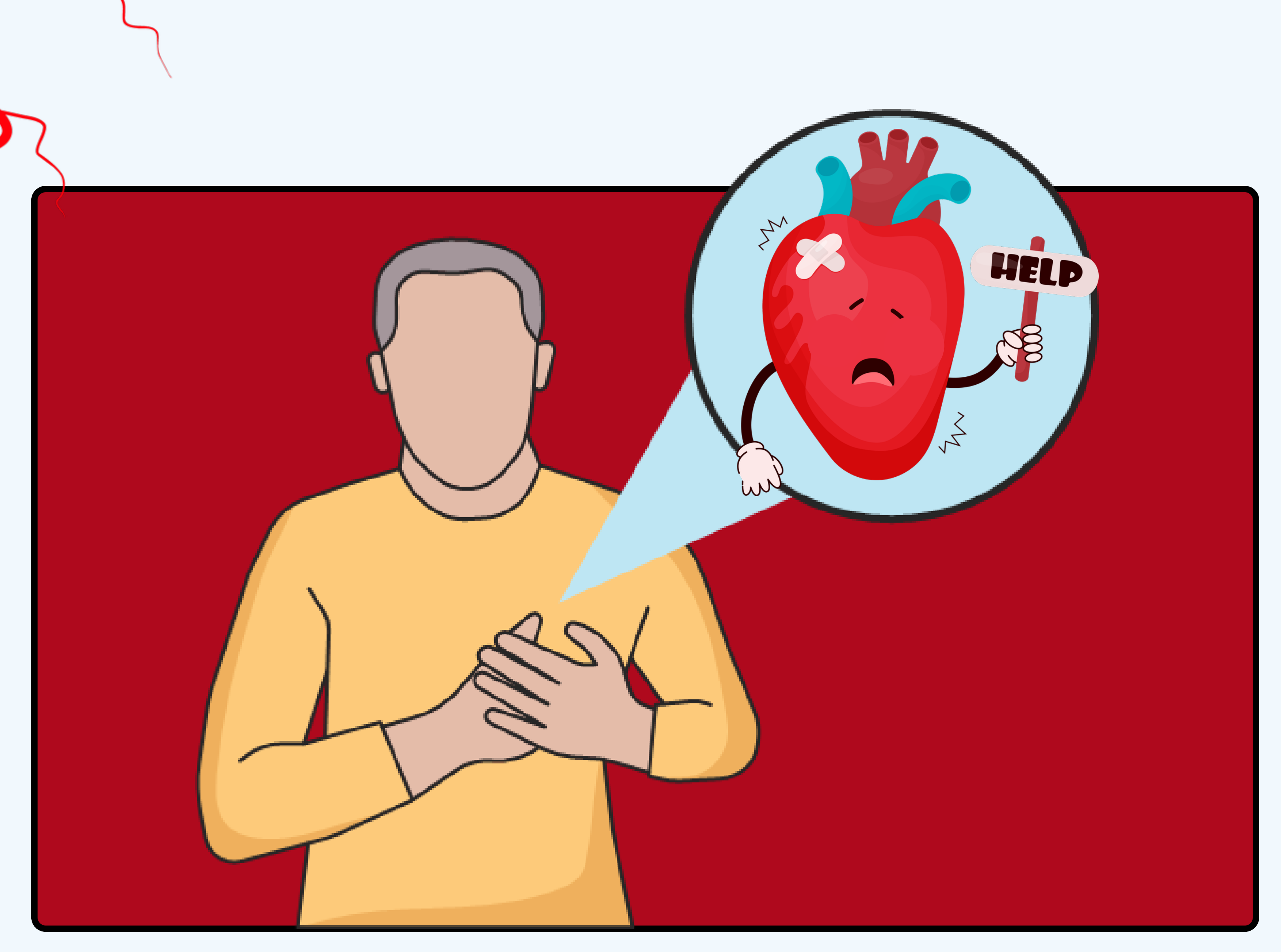


Frozen but Not Finished:

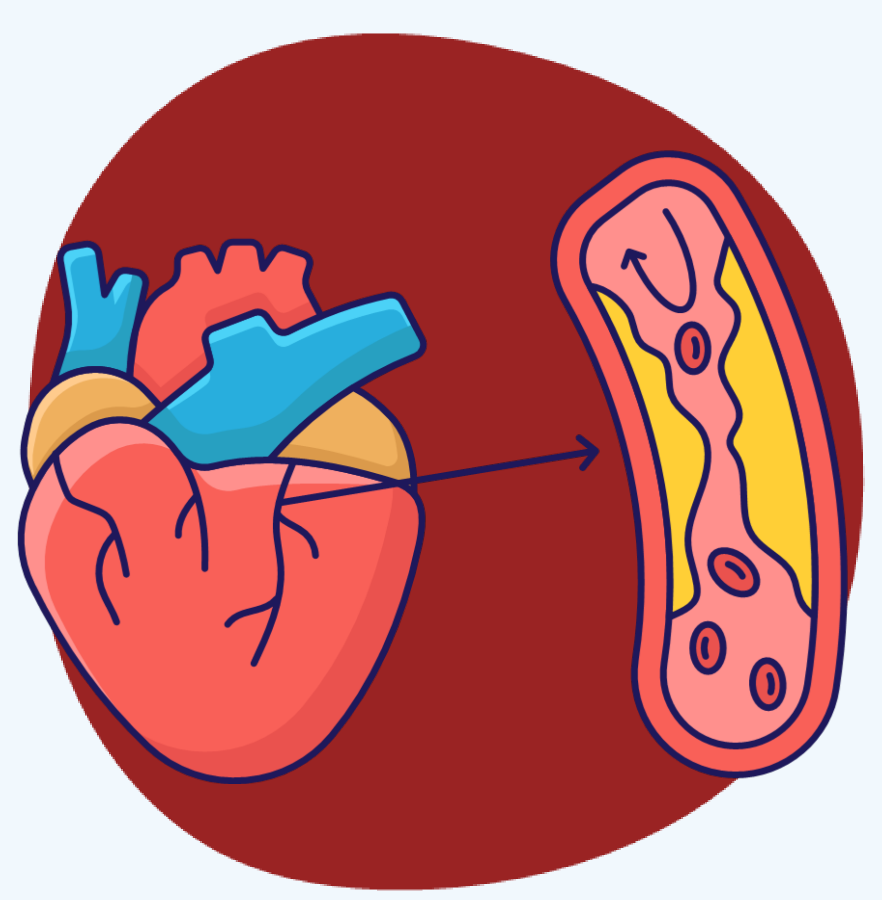
The Approach To Hypothermic Cardiac Arrest Resuscitation in the ED

Taylor Harrell, MD
Emergency Medicine PGY-3
Washington University in St. Louis

I have no disclosures.

