment
E
Temperature Control
• To Cool or Not to Cool?
• 32-36°C? vs Normothermia?
°F
°C
INDUCED HYPOTHERMIA AFTER OUT-OF-HOSPITAL CARDIAC ARREST
TREATMENT OF COMATOSE SURVIVORS OF OUT-OF-HOSPITAL CARDIAC ARREST WITH INDUCED HYPOTHERMIA
The New England Journal of Medicine
MILD THERAPEUTIC HYPOTHERMIA TO IMPROVE THE NEUROLOGIC OUTCOME AFTER CARDIAC ARREST
32°C to 34°C for 12-24 hours
SAINT LOUIS UNIVERSITY.

23


And Then…
E
TTM-1
2013
ORIGINAL ARTICLE
Targeted Temperature Management at 33°C versus 36°C after Cardiac Arrest
• "…33°C did not confer a benefit as compared with a targeted temperature of 36°C."
33C vs 36C
SAINT LOUIS UNIVERSITY.
Nielsen et al; TTM Trial Investigators. NEJM 2013

24

Targeted Temperature Management… Post TTM-1

HYPERION Trial
October 2019

The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Targeted Temperature Management for Cardiac Arrest with Nonshockable Rhythm

>10% alive with good neuro outcome at 90 days at 33C (vs 5.7% at 37C).

March 2020

Targeted Temperature Management at 33 Versus 36 Degrees: A Retrospective Cohort Study

Trend toward increased survival (and favorable neuro outcomes) with TTM 33C.

SAINT LOUIS UNIVERSITY.

Lascarrou JB, Merdji H, Le Gouge A, et al. Targeted Temperature Management for Cardiac Arrest with Nonshockable Rhythm. *N Engl J Med*. 2019.
Johnson NJ, et al. Targeted Temperature Management at 33 Versus 36 Degrees: A Retrospective Cohort Study. *Crit Care Med*. 2020.

25

Should we cool them after cardiac arrest?

2021

The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Hypothermia versus Normothermia after Out-of-Hospital Cardiac Arrest

TTM-2

- "…targeted hypothermia (33°C) ***did not lead to a lower incidence*** of death by 6 months than targeted normothermia (37.5°C)."

Rebound Hyperthermia

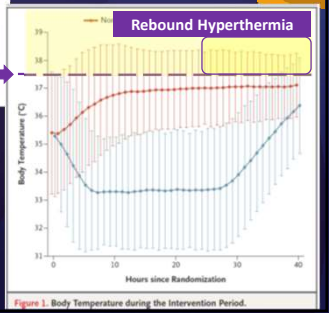


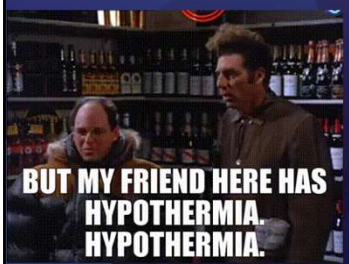
Figure 1. Body Temperature during the Intervention Period.

SAINT LOUIS UNIVERSITY.

Dankiewicz J for the TTM2 Trial Investigators. NEJM June 2021.

26

TTM 36 ≠ Normothermia



ROSC + Comatose

Fever Control for ALL

TTM ≤ 36-37°C

Deeper TTM (33-35°C)

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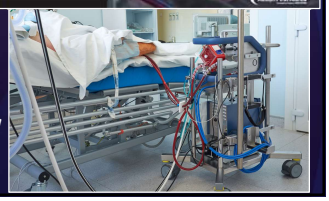
Further Considerations

ECMO for Cardiac Arrest?

CPR
+
ECMO
= E-CPR aka ECLS



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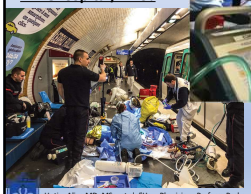
28

Where should ECMO occur?

- OR/Cath Lab
- ICU
- **Emergency Department**
- **…Prehospital/EMS?**



Albuquerque Journal

Hamway, Stephen. "UNM debuts new response to cardiac arrest." Albuquerque Journal. 7 October, 2019.

@ZachShinar. "University of New Mexico has performed the first prehospital ECPR in the US." Twitter. 8 October, 2019, 10:46p.m.

Hutin, Alice MD, MSc, et al. "How Physicians Perform Prehospital ECMO on the Streets of Paris." Journal of Emergency Medical Services (online). December 1, 2017.

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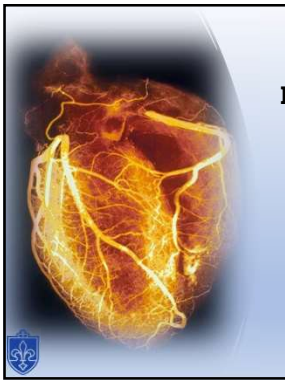
29



Key Scenarios for ED-ECMO

- Hypoxemic Respiratory Failure/COVID-19
- Massive Pulmonary Embolism
- Toxicologic Overdoses
- Severe Cardiogenic Shock
- Cardiac Arrest/ Refractory Ventricular Tachyarrhythmias

