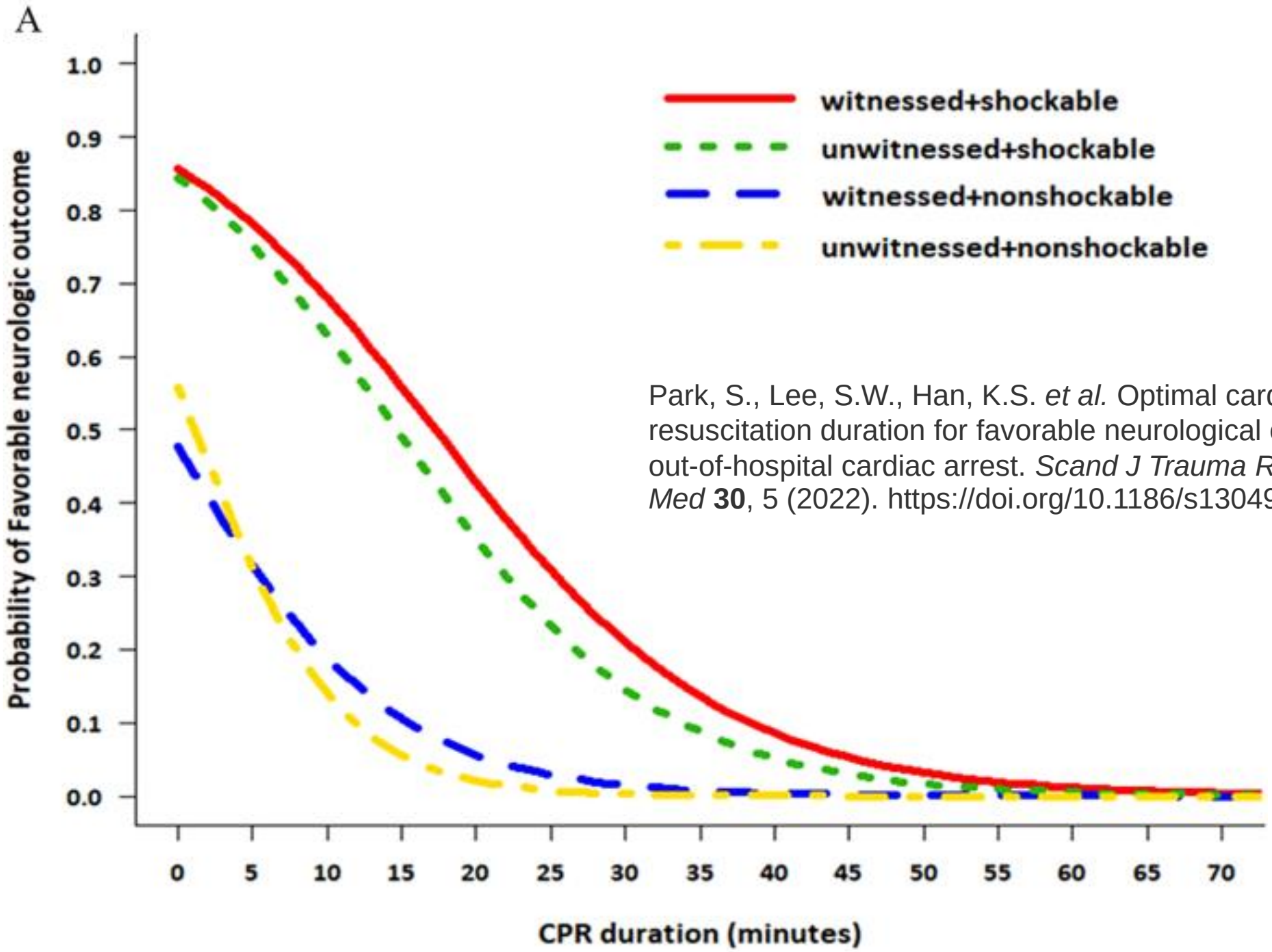
Re-Tune with the Balloon: Can REBOA Catheters Really be Used for Cardiac Arrest

Scott T Youngquist, MD, MSc

Salt Lake City Fire Department

Spencer F Eccles School of Medicine at the University of Utah



Park, S., Lee, S.W., Han, K.S. *et al.* Optimal cardiopulmonary resuscitation duration for favorable neurological outcomes after out-of-hospital cardiac arrest. *Scand J Trauma Resusc Emerg Med* **30**, 5 (2022). https://doi.org/10.1186/s13049-022-00993-8


EPARTMENT.

