

HENRY
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HEALTH®

356,000

American Heart Association's Heart & Stroke Statistics - 2020 Update

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7-9%

Circulation: Cardiovascular Quality and Outcomes. 2019;12:e005580

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292,000

Circulation: Cardiovascular Quality and Outcomes. 2019;12:e005580

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20-30%

American Heart Association's Heart & Stroke Statistics - 2020 Update

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Conventional CPR (CCPR)

- Over 350,000 cases of out of hospital cardiac arrest (OHCA)
 - **Survival rate 8-10%**
- Over 292,000 cases of in hospital cardiac arrest (IHCA)
 - **Survival rate 15-17%**
- **Refractory cardiac arrest**
 - **In OHCA with CPR >35 minutes, <1% of patients will have ROSC with a favorable neurological outcome**

Federico Pappalardo. What is extracorporeal cardiopulmonary resuscitation? Vol 9, No 6 June, 2017.

Goto Y. Relationship between the duration of CPR and favorable neurological outcomes after out-of-hospital cardiac arrest: a prospective, nationwide, population-based cohort study. J Am Heart Assoc. 2016

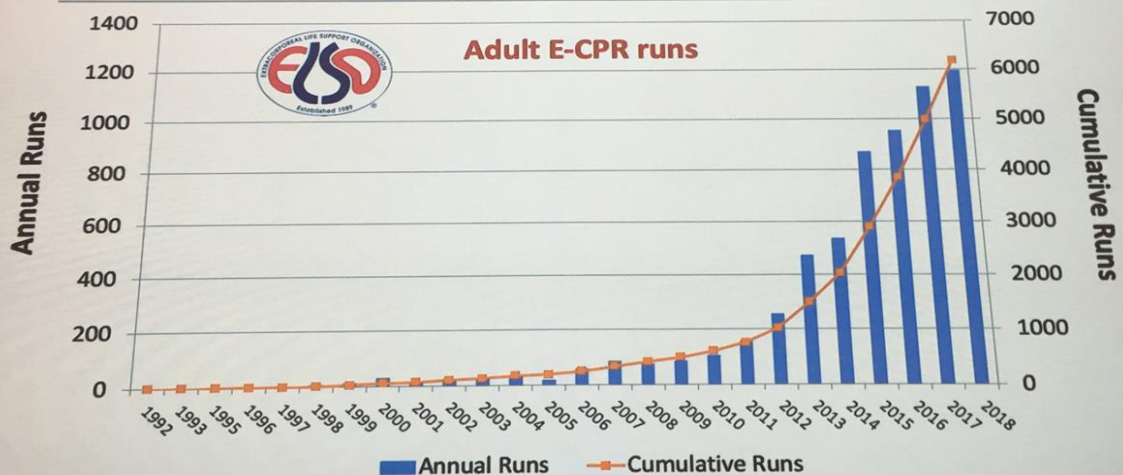
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ECMO in the ED eCPR: The Why?

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E-CPR is increasingly used



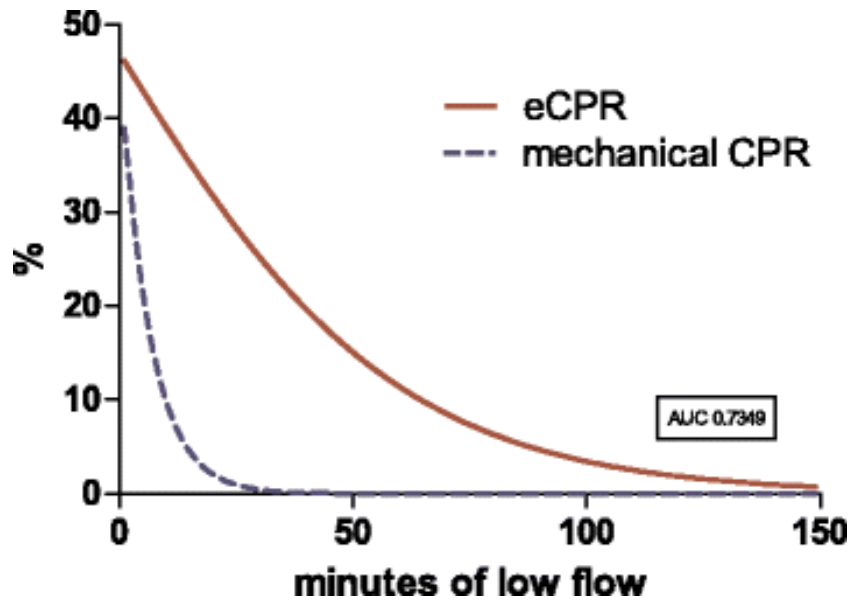
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CCPR