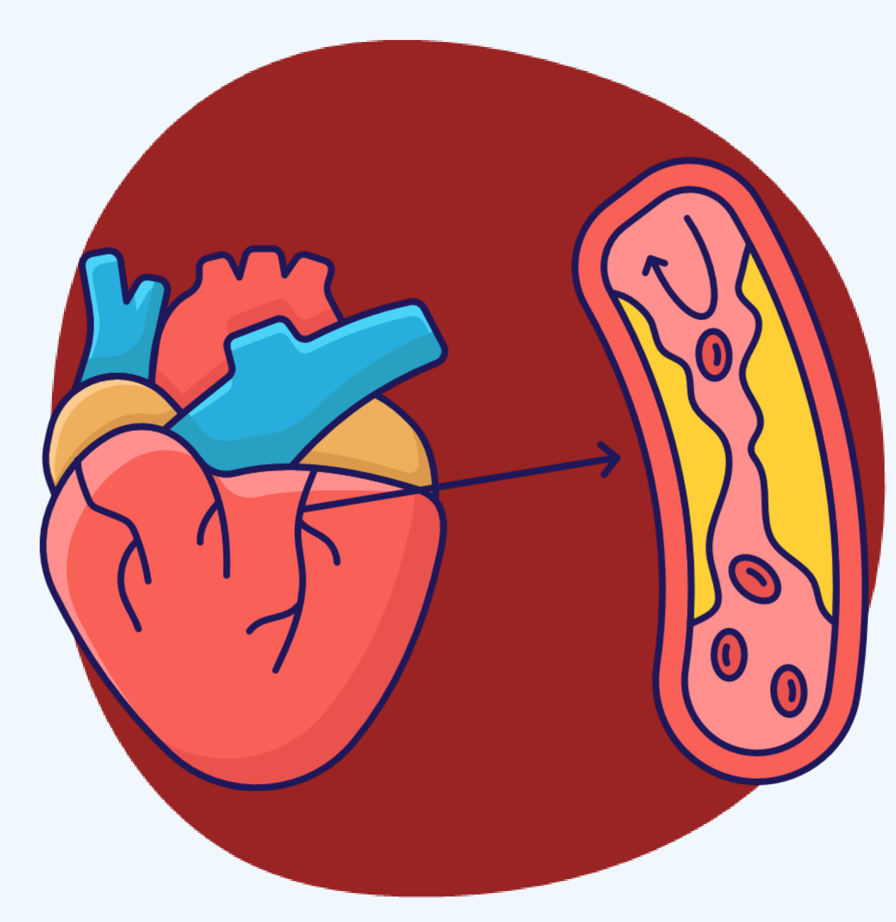
Objectives

Objectives



Hypothermic Arrest Overview

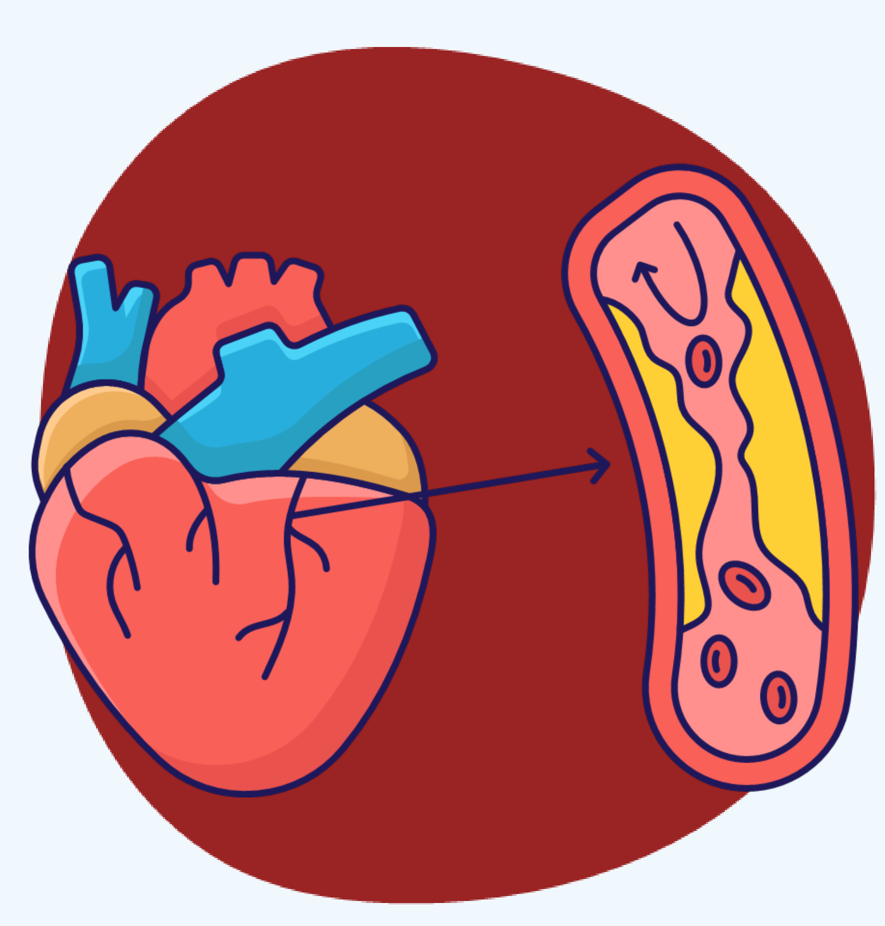
Objectives



Hypothermic Arrest Overview

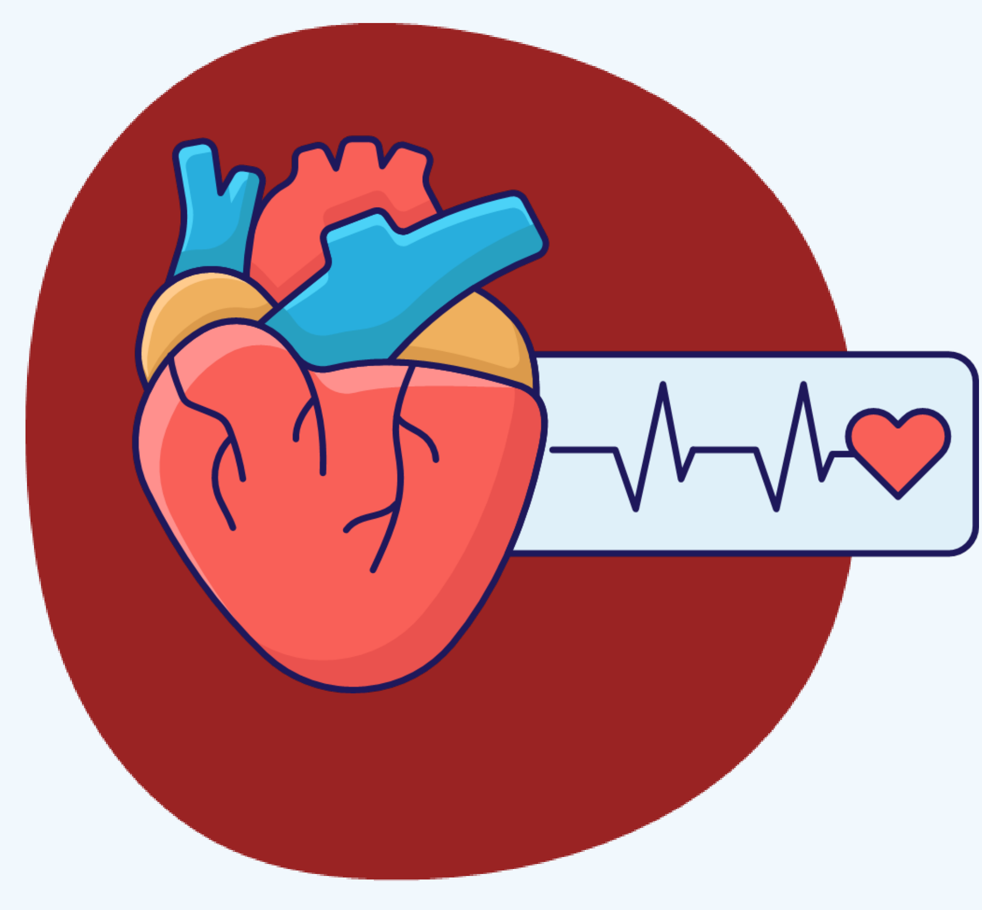
ACLS Modifications

Objectives



Hypothermic Arrest Overview

ACLS Modifications



Re-Warming Strategies

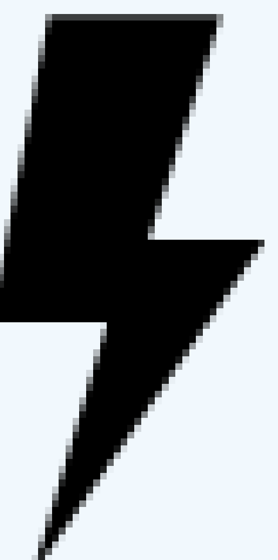
NEWS
CITY OF ST. LOUIS OPENING ADDITIONAL EMERGENCY WARMING CENTERS
CHEROKEE RECREATION CENTER
3200 S Jefferson Ave #3102, St. Louis, MO 63118 Open 10am - 5pm
ST. LOUIS CITY OFFICE BUILDING
1520 Market St, St. Louis, MO 63103 Open 9am - 5pm
GAMBLE RECREATION CENTER
2907 Gamble St, St. Louis, MO 63106
Open 7am - 5pm

Example Case

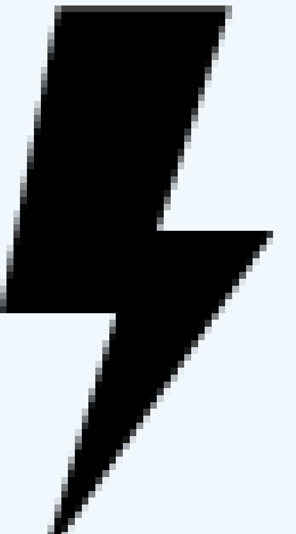
Example Case

Example Case

Example Case



Example Case



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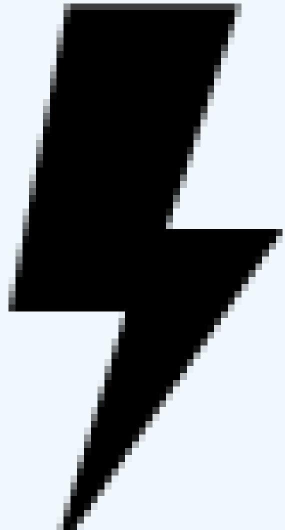

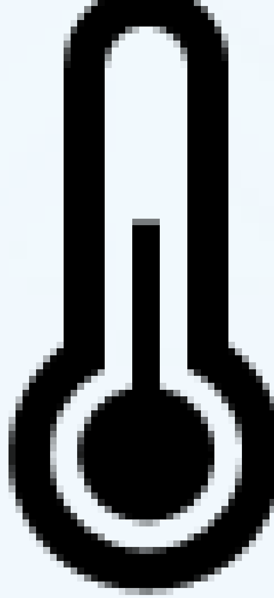

Example Case

How do we define hypothermia?

How do we define hypothermia?

staging, physiology, and typical therapies of hypothermia

Severity	Neurologic	Cardiac	Pulmonary	Renal	Typical therapy[&]
Mild (HT1)* 32-35C 90-95F	Alert, shivering* Ataxia Impaired judgement	Tachycardia Hypertension	Tachypnea Bronchorrhea	Cold diuresis	- Exposure-related: Passive external rewarming (e.g. blankets) - Spontaneous: Warming blanket
Moderate (HT2)* 28-32C 82-90F	Drowsy, non-shivering* Delirium Paradoxical undressing Dilated pupils	Bradycardia Hypotension Atrial fibrillation	Hypoventilation	Cold diuresis	Active external rewarming - Warming blanket - Warmed/humidified air (If possible, fluid being administered should be warmed)
Severe (HT3)* 24-28C 75-82F	Unconscious with pulse* Coma Fixed dilated pupils Areflexia	Heart block Cardiogenic shock	Pulmonary edema Agonal respirations	Oliguria	- Active external rewarming (see above). - If refractory shock or hypothermia, also consider active internal warming (e.g. thoracic/bladder lavage).
Pulseless (HT4)* <24C <75F	Appears dead	Pulseless* - Ventricular arrhythmia - Asystole	Apnea		Active external rewarming plus Active internal rewarming - Ideally: ECMO or cardiopulmonary bypass - Alternative: thoracic lavage

Staging and treatment of hypothermia. The provided temperature ranges generally correlate with clinical findings, but this correlation isn't perfect. When classifying the severity of hypothermia, both the temperature and clinical manifestations should be considered.

- * Key clinical features which may be used to stage patients in the field (if immediate temperature measurement isn't available).
- * Swiss Staging system for hypothermia.
- & Therapy depends on clinical details, response to prior treatments, available resources, and risk/benefit calculus for each intervention. Listed treatments in this column are merely provided to give a general concept of how these patients might often be managed.