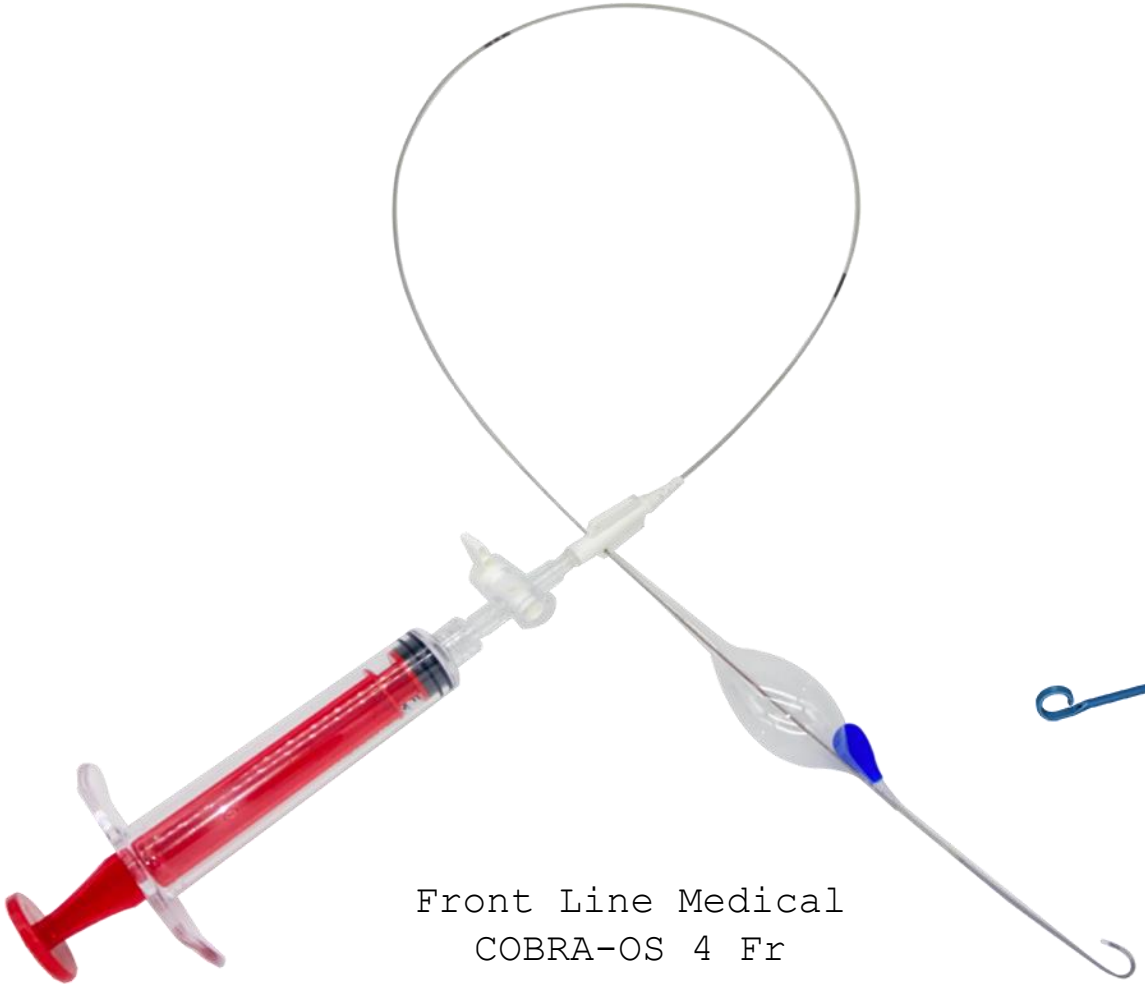
Location-Based ECPR

Survivable

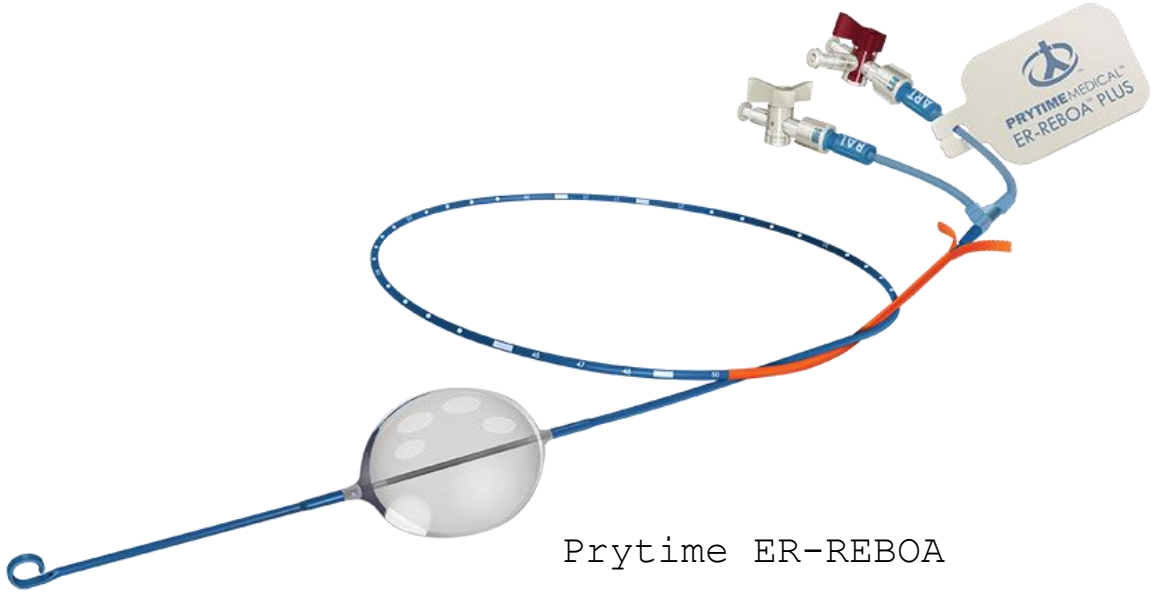
Feasible but difficult

Infeasible

Resuscitative **E**ndovascular **B**alloon **O**cclusion of the **A**orta

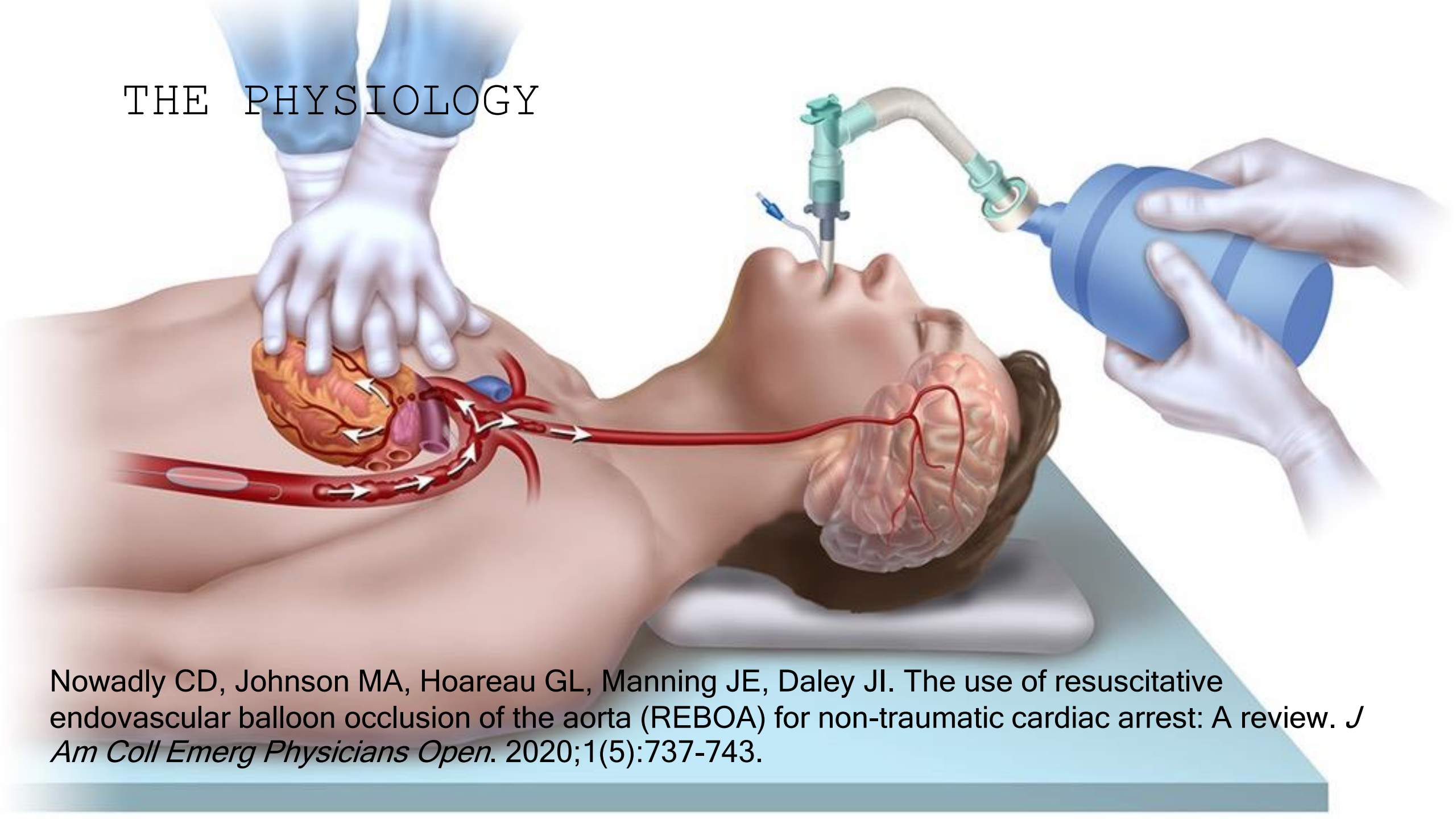


Front Line Medical
COBRA-OS 4 Fr



Prytime ER-REBOA

THE PHYSIOLOGY

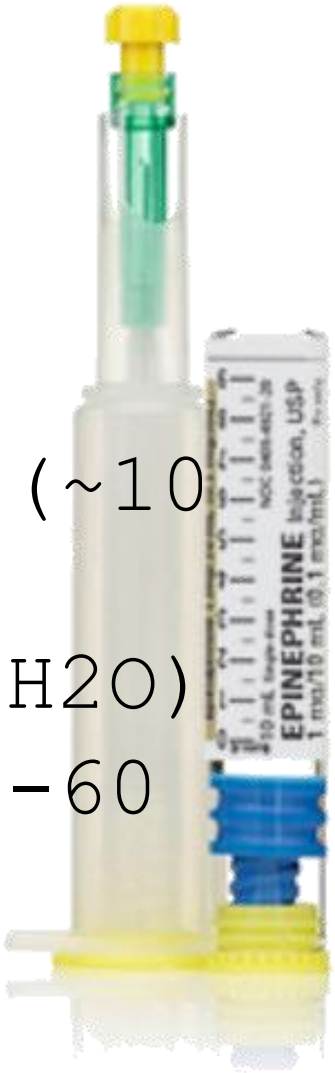


Nowadly CD, Johnson MA, Hoareau GL, Manning JE, Daley JI. The use of resuscitative endovascular balloon occlusion of the aorta (REBOA) for non-traumatic cardiac arrest: A review. *J Am Coll Emerg Physicians Open*. 2020;1(5):737-743.

What does it do?

Epinephrine in a catheter

- Raises BP to brain and heart (~10 mmHg)
- Raises end-tidal CO2 (~10 cm H2O)
- Creates ROSC (40-60% after 40-60 min)



ORIGINAL RESEARCH

Feasibility of Pre-Hospital Resuscitative Endovascular Balloon Occlusion of the Aorta in Non-Traumatic Out-of-Hospital Cardiac Arrest

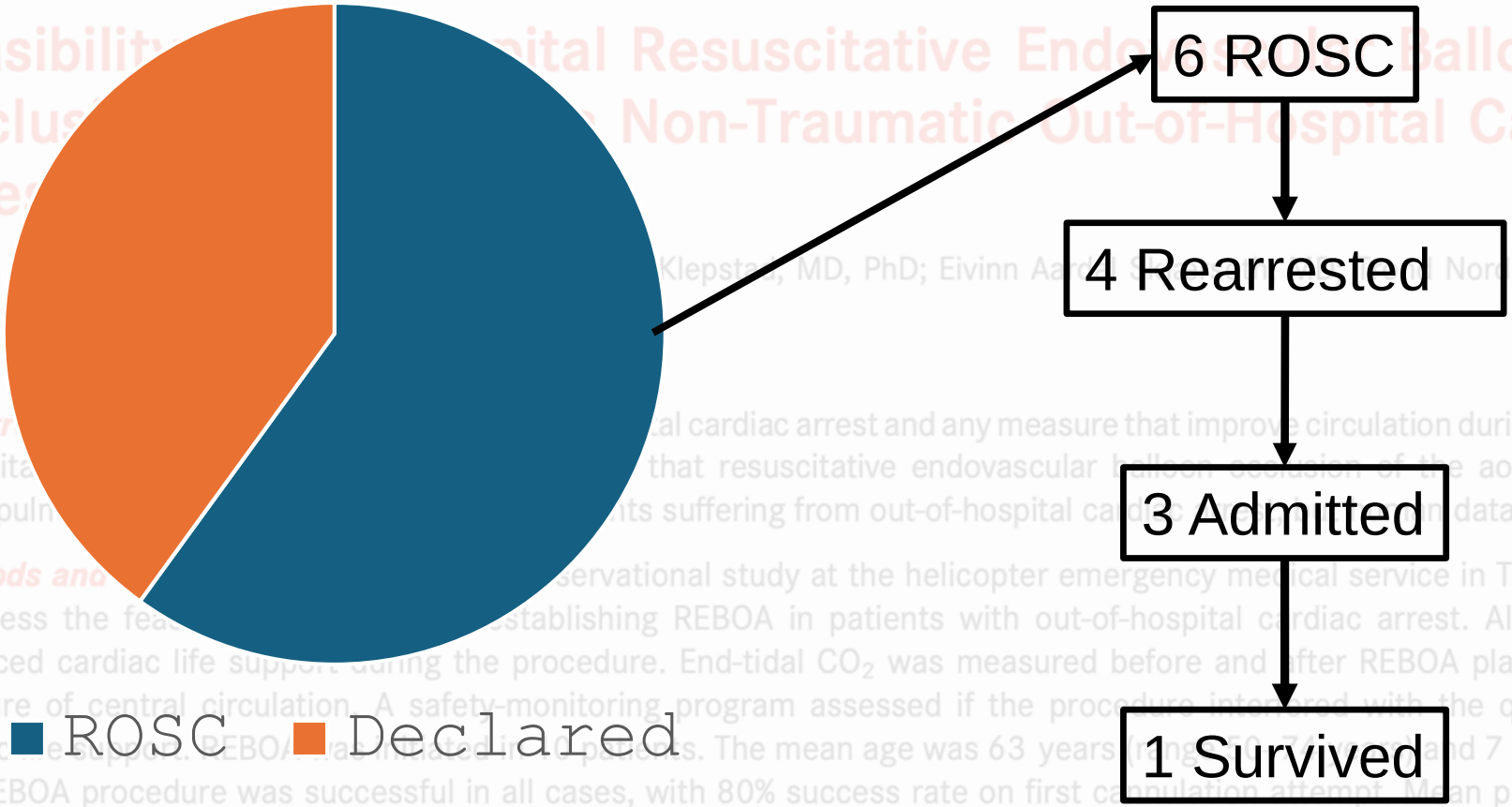
Jostein Rødseth Brede, MD; Thomas Lafrenz, MD; Pål Klepstad, MD, PhD; Eivinn Aardal Skjærseth, MD; Trond Nordseth, MD, PhD; Edmund Søvik, MD; Andreas J. Krüger, MD, PhD

***Background*—**Few patients survive after out-of-hospital cardiac arrest and any measure that improve circulation during cardiopulmonary resuscitation is beneficial. Animal studies support that resuscitative endovascular balloon occlusion of the aorta (REBOA) during cardiopulmonary resuscitation might benefit patients suffering from out-of-hospital cardiac arrest, but human data are scarce.