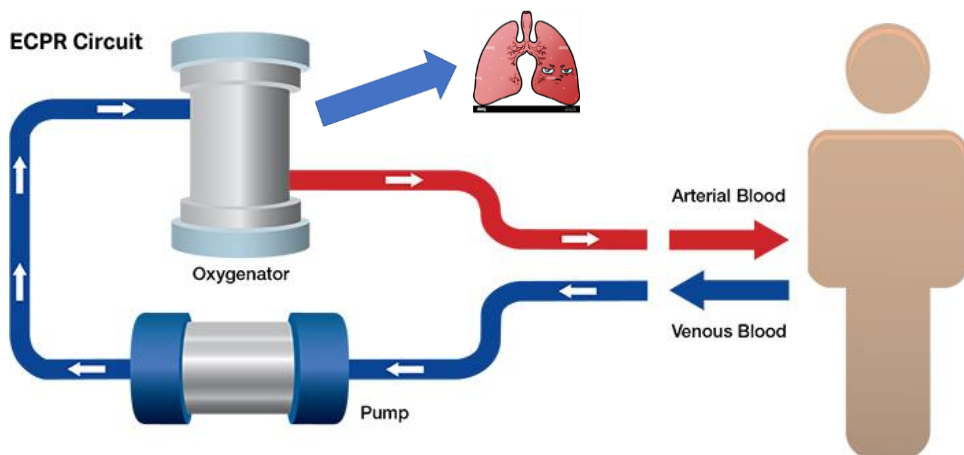
Delivers only 15% to 25% of normal cardiac output
(cardiac index of ≈ 0.6 L/min per m^2)

Development of ischemic damage to vital organs -
low-flow state.

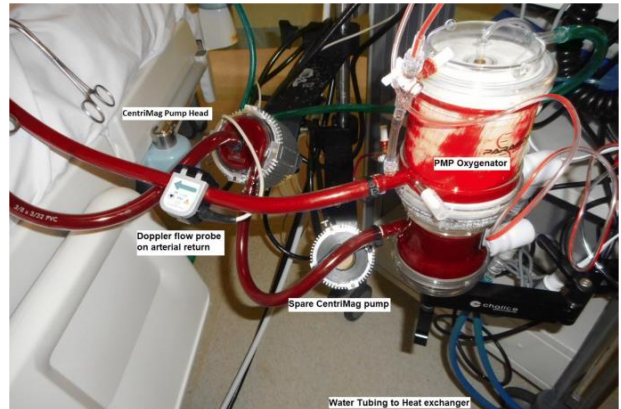
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Case Presentation

- 21-years-old, 70 kg woman, presents in cardiopulmonary arrest following an ingestion of 3 grams of hydroxychloroquine that she was taking for extreme COVID prophylaxis. Upon the arrival to the ED, she was unconscious with a GCS of 6, bradypneic and with trismus. ECG showed ST-segment changes, with pulseless ventricular tachycardia immediately following. She was intubated. CPR was initiated but despite chest compressions, defibrillation and epinephrine for 4 rounds of ACLS, there was no ROSC.
- Resuscitation was continued with three additional doses of epi, correction of hypokalemia, administration of an amiodarone bolus and infusion, a bicarbonate bolus, fluid resuscitation and intravenous lipid emulsion infusion.
- Despite these measures, resuscitation was unsuccessful, and ROSC is not achieved.