-The Internet Book of Critical Care, by @PulmCrit

How do we define hypothermia?

staging, physiology, and typical therapies of hypothermia

Severity	Neurologic	Cardiac	Pulmonary	Renal	Typical therapy[&]
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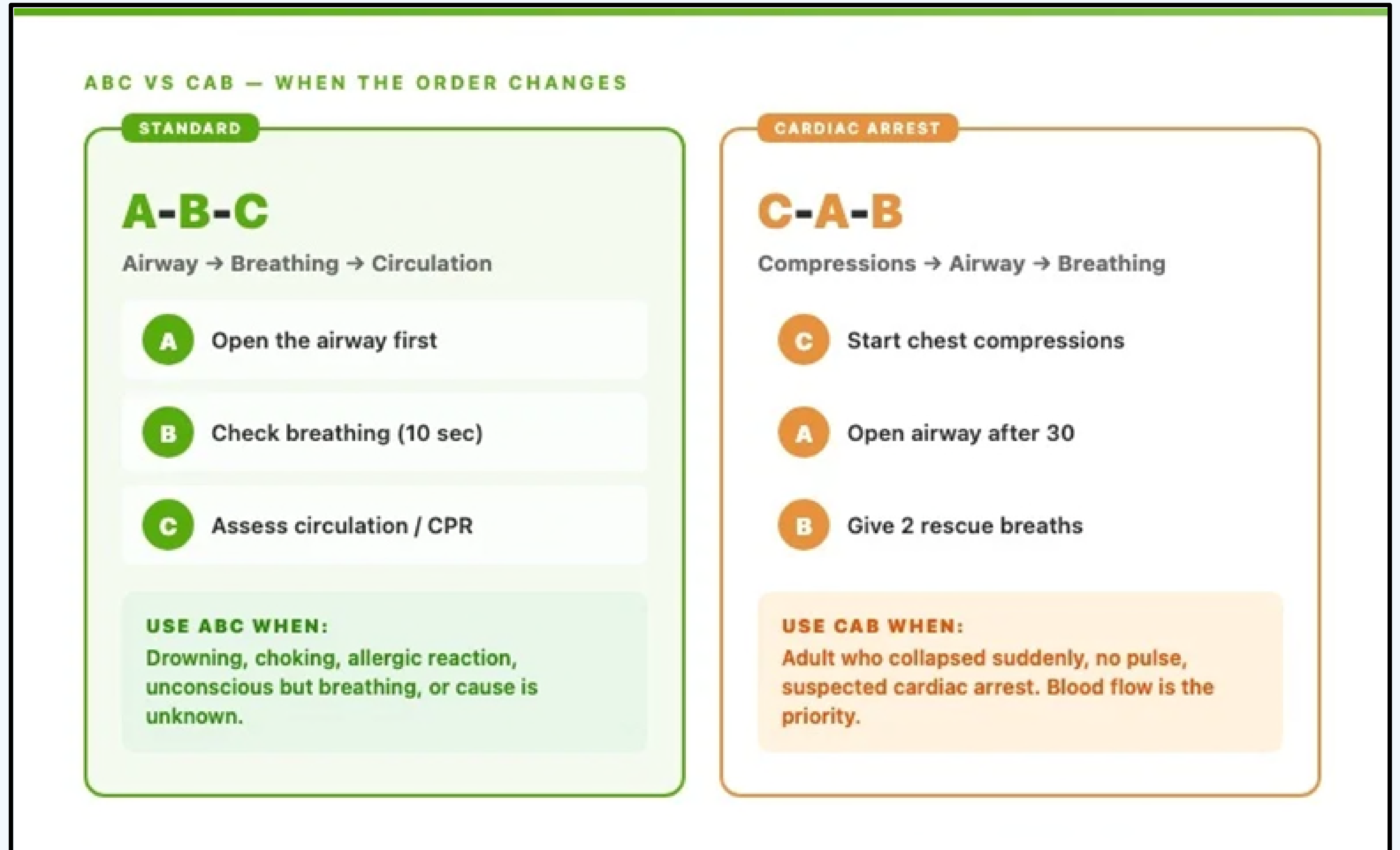
Initial ED Approach



Initial ED Approach

ABC VS CAB — WHEN THE ORDER CHANGES

STANDARD

A-B-C

Airway → Breathing → Circulation

- **A** Open the airway first
- **B** Check breathing (10 sec)
- **C** Assess circulation / CPR

USE ABC WHEN:
Drowning, choking, allergic reaction, unconscious but breathing, or cause is unknown.

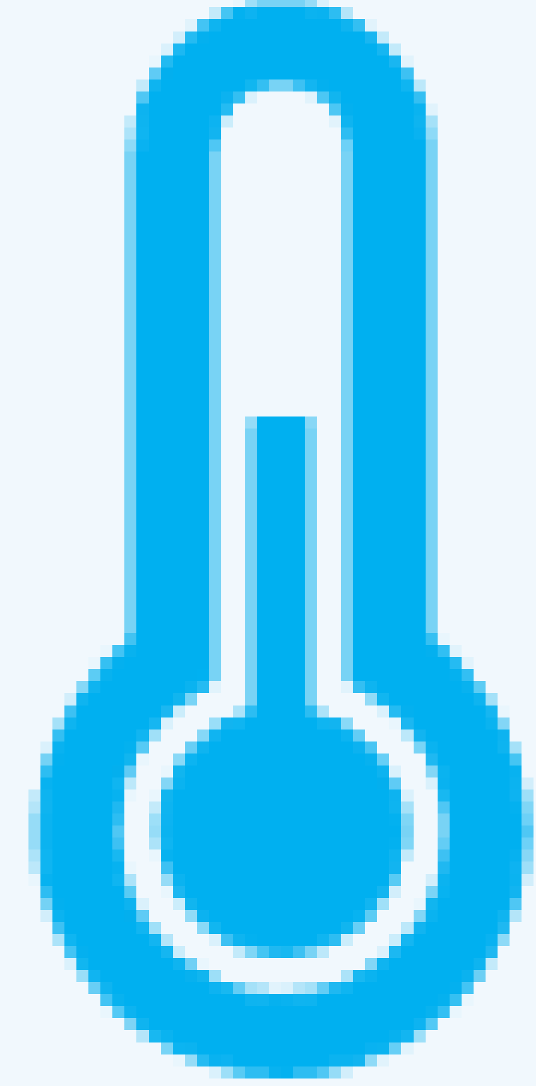
CARDIAC ARREST

C-A-B

Compressions → Airway → Breathing

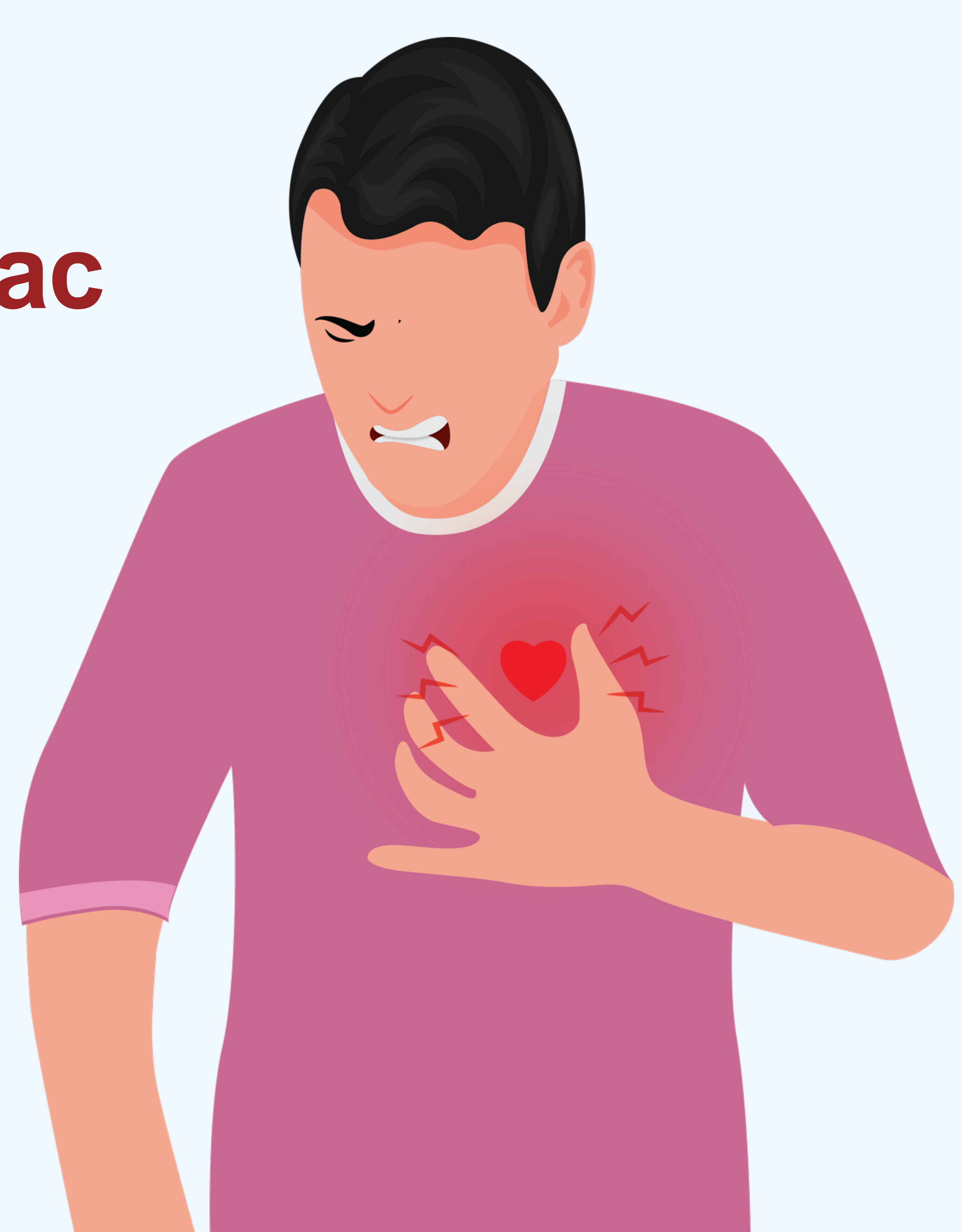
- **C** Start chest compressions
- **A** Open airway after 30
- **B** Give 2 rescue breaths

USE CAB WHEN:
Adult who collapsed suddenly, no pulse, suspected cardiac arrest. Blood flow is the priority.



Recognition of hypothermic cardiac arrest can save a patient’s life.

Check a core temp!