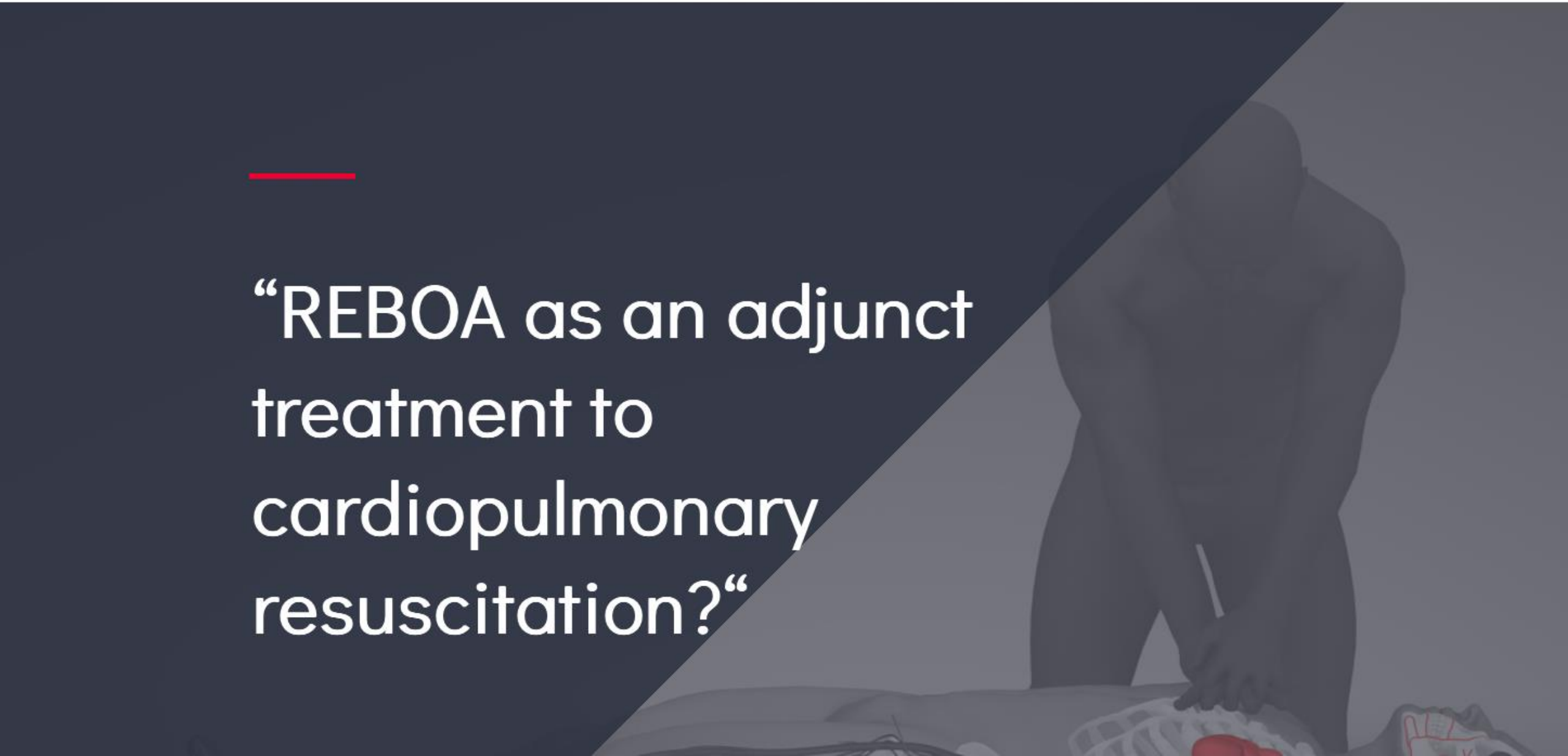
***Methods and Results*—**We performed an observational study at the helicopter emergency medical service in Trondheim (Norway) to assess the feasibility and safety of establishing REBOA in patients with out-of-hospital cardiac arrest. All patients received advanced cardiac life support during the procedure. End-tidal CO_2 was measured before and after REBOA placement as a proxy measure of central circulation. A safety-monitoring program assessed if the procedure interfered with the quality of advanced cardiac life support. REBOA was initiated in 10 patients. The mean age was 63 years (range 50–74 years) and 7 patients were men. The REBOA procedure was successful in all cases, with 80% success rate on first cannulation attempt. Mean procedural time was 11.7 minutes (SD 3.2, range 8–16). Mean end-tidal CO_2 increased by 1.75 kPa after 60 seconds compared with baseline ($P<0.001$). Six patients achieved return of spontaneous circulation (60%), 3 patients were admitted to hospital, and 1 patient survived past 30 days. The safety-monitoring program identified no negative influence on the advanced cardiac life support quality.