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TIME TO INTERVENTION
I.E. LOW FLOW TIME



RHYTHM



IN HOSPITAL VS OUT OF
HOSPITAL CARDIAC ARREST

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Extracorporeal cardiopulmonary resuscitation in patients with in-hospital cardiac arrest: A comparison with conventional cardiopulmonary resuscitation.
Shin et al.

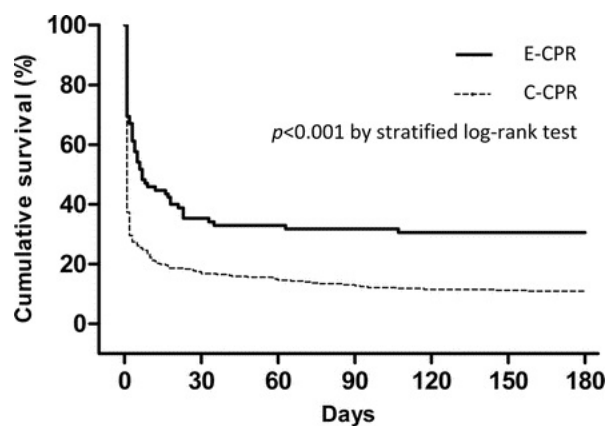
- The survival of patients with IHCA could be extended by eCPR compared with CCPR
- Single-center, retrospective, observational study
- **Primary Outcome:** Survival to discharge with minimal neurologic impairment
- 406 total IHCA receiving CPR for >10 mins
 - 85 in eCPR cohort
 - 321 CCPR cohort

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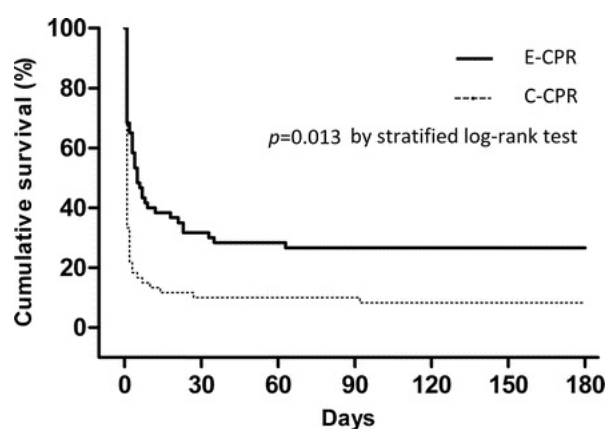
Inclusion	Exclusion
18-80 years of age	Do not resuscitate code status
IHCA suspected cardiac and non cardiac etiology	Severe irreversible brain injury, terminal malignancy, traumatic etiology of arrest
CPR > 10 min	CPR <10 min

Shin TG, et al. Extracorporeal cardiopulmonary resuscitation in patients with in hospital cardiac arrest: A comparison with conventional cardiopulmonary resuscitation. *Crit Care Med.* 2011;39(1):1-7. doi:10.1097/CCM.0b013e3181feb339C

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Kaplan-Meier curves of survival with minimal neurologic impairment for the study population.



Kaplan-Meier curves of survival with minimal neurologic impairment for the propensity score-matched patients.

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Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion. CHEER trial (mechanical CPR, Hypothermia, ECMO and Early Reperfusion)

- Single center, prospective, observational study

- Implementation of CHEER protocol

26 patients with refractory IHCA and OHCA

- IV administration of cold saline to induce intra-arrest therapeutic hypothermia
- Cannulated for VA ECMO
- Suspected coronary artery occlusion underwent cardiac catheterization
- Therapeutic hypothermia (33 °C) for 24 hours