ACLS Modifications in Hypothermia

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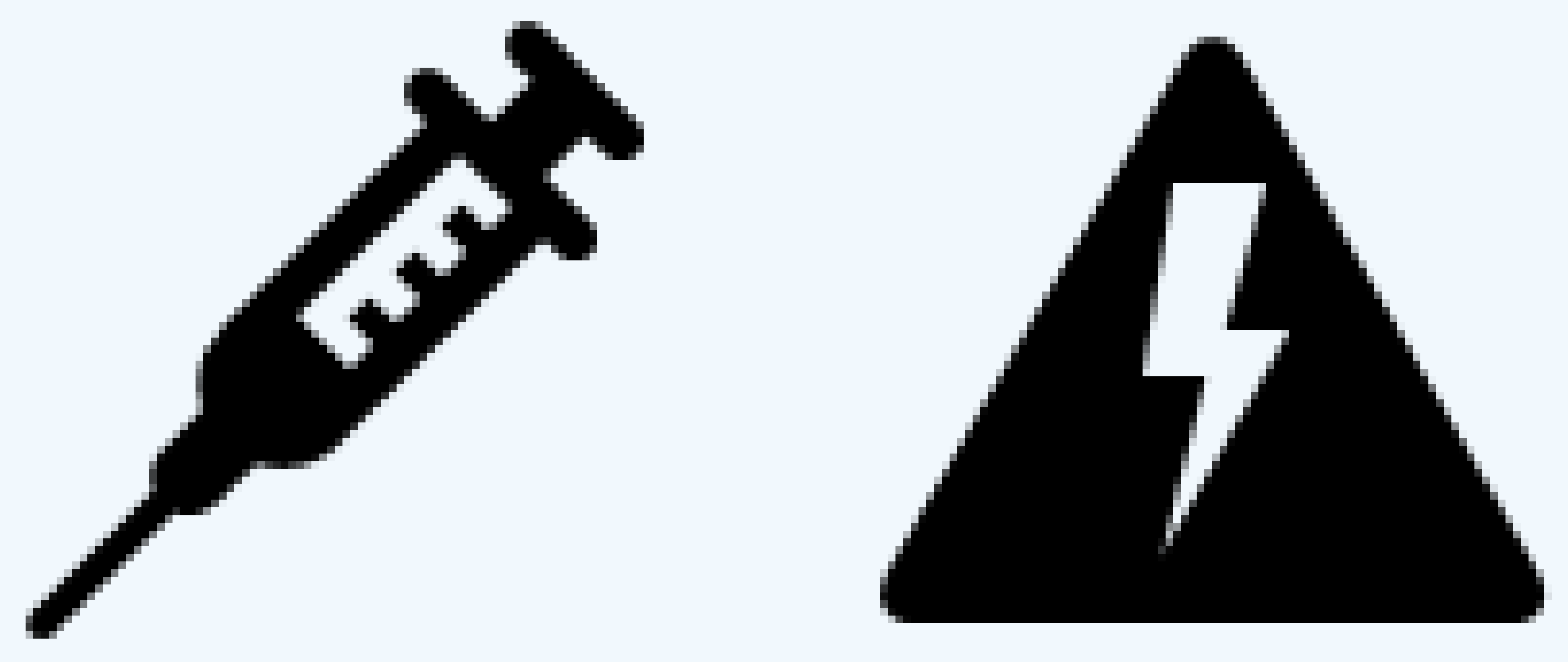
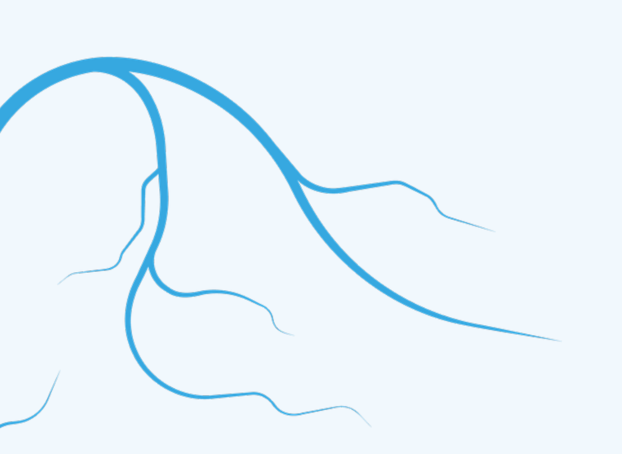
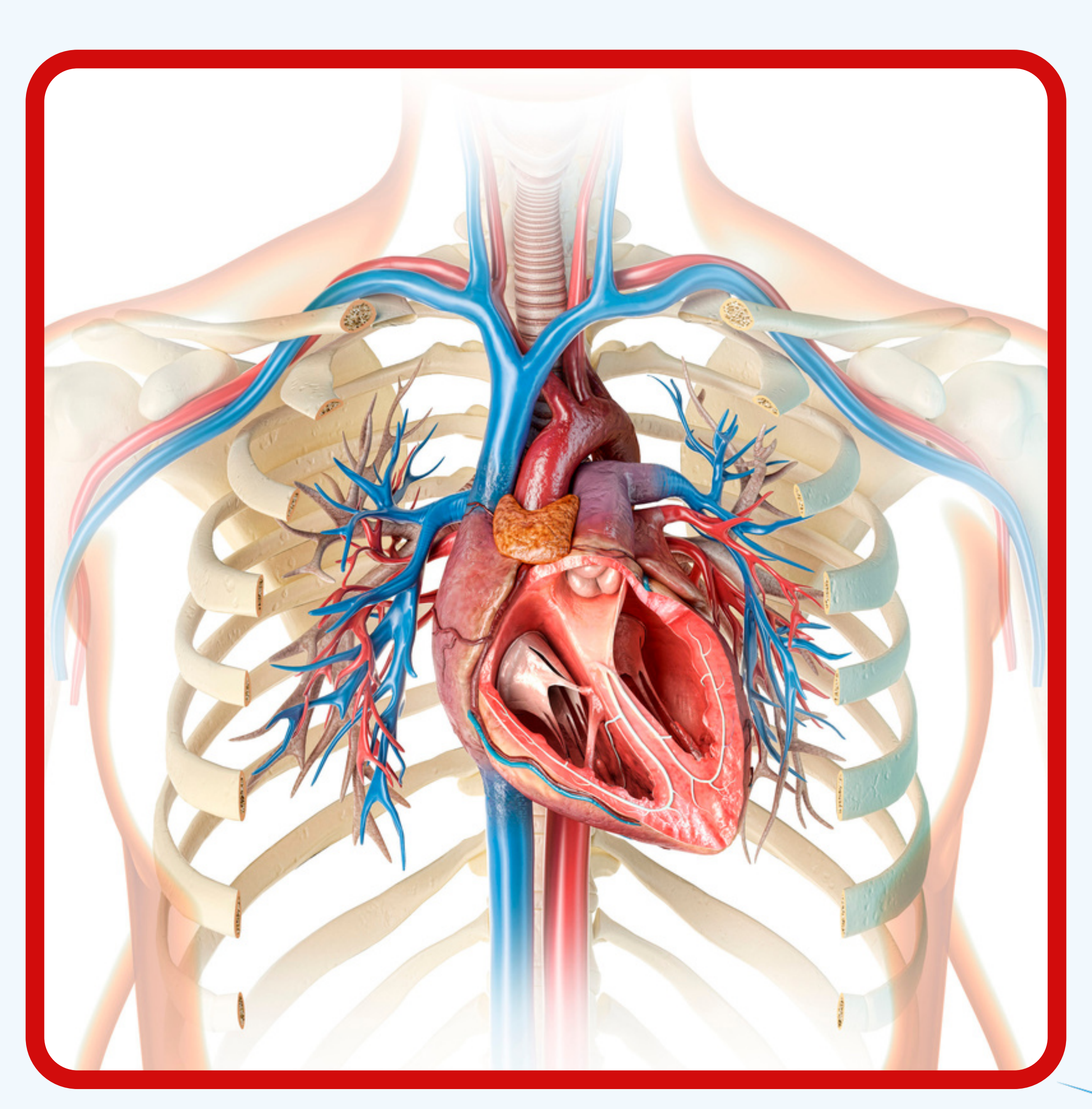


ACLS Modifications in Hypothermia



Rewarming Strategies

- Passive external
- Active external
- Active internal
- Extracorporeal rewarming



Rewarming Strategies

Technique	Rewarming rate (C/hr)	Indication
Warm environment, movement	2	HT I
Active external/minimally invasive (bair hugger, fluids)	0.1-3.4	HT II or HT III stable
PD	1-30	uncertain
HD	2-4	uncertain
Thoracic lavage	3	HT IV unstable if no ECMO
VV ECMO	4	uncertain
VA ECMO	6	HT III unstable or HT IV
CPB	9	As above if no ECMO

Table 3 Comment: studied in avalanche victims, rewarming rates can vary significantly in underlying illness (sepsis etc.), see discussion of rewarming in urban patient population (Brown 2012, PMID: 23150960)