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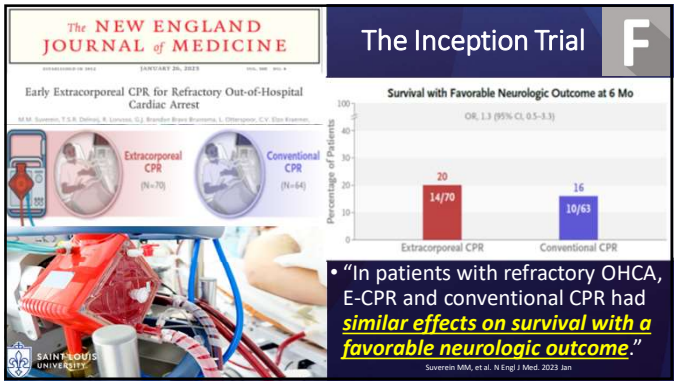
30


The NEW ENGLAND JOURNAL of MEDICINE
Early Extracorporeal CPR for Refractory Out-of-Hospital Cardiac Arrest
Extracorporeal CPR (N=70)
Conventional CPR (N=64)
The Inception Trial
F
Survival with Favorable Neurologic Outcome at 6 Mo
OR, 1.3 (95% CI, 0.5–3.3)
Percentage of Patients
20
14/70
16
10/63
Extracorporeal CPR
Conventional CPR
• "In patients with refractory OHCA, E-CPR and conventional CPR had similar effects on survival with a favorable neurologic outcome."
Suverein MM, et al. N Engl J Med. 2023 Jan
SAINT LOUIS UNIVERSITY

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ECMO IS A BRIDGE
•Bridge to Recovery
•Bridge to Advanced Therapy
•Bridge to Decision
•Bridge to Transplantation
"Indications and Contraindications for ECMO" http://cuecmo.ca/index.htm
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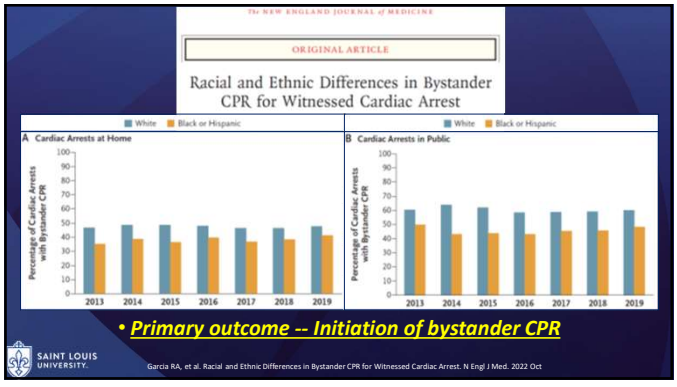
32


The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Racial and Ethnic Differences in Bystander CPR for Witnessed Cardiac Arrest
White
Black or Hispanic
A Cardiac Arrests at Home
B Cardiac Arrests in Public
Percentage of Cardiac Arrests with Bystander CPR
2013
2014
2015
2016
2017
2018
2019
• Primary outcome -- Initiation of bystander CPR
Garcia RA, et al. Racial and Ethnic Differences in Bystander CPR for Witnessed Cardiac Arrest. N Engl J Med. 2022 Oct
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33

SUMMARY

- ***A*** – Video Intubation, No/limit CPR pauses.
- ***B*** – Lung Protective Ventilation is essential!
  - *Goal SpO2 92% - 98% and PaO2 75-100 mmHg*
- ***C*** – Anterior-Posterior Pads = better capture.
  - *– Goal MAP = 65-70 (SBP>90).*
    - *After ROSC > Norepi 1st for shock.*
- ***D*** – Comatose? > CT head +/- EEG > TTM
- ***E*** – Prevent & Control Fevers. ***TTM 36-37***.
  - TTM ≠ Normothermia
- ***F*** – ECMO/ECLS is a Bridge…

Adult OHCA Chain of Survival

Good CPR is most important.

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34

References

Airway

- Robinson AE, Driver BE, Prekker ME, Reardon RF, Horton G, Stang JL, Collins JD, Carlson JN. First attempt success with continued versus paused chest compressions during cardiac arrest in the emergency department. Resuscitation. 2023 Feb 9:109726. doi: 10.1016/j.resuscitation.2023.109726. Epub ahead of print. PMID: 36764570. https://pubmed.ncbi.nlm.nih.gov/36764570/

Double Sequential External Defibrillation

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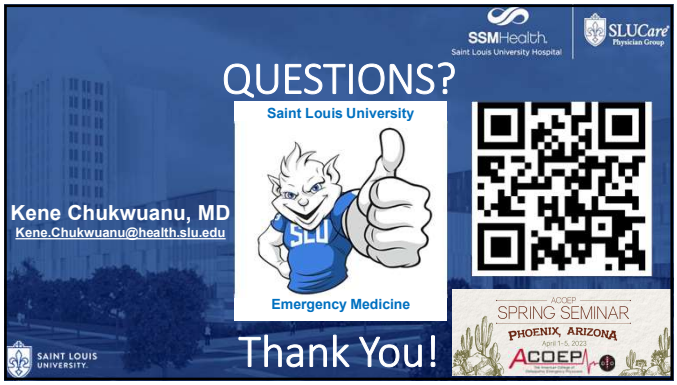
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