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Inclusion	Exclusion
18-65 years of age	Significant pre-existing neurological disability
Refractory cardiac arrest >30 min due to suspected cardiac etiology	Co-morbidities that cause limitations in activities of daily living
Chest compressions within 10 minutes of arrest	
Initial cardiac arrest rhythm of ventricular fibrillation	

***IHCA were eligible for E-CPR at the discretion of the physician when it was thought the etiology of cardiac arrest would be reversible

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Refractory cardiac arrest treated with mechanical CPR, hypothermia, ECMO and early reperfusion. CHEER trial (mechanical CPR, Hypothermia, ECMO and Early Reperfusion)

- VA ECMO established in 24/26 patients
- Median time collapse until initiation of ECMO of 56 min
 - PCI was performed on 42%
 - Pulmonary embolectomy on 1 patient
 - ROSC was achieved in 96% patients
- Survival to hospital discharge with full neurological recovery occurred in **54%** of patients

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Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST):

- Single center, phase 2, single center, open-label RCT
- Comparing early ECMO + cardiac catheterization to standard ACLS resuscitation in OHCA

30 total patients

- **Primary Outcome:** Survival to hospital discharge
- **Secondary outcome:** Survival and favorable neurological outcomes at 3 and 6 months post discharge

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Inclusion	Exclusion
18-75 years of age	Do not resuscitate
Initial rhythm v fib or pulseless VT	Mechanism: Drowning, trauma, overdose
No ROSC after 3 shocks	Pregnancy, terminal cancer, bleeding
Transport time <30 min	Prisoner or nursing home resident
Body habitus supports mechanical CPR	Cath Lab unavailable

Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST): a phase 2, single center, open-label, randomized controlled trial.

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Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST):

- Survival
 - ECMO group: **43%** (6/14)
 - ACLS group: **7%** (1/15)
- All survivors had good functional assessment scores at 6 months

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Strengths

RCT with consecutive enrollment
 Simple exclusion/inclusion criteria-generalizable
 Focused on VF/VT arrest-likely better chance of survival
 Fast time from randomization to ECMO initiation
 Excellent safety reporting measure



Weakness

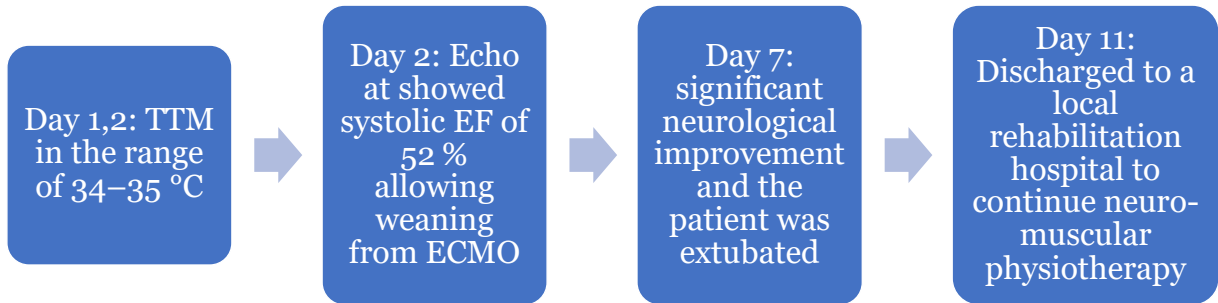
Small Number of Patients
 Single Center
 Need for highly trained and expert teams
 Rates of bystander CPR
 Compared standard ACLS vs ECMO plus angiography

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Studies	eCPR Survival to discharge (%)
Chen et al. 2008	41% IHCA
Shin et al. 2011	32% IHCA
CHEER 2015	54% IHCA and OHCA
2CHEER 2020	44% IHCA and OHCA
ARREST 2020	43% OHCA
Sudden Death Expertise Center investigators 2020	8% OHCA

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Case Continued



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Summary

- eCPR is likely beneficial in select patients with refractory cardiac arrest
- Successful outcomes for eCPR require extensive resources
- Duration of the low flow state indirectly correlates with survivability with both CCPR and eCPR

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