Rewarming Strategies

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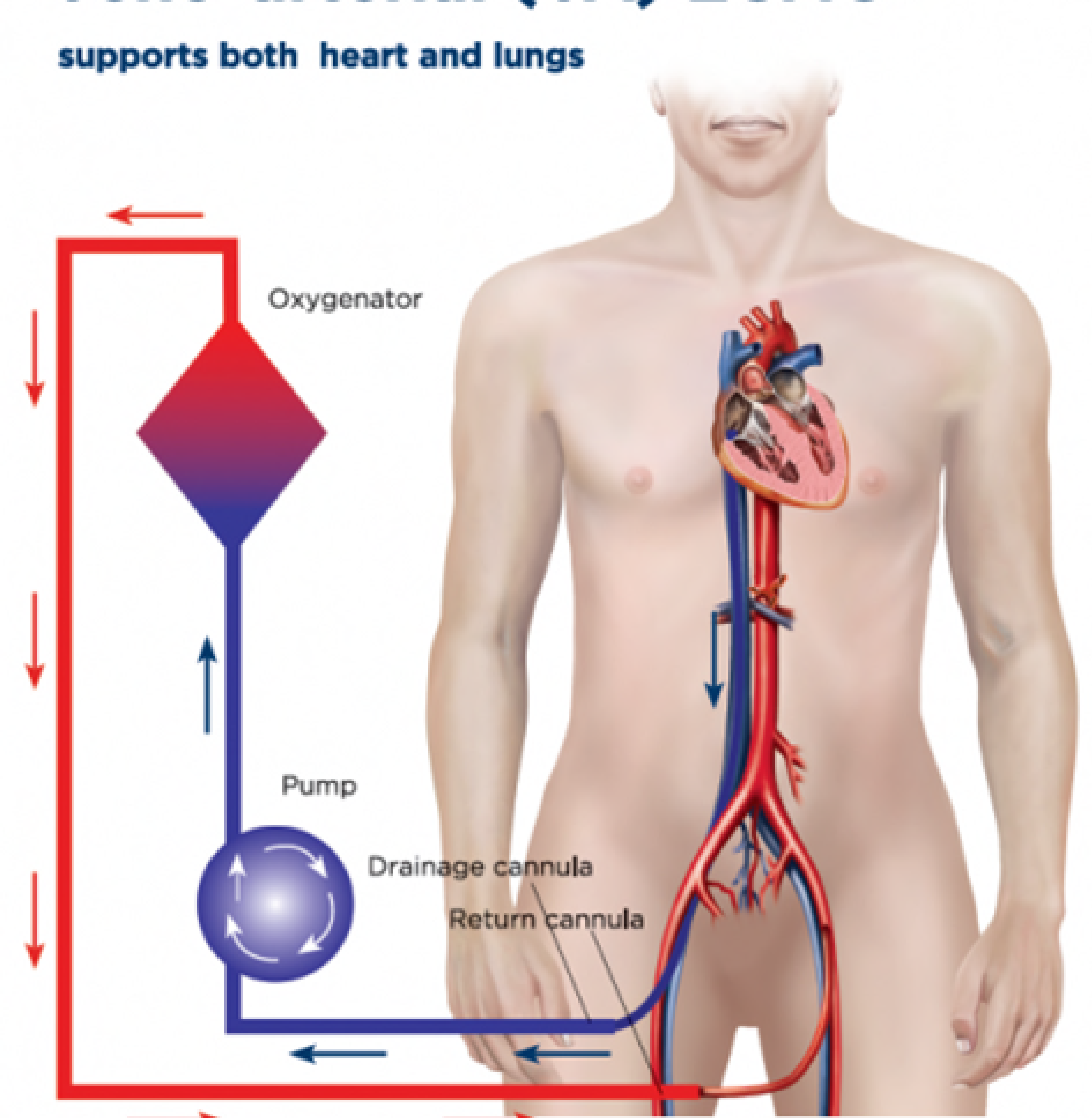
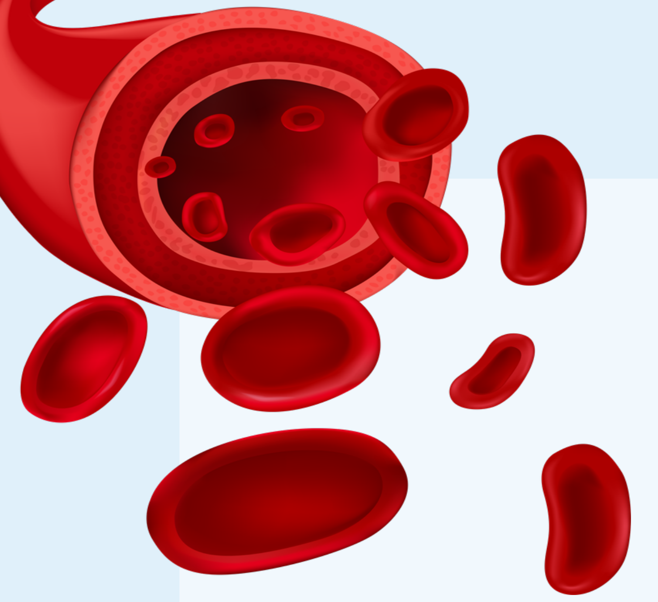
Veno-arterial (VA) ECMO

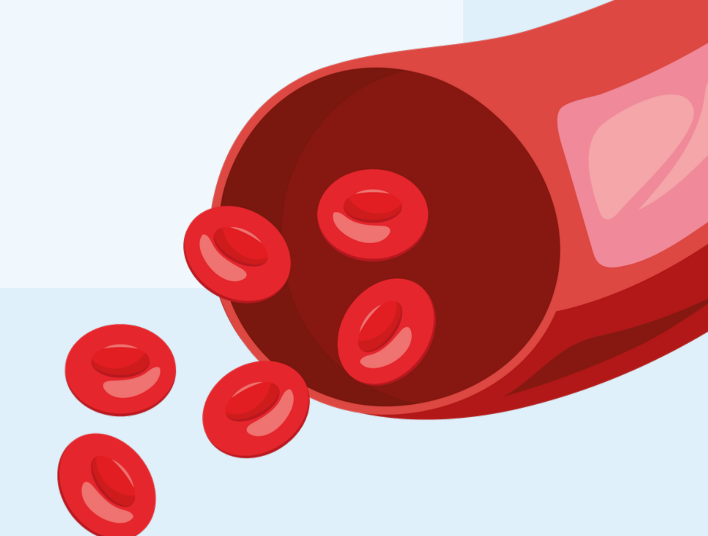
supports both heart and lungs





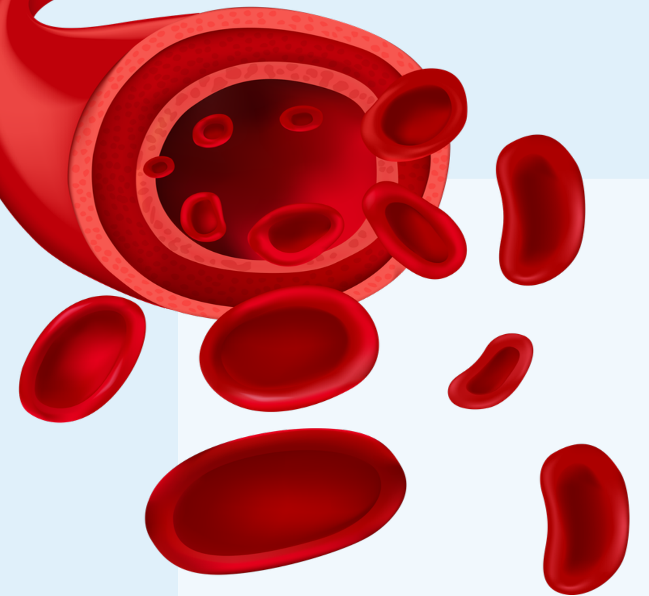
ECMO: When Should You Call?

If you have a suspicion that the cardiac arrest is secondary to hypothermia and the potassium is less than 12, activate ECMO.



The HOPE Score

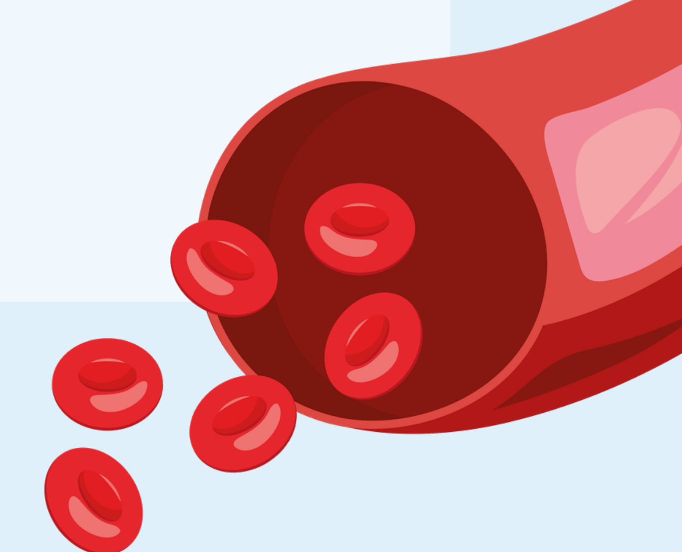
Sex	Female / Male
Hypothermia with asphyxia	No / Yes
Age, years	years
Potassium	Norm: 3.5 - 5.2 mEq/L
CPR duration, min	min
Temperature	Norm: 97 - 100 F



ECMO: When Is The Answer No?

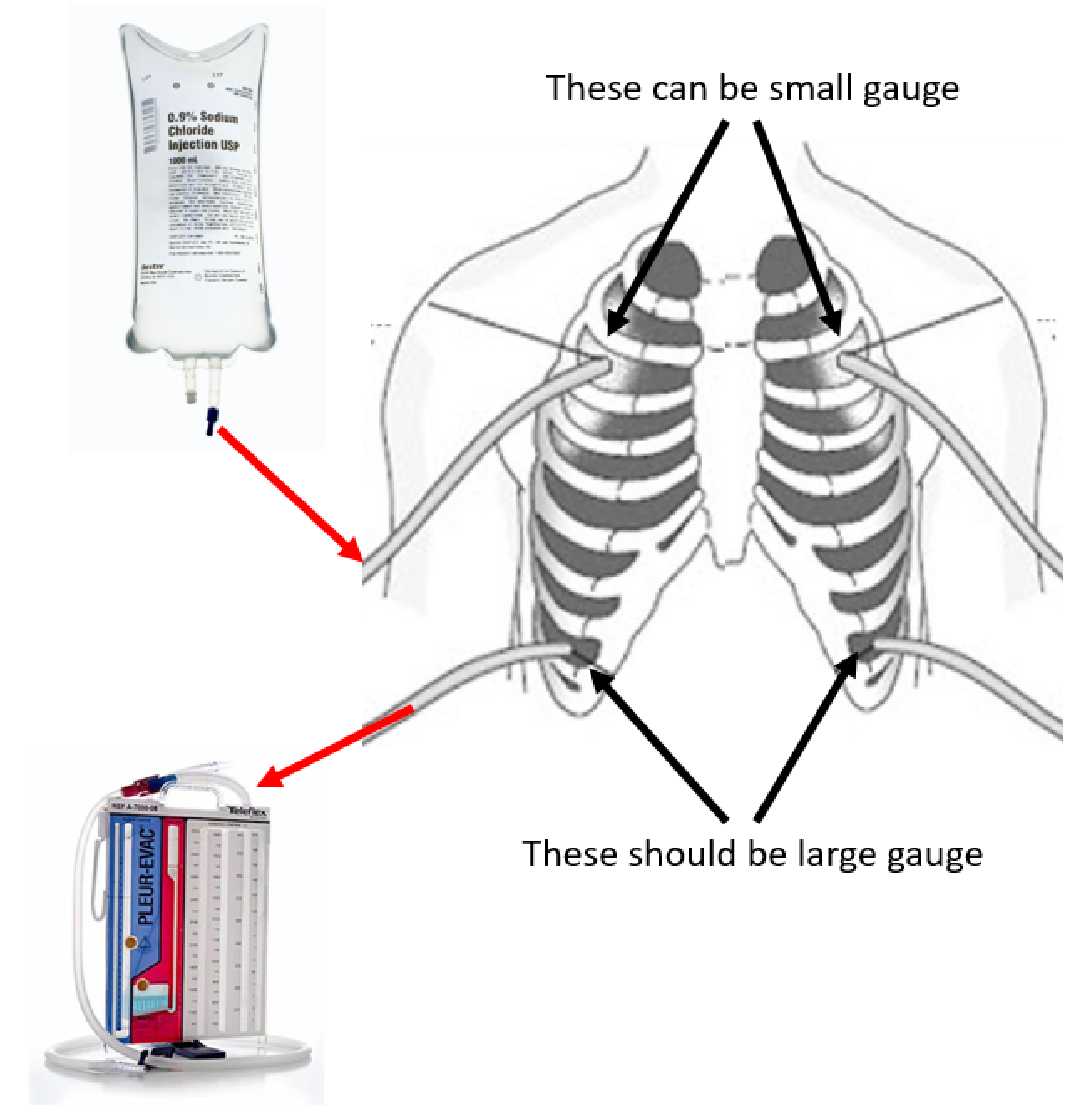
CONTRAINDICATIONS to rewarming via ECLS

Core temp > 30 degrees Celsius
Major trauma (**TBI is not a contraindication**)
Futile comorbidities
Chest compressions impossible due to tissue freezing
HOPE score </= 10