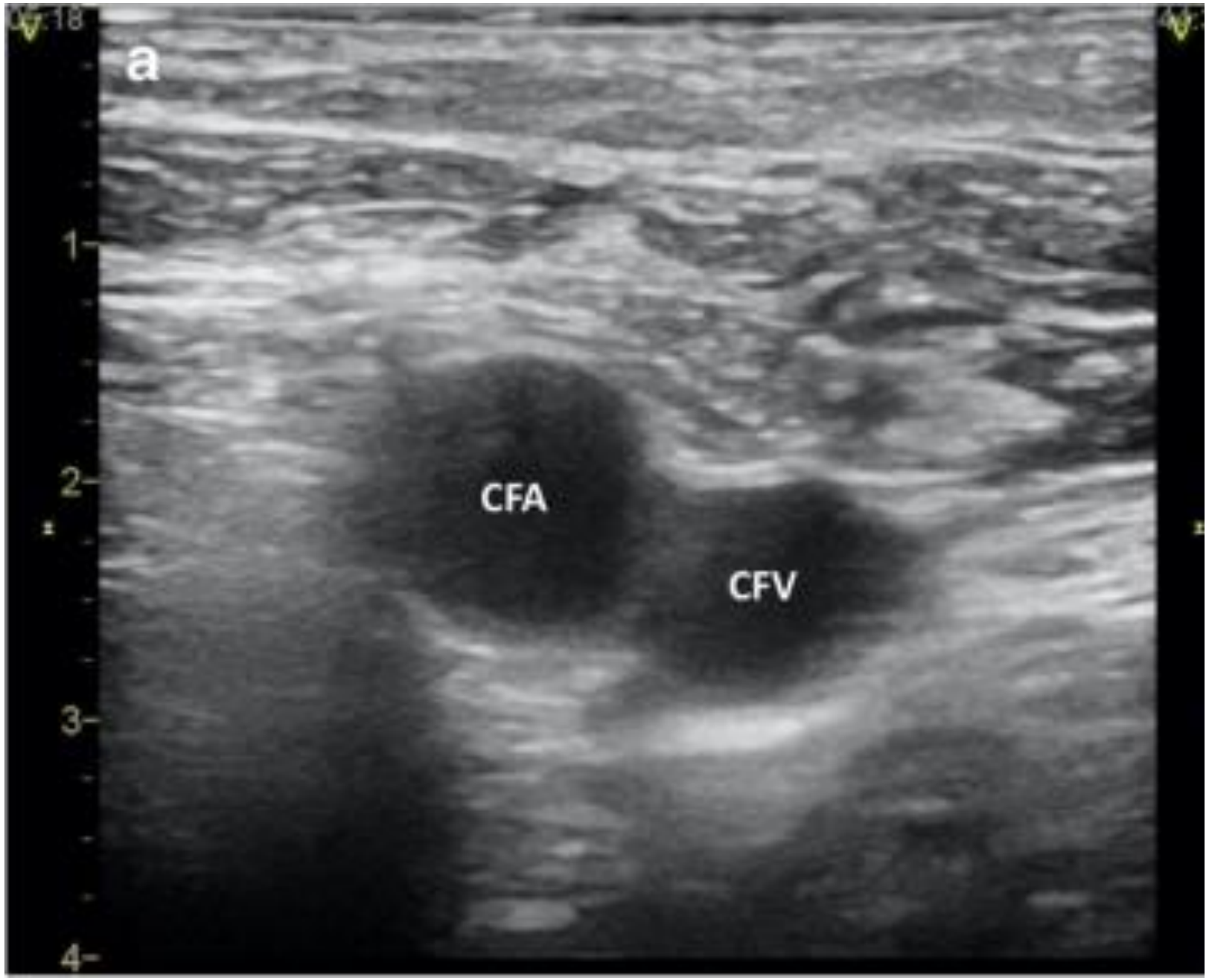
***Conclusions*—**To our knowledge, this is the first study to demonstrate that REBOA is feasible during non-traumatic out-of-hospital cardiac arrest. The REBOA procedure did not interfere with the quality of the advanced cardiac life support. The significant increase

Field Outcome N=10



“REBOA as an adjunct treatment to cardiopulmonary resuscitation?“




a
CFA
CFV
1
2
3
4

If it works who will do it?

Options:

- REBOA receiving centers
- Field Insertion
  - MDs in field
  - Critical Care Paramedic

Head and Thorax Elevation CPR: A New Way to Perform CPR

- Head and Thorax Elevation CPR usi
  a patient positioning device
- Active Compression Decompression
  (ACD) CPR and/or automated CPR
- Impedance Threshold Device (ITD)

Devices work together to improve organ perfusion and outcomes

This bundle of therapy = Automated Head and Thorax Elevation CPR (AHUP), “Head Up” CPR

Hennepin Healthcare

What happens if we combine REBOA with Head Up CPR?