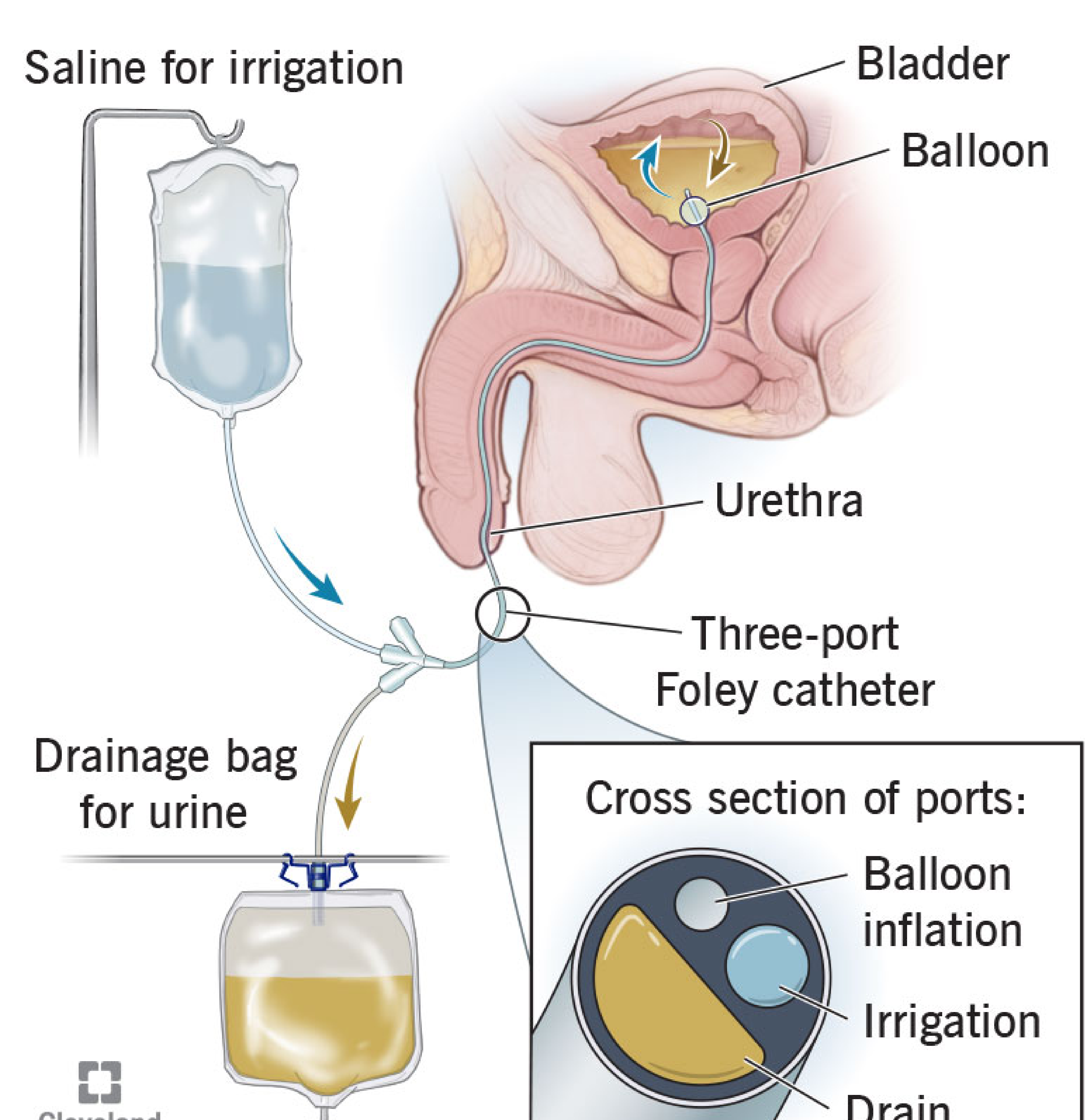


What’s Next If ECMO Says No?

Thoracic Lavage



Bladder Lavage



Warmed Fluids Through Central Access

Take-Home Points

- Hypothermic arrests have a fairly good prognosis compared to other types of cardiac arrest
- Recognize hypothermic arrest early, and have a low threshold to activate your ECMO team
- Multiple adjunct procedures are able to be performed for re-warming if ECMO is not available

Sources

Ahsan, S. (n.d.). Hypothermia. Core EM. https://coreem.net/core/hypothermia/

Duong, H., & Patel, G. (2024, January 19). Hypothermia. StatPearls - NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK545239/

Mazur P, Kosiński S, Podsiadło P, et al. Extracorporeal membrane oxygenation for accidental deep hypothermia-current challenges and future perspectives. Ann Cardiothorac Surg. 2019;8(1):137-142. doi:10.21037/acs.2018.10.12

Paal P, Pasquier M, Darocha T, et al. Accidental Hypothermia: 2021 Update. *Int J Environ Res Public Health*. 2022;19(1):501. Published 2022 Jan 3. doi:10.3390/ijerph19010501

Podsiadło P, Mendrala K, Hymczak H, et al. Hypothermic cardiac arrest: prognostic factors for successful resuscitation before rewarming. *Scand J Trauma Resusc Emerg Med*. 2024;32(1):114. Published 2024 Nov 14. doi:10.1186/s13049-024-01288-w

THE SILENT WOUND

PTSD in Emergency Medicine

Abra Miller, MD
St. Louis University Hospital

MOCEP 2026

WHY THIS MATTERS TO ME

A patient I was caring for took their own life in our Emergency Department.

In the aftermath, some providers in our department, including myself, developed PTSD.

I am a resident. I work alongside you. And I am far from alone.

We are trained to absorb trauma on behalf of our patients. Nobody trains us to process it — and the culture we work in can make asking for help feel like weakness.

This talk is for us.

WHY WE ARE AT PARTICULAR RISK

It's not just what we see — it's the conditions under which we see it, over and over again.

01 Inescapable, cumulative exposure

Unlike first responders who may leave a scene, ED physicians remain embedded in the environment. Traumatic events are not isolated — they stack across every shift, every year of training.

02 Zero processing time

A pediatric code ends. The next patient is in the next bay. There is no structured debrief, no transition, no moment to metabolize what just happened before the next patient arrives.

03 A culture that punishes vulnerability

Medicine selects for people who push through. Disclosing distress risks being seen as weak, unreliable, or unfit. The hidden curriculum: absorb it and move on.

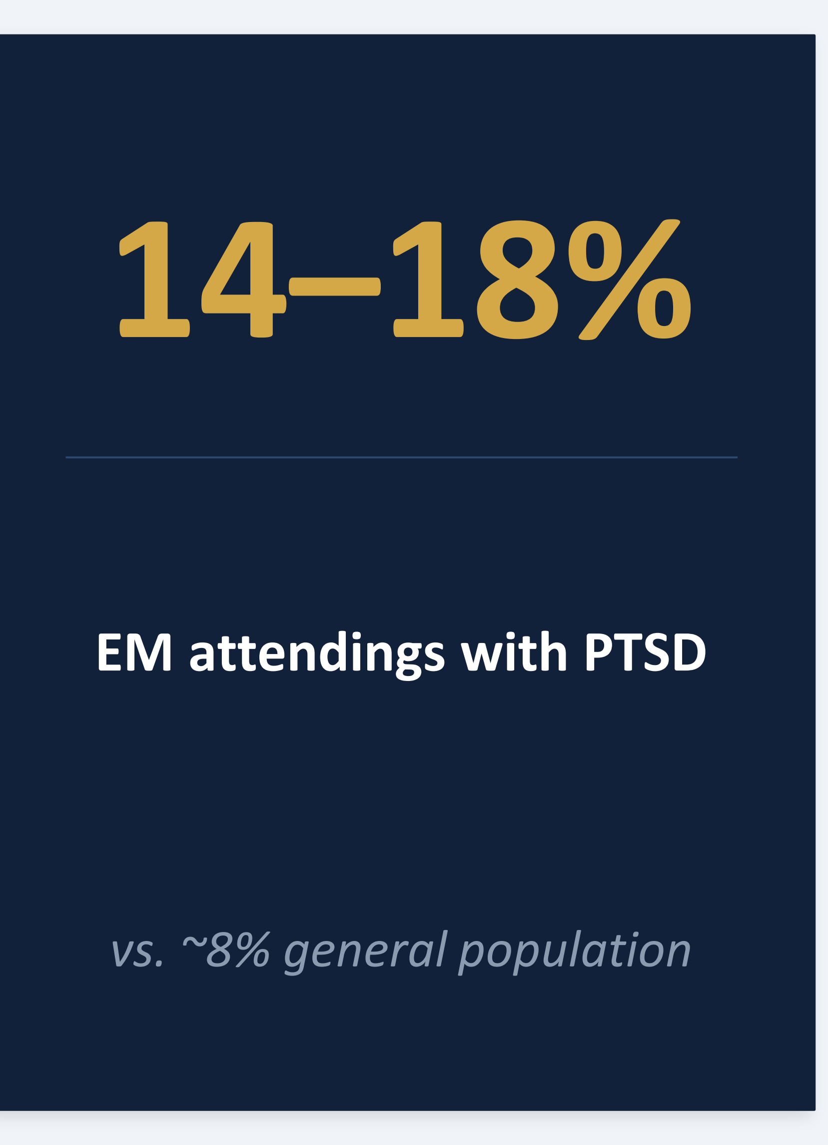
04 Resident-specific compounders

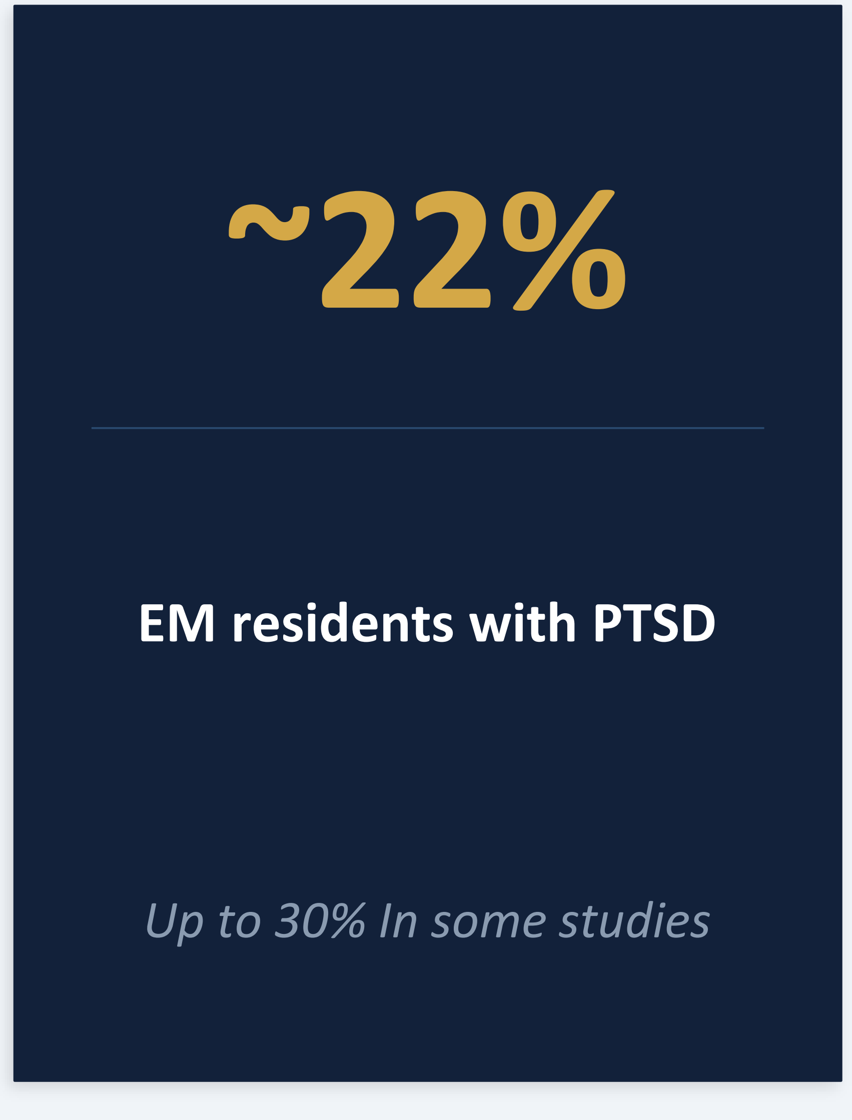
Sleep deprivation, loss of autonomy, hierarchical power dynamics, and identity formation mid-trauma. Emergency residents are building who they are as physicians while simultaneously being traumatized by the work.

Sources: Benedek et al. 2007; West et al. 2018; ACGME Resident Survey Data

THE PROBLEM

Emergency medicine places physicians among the highest-risk occupations for trauma exposure.





Sources: Petrie et al. 2018; Erdur et al. 2006; ACEP Wellness Survey 2022

WHAT IT LOOKS LIKE IN US

DSM-5 requires Criterion A exposure plus symptoms across four clusters. May of us check every box.

Re-experiencing

DSM: Intrusions, flashbacks, nightmares

In us: Triggered mid-shift by a presentation. A trauma bay that looks the same. A sound.

B

Avoidance

DSM: Avoiding trauma-related thoughts, people, or situations

In us: Dreading certain case types. Emotional shutdown during resuscitations.

C

Negative Cognition

DSM: Distorted blame, persistent negative emotions, detachment

In us: "I should have caught it." Cynicism. Depersonalizing patients. Guilt.

D

Hyperarousal

DSM: Hypervigilance, sleep disruption, irritability, concentration deficits

In us: Looks like being thorough. Feels like never being able to turn it off.

Source: DSM-5, APA 2013

BARRIERS & WHAT ACTUALLY HELPS

WHY WE DON'T GET HELP
— Fear of licensing or credentialing consequences
— "I can handle this" — physician identity
— Stigma from peers and within ourselves
— No time — especially in training
— Mandatory reporting concerns

WHAT ACTUALLY WORKS	
CPT:	Cognitive Processing Therapy — first-line
EMDR:	Eye Movement Desensitization & Reprocessing
Prolonged Exposure:	Structured, evidence-based
SSRIs / SNRIs:	Sertraline, venlafaxine — FDA-approved for PTSD
Peer support:	Structured programs — more effective than EAP alone

Physician Support Line | 1-888-409-0141 | free, anonymous, no documentation

TREATMENT IN DEPTH

PSYCHOTHERAPY

Cognitive Processing Therapy (CPT)

12 structured sessions. Targets distorted beliefs about the trauma — guilt, self-blame, "I should have saved them." Strong evidence in first responders and military populations.

Prolonged Exposure (PE)

Gradual, controlled re-engagement with trauma memories and avoided situations. Reduces avoidance behaviors that keep PTSD entrenched. 8–15 sessions.

EMDR

Eye Movement Desensitization & Reprocessing. Bilateral stimulation while processing trauma memory. Comparable efficacy to CPT/PE with potentially fewer sessions. Well-suited for single-incident trauma.

PHARMACOLOGY

Sertraline:	FDA-approved for PTSD. First-line SSRI. Start low, titrate over 4–6 weeks.
Paroxetine:	FDA-approved. Second SSRI option. Consider side effect profile.
Venlafaxine:	SNRI. Strong evidence, often preferred for comorbid depression.
Prazosin:	Alpha-1 blocker. Specifically targets trauma nightmares and sleep disruption — highly relevant for us.

FOR US SPECIFICALLY

Seek providers with experience treating physicians. Ask about confidentiality structures. The Physician Support Line (1-888-409-0141) can help with referrals.

Sources: VA/DoD Clinical Practice Guideline for PTSD 2023; Foa et al. 2007; Shapiro 2018; APA Practice Guideline 2017

Thank you

Questions?

Abra Miller, MD
St. Louis University Hospital
MOCEP 2026

REFERENCES

1. American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). APA Publishing.
2. American Psychiatric Association. (2017). Clinical Practice Guideline for the Treatment of PTSD. APA.
3. VA/DoD Clinical Practice Guideline for the Management of Posttraumatic Stress Disorder and Acute Stress Reaction. Version 4.0. 2023.
4. Petrie K, Crawford J, Baker STE, et al. Interventions to reduce symptoms of common mental disorders and suicidal ideation in physicians. Lancet Psychiatry. 2019;6(3):225-234.
5. Erdur B, Ergin A, Turkcuer I, et al. A study of depression and anxiety among doctors working in emergency units in Denizli, Turkey. Emerg Med J. 2006;23(10):759-763.
6. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: contributors, consequences and solutions. J Intern Med. 2018;283(6):516-529.
7. Benedek DM, Fullerton C, Ursano RJ. First responders: mental health consequences of natural and human-made disasters. Annu Rev Public Health. 2007;28:55-68.
8. American College of Emergency Physicians (ACEP). Emergency Physician Wellness Survey. 2022.
9. Foa EB, Hembree EA, Rothbaum BO. Prolonged Exposure Therapy for PTSD. Oxford University Press; 2007.
10. Shapiro F. Eye Movement Desensitization and Reprocessing (EMDR) Therapy (3rd ed.). Guilford Press; 2018.
11. Physician Support Line. Free, confidential peer support for physicians and residents. www.physiciansupportline.com. 1-888-409-0141.

Heads-Up-CPR:

A review of the physiology and current data

AARON GRAVES DO, MS

EMERGENCY MEDICINE PGY1 – UMKC

Agenda

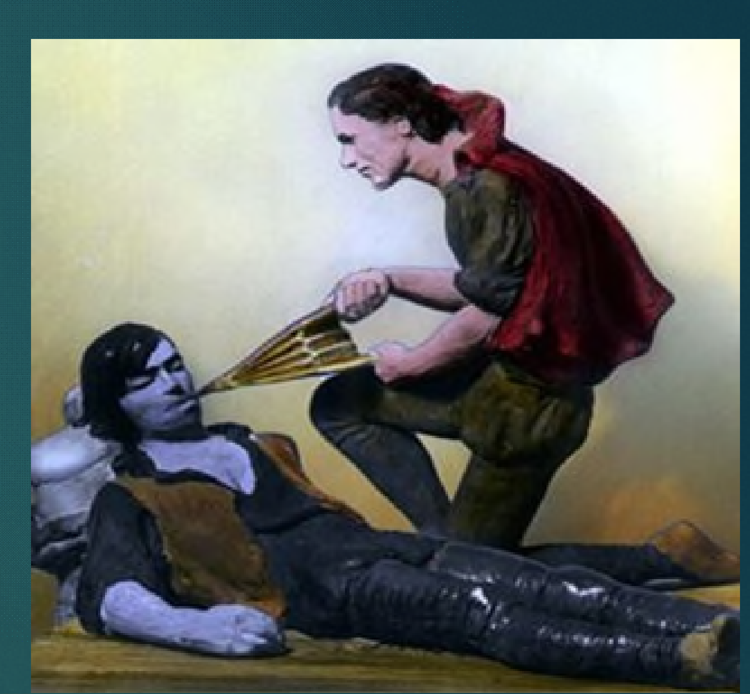
- Background/Physiology behind Heads-Up-CPR (HUP)
- Review of major evidence to date
- Current Practices/Recommendations
- Future Directions
- Questions

Cardiac Arrest and Why HUP Matters

- OHCA: Appx. 350,000 non-traumatic OHCA/year
  - Despite advances, improved outcomes largely been determined by early high-quality CPR and early defibrillation.
- Survival Rates, bumped slightly in early 2000s' but, over last 20 years have largely remained stagnant.
- OHCA: ~10%
- INCA: ~21%

Evolving Strategies for Cardiac Arrest

- Strategies toward improving survival rates and neurologic outcomes have fluctuated over time.
- 1950s: Mouth-Mouth and external defibrillators.
- 1970s-80s: Public health training bystander CPR. ACLS textbook.
- 1990s: AEDs introduced to public.
- 2000s: Increased focus on simplifying bystander CPR.
  - Pharmacologic changes in ACLS: removal of lidocaine, bicarb… etc



What is Heads-Up-CPR?