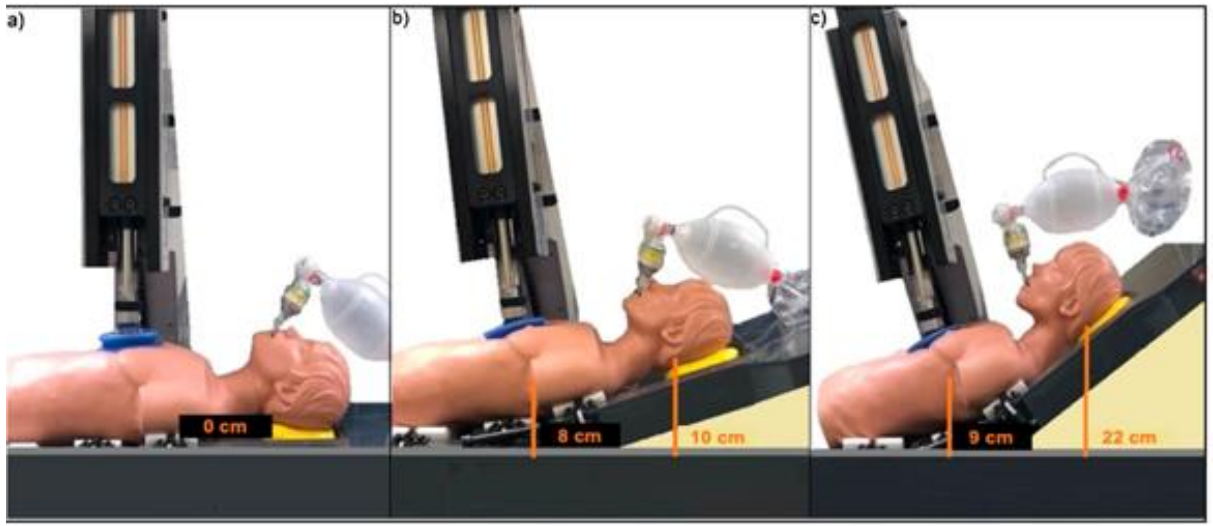
7/5/2024

Synergy of Elevation of the Head and Thorax and Resuscitative Endovascular Balloon Occlusion of the Aorta in a Porcine Model of Prolonged Cardiac Arrest: A Pilot Study

- Johanna C Moore MD MSc,[1-3] Bayert Salverda BA,[2] Michael Lick BA,[2] Susana Arango MD,[3] Mithun Suresh MD,[4] Anja Metzger PhD,[3] Keith Lurie MD[1-3] M Austin Johnson MD PhD[5]
- 1. Hennepin Healthcare, Minneapolis, MN, 2. Hennepin Healthcare Research Institute, Minneapolis, MN, 3. University of Minnesota, Minneapolis, MN 4. St. Cloud Hospital, St. Cloud, MN 5. University of Utah, Salt Lake City, UT

Hypothesis

- Cerebral perfusion pressure (CerPP) and coronary perfusion pressures (CoPP) will be significantly higher in pigs receiving a Automated Head and Thorax Elevation CPR based bundle of care +REBOA as compared to the flat position with REBOA.



Components of AHUP CPR in the laboratory. Automated active compression-decompression CPR, impedance threshold device, automated head and thorax elevation device. Figure adapted from Moore et al. Resuscitation 2021.

Hennepin Healthcare

Methods

- Pigs (~40 kg) intubated, and anesthetized.
- REBOA placement in the proximal thoracic aorta through femoral artery
- After **36 minutes of AHUP-CPR**, animals underwent two-minute periods of:
  - AHUP-CPR,
  - AHUP+REBOA CPR,
  - ACD+ITD CPR flat + REBOA,
  - ACD+ITD CPR flat

Hennepin Healthcare

Results

	Flat-CPR	Flat-CPR+REBOA
CorPP	**7**± 12	**16**± 19
CerPP	**14**± 7	**26**±12

All CPR performed with active compression-decompression (ACD) and an impedance threshold device (ITD)