- Cardiopulmonary resuscitation where the head and shoulders are raised ~30 degrees
- Theory: Improved neurologic outcomes via
  - Increased cerebral venous drainage.
  - Lower ICP → increased CerPP

Heads-Up-CPR

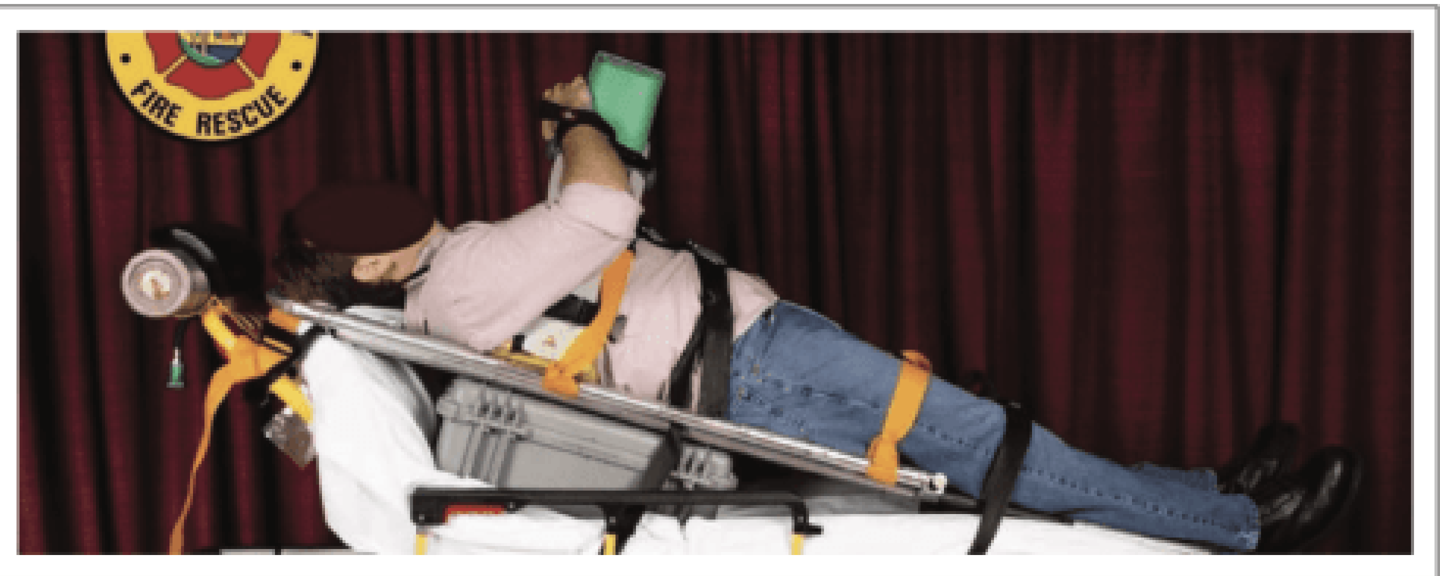


Figure 2. Procedure used by the emergency medical services agency to provide elevation of the head and torso during mechanical cardiopulmonary resuscitation using a LUCAS (Physio-Control Corporation, Redmond, WA) device attached to a scoop stretcher that is supported and angled upward (reverse Trendelenburg) with hard-edge case positioned toward the top end of the stretcher.

Heads-Up CPR: Prior Animal Models and Physiologic Outcomes

- Moore, et al, 2018. (3)
  - Decreased ICP, increased CerPP in porcine models using Heads-up CPR
- Kim, et al, 2017. (4)
  - Increased CerPP *and* Coronary PP (depending on angle of incline)

- Jaeger, et al, 2019 (5)
  - Heads-up CPR did not increase CerPP in porcine models
  - Internal Carotid blood flow was actually DECREASED
  - **Why the discrepancy?**

RESUSCITATION

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CLINICAL PAPER · Volume 179, P9-17, October 2022 · *Open Access*

Head and thorax elevation during cardiopulmonary resuscitation using circulatory adjuncts is associated with improved survival

Johanna C. Moore[a,b,c] · Paul E Pepe[d] · Kenneth A. Scheppke[e] · Charles Lick[f] · Sue Duval[b] · Joseph Holley[g] · Bayert Salverda[c] · Michael Jacobs[h] · Paul Nystrom[a,i] · Ryan Quinn[i] · Paul J. Adams[j] · Mack Hutchison[k] · Charles Mason[k] · Eduardo Martinez[j] · Steven Mason[j] · Armando Clift[j] · Peter M. Antevy[e] · Charles Coyle[e] · Eric Grizzard[l] · Sebastian Garay[e] · Remle P. Crowe[m] · Keith G Lurie[a,b,c] · Guillaume P. Debaty[n] · José Labarère[o] Show less

- ACE-CPR vs C-CPR
- 409 patients, 10 EMS agencies in the US (222 matched/analyzed)
- *"rapid initiation of ACE-CPR was associated with a higher likelihood of survival to hospital discharge after OHCA."*
- ---
- *Limitations:*
  - *Conclusions by authors represent a small subset of overall study population (outside of primary outcomes) → concern data dredging*
  - *Nearly half of EMS agency data was removed → concern for selection bias*

- Prospective, single-arm study in France (2019-2022)
- Did show increased intra-arrest Peak EtCO2 levels w/ AHUP-CPR compared to C-CPR
- No difference in favorable neurologic outcome or survival on hospital admission

Current Practices

- National Association of EMS Physicians (NAEMSP)
  - Strongly pushed back against any adoption of HUP-CPR as being practiced as "Standard of Care"
- American Red Cross and American Heart Association
  - Do not recommend use of HUP-CPR outside of clinical studies

---

- National Fire Protection Association: Endorsed a position of widespread use of HUP-CPR (2023)- ***subsequently retracted***
- Scattered agencies around US currently using HUP-CPR in daily practice

Future Directions

- Is there sufficient data to set HUP-CPR as a standard of care for IHCA or OHCA?
  - Continues to be controversial
  - Large lack of support for widespread adoption
- Future clinical studies definitely needed
- Implementation…?
  - Feasibility and realistic expectations from EMS and General Public

Thank you

- Questions?

Citations

- CPR Facts & Statistics | Red Cross
- Neuroprotective CPR
- In the Pipeline: Head Up CPR in OHCA? - REBEL EM - Emergency Medicine Blog
- Merchant RM, Becker LB, Brooks SC, Chan PS, Del Rios M, McBride ME, Neumar RW, Previdi JK, Uzendu A, Sasson C; American Heart Association. The American Heart Association Emergency Cardiovascular Care 2030 Impact Goals and Call to Action to Improve Cardiac Arrest Outcomes: A Scientific Statement From the American Heart Association. Circulation. 2024 Feb 20;149(8):e914-e933. doi: 10.1161/CIR.0000000000001196. Epub 2024 Jan 22. PMID: 38250800; PMCID: PMC12108947.
- Moore JC, Holley J, Segal N, Lick MC, Labarère J, Frascone RJ, Dodd KW, Robinson AE, Lick C, Klein L, Ashton A, McArthur A, Tsangaris A, Makaretz A, Makaretz M, Debaty G, Pepe PE, Lurie KG. Consistent head up cardiopulmonary resuscitation haemodynamics are observed across porcine and human cadaver translational models. Resuscitation. 2018 Nov;132:133-139. doi: 10.1016/j.resuscitation.2018.04.009. Epub 2018 Apr 24. PMID: 29702188.
- Kim T, Shin SD, Song KJ, Park YJ, Ryu HH, Debaty G, Lurie K, Hong KJ. The effect of resuscitation position on cerebral and coronary perfusion pressure during mechanical cardiopulmonary resuscitation in porcine cardiac arrest model. Resuscitation. 2017 Apr;113:101-107. doi: 10.1016/j.resuscitation.2017.02.008. Epub 2017 Feb 16. PMID: 28215591.
- Jaeger D, Kosmopoulos M, Voicu S, Kalra R, Gaisendrees C, Schlartenberger G, Bartos JA, Yannopoulos D. Cerebral hemodynamic effects of head-up CPR in a porcine model. Resuscitation. 2023 Dec;193:110039. doi: 10.1016/j.resuscitation.2023.110039. Epub 2023 Nov 5. PMID: 37935278.
- Moore JC, Pepe PE, Scheppke KA, Lick C, Duval S, Holley J, Salverda B, Jacobs M, Nystrom P, Quinn R, Adams PJ, Hutchison M, Mason C, Martinez E, Mason S, Clift A, Antevy PM, Coyle C, Grizzard E, Garay S, Crowe RP, Lurie KG, Debaty GP, Labarère J. Head and thorax elevation during cardiopulmonary resuscitation using circulatory adjuncts is associated with improved survival. Resuscitation. 2022 Oct;179:9-17. doi: 10.1016/j.resuscitation.2022.07.039. Epub 2022 Aug 4. PMID: 35933057.
- Debaty G, Segond N, Duhem H, Crespi C, Behouche A, Boeuf J, Sanchez C, Chouihed T, Moore J, Lurie K, Labarere J. Comparison of end tidal CO_2 levels between automated head up and conventional cardiopulmonary resuscitation: A pre-post intervention trial. Resuscitation. 2024 Nov;204:110406. doi: 10.1016/j.resuscitation.2024.110406. Epub 2024 Oct 2. PMID: 39366543.