Hennepin Healthcare

Results

	HUP-CP	+REBOA	HUP-CPR
CorPP		**16**± 19	**14**± 22
CerPP	**14**± 7	**26**±12	
	31± 16	**43**± 12	

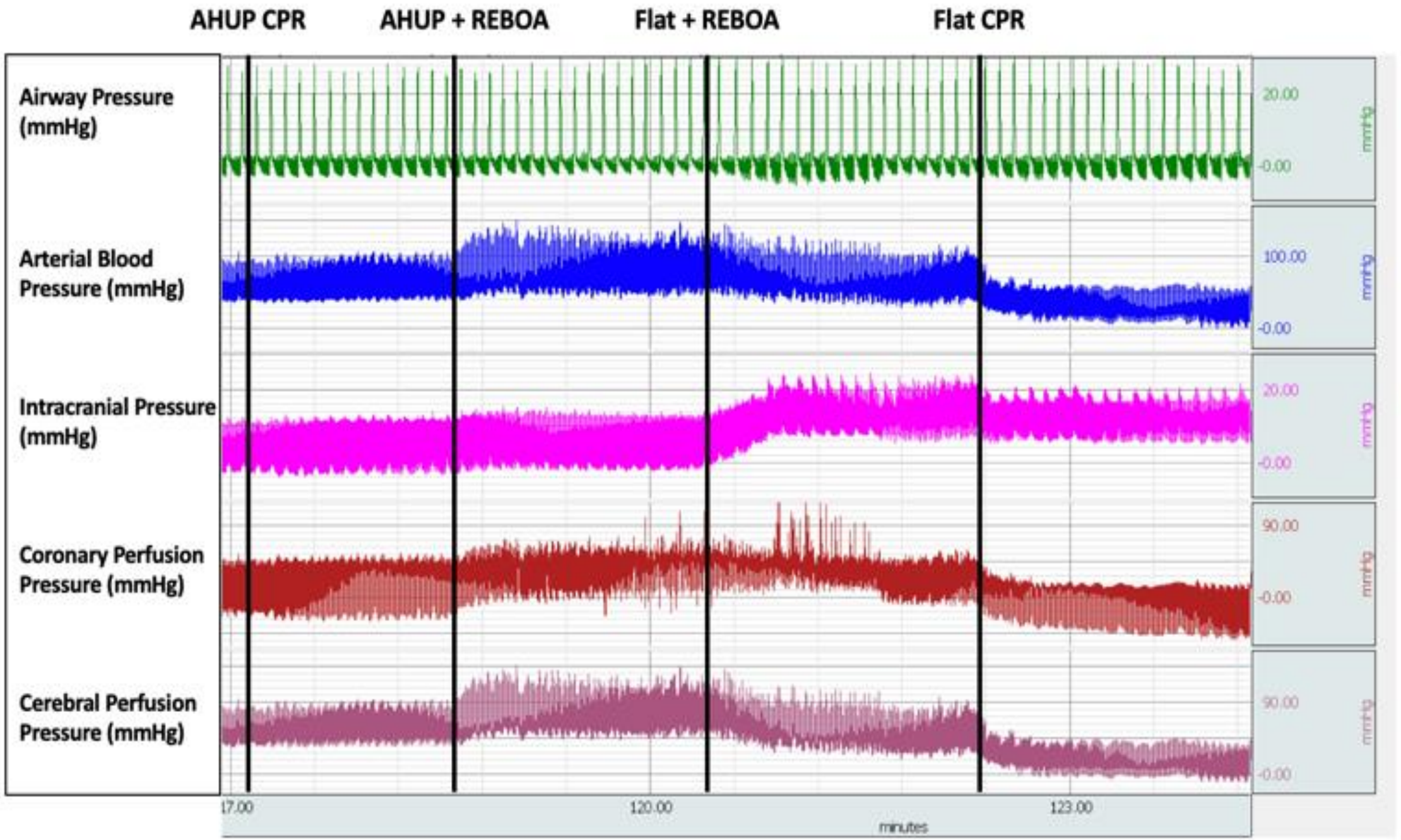
All CPR performed with active compression-decompression (ACD) and an impedance threshold device (ITD)

Hennepin Healthcare

Results

	Flat-CPR	Flat-CPR+REBOA	HUP-CPR	HUP-CPR+REBOA
CorPP	7± 12	16± 19	14± 22	20± 20
CerPP	14± 7	26±12	31± 16	43± 12

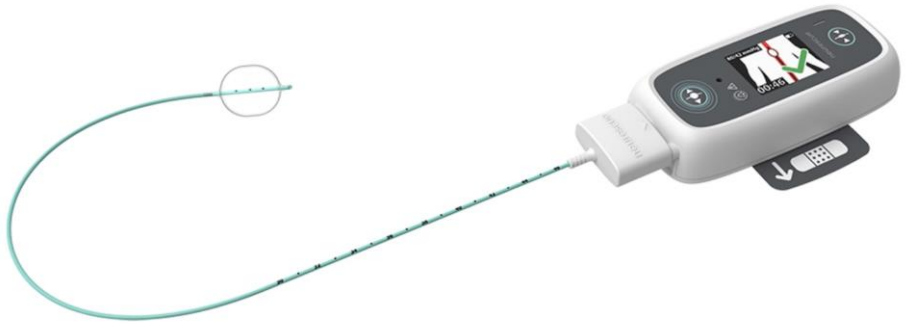
All CPR performed with active compression-decompression (ACD) and an impedance threshold device (ITD)



Representative study tracing from one

Head Up CPR with REBOA: Pilot Study in Grenoble, France

Guillaume Debaty MD PhD and Nicolas Segond MD



Pilot study of 20 patients
Hopefully to start in 2024

Hennepin Healthcare

Conclusions

AHUP-CPR + REBOA is feasible and promising.

CorPP and CerPP improved with AHUP-CPR + REBOA.

These two interventions work synergistically together.

REBOA provides directed flow and pressure to the heart and brain. AHUP CPR improves preload to the right side of the heart and reduces intracranial pressure.

Further work is needed with this device combination to find optimal timing of use and hemodynamics.