Refractory cardiac arrest, shall we decide to cannulate ?

CONS

ECOS-TCS
June 24th 2024

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SOCIÉTÉ
DE RÉANIMATION
DE LANGUE FRANÇAISE

No conflict of Interest

Observational Study > Circ Cardiovasc Qual Outcomes. 2019 Jul 9;12(7):e005580.

Annual Incidence of Adult and Pediatric In-Hospital Cardiac Arrest in the United States

Mathias J. Holmberg [1 2], Catherine E. Ross [3], Garrett M. Fitzmaurice [4 5 6], Paul S. Chan [7], Jordan Duval-Arnould [8], Anne V. Grossestreuer [2], Tuyen Yankama [2], Michael W. Donnino [2 9], Lars W. Andersen [1 2];
American Heart Association's Get With The Guidelines–Resuscitation Investigators

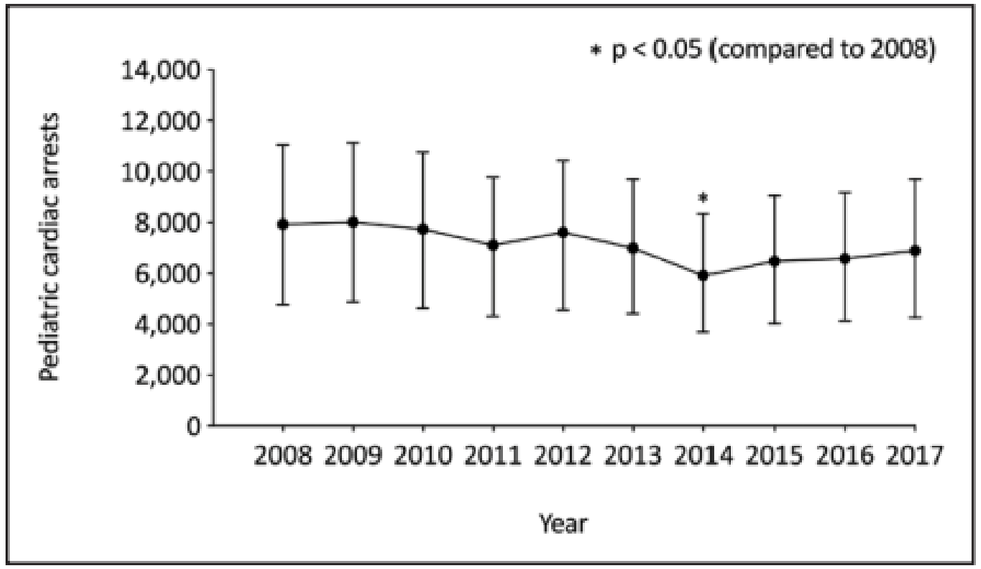


Figure 2. Annual trends in the incidence of pediatric pulseless in-hospital cardiac arrest in the United States.
The average number of index pulseless cardiac arrests occurring in hospitalized pediatric patients between 2008 and 2017 was estimated at 7100 (95% prediction interval, 4400–9900) cases per year. There was no clear change in incidences over time (incidence rate ratio, 0.97; 95% CI, 0.94–1.00), *P*=0.08). Numerical estimates are provided in Table XI in the Data Supplement.

Survival rate at PICU discharge
= 32 - 50.6 %

OHCA
survival rate = 0 – 10 %

High morbidity
++ neurological morbidity
for the survivors

WHAT DOES PEDIATRIC LITERATURE SAY on E CPR in OHCA ?

EXISTING RECOMMANDATIONS (1)

Review > Circulation. 2019 Dec 10;140(24):e904-e914. doi: 10.1161/CIR.0000000000000731. Epub 2019 Nov 14.

2019 American Heart Association Focused Update on Pediatric Advanced Life Support: An Update to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care

Jonathan P Duff, Alexis A Topjian, Marc D Berg, Melissa Chan, Sarah E Haskell, Benny L Joyner Jr, Javier J Lasa, S Jill Ley, Tia T Raymond, Robert Michael Sutton, Mary Fran Hazinski, Dianne L Atkins

PMID: 31722551 DOI: 10.1161/CIR.0000000000000731

Recommendation—Updated 2019

1. **ECPR may be considered for pediatric patients with cardiac diagnoses who have IHCA in settings with existing ECMO protocols, expertise, and equipment (Class 2b; Level of Evidence C-LD).**

There is insufficient evidence to recommend for or against the use of ECPR for pediatric patients experiencing OHCA or for pediatric patients with noncardiac disease experiencing IHCA refractory to conventional CPR.

EXISTING RECOMMANDATIONS (2)

RESUSCITATION 161 (2021) 327 –387

Available online at www.sciencedirect.com

Resuscitation

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

European Resuscitation Council Guidelines 2021: Paediatric Life Support

Patrick Van de Voorde[a,b,], Nigel M. Turner[c], Jana Djakow[d,e], Nieves de Lucas[f], Abel Martinez-Mejias[g], Dominique Biarent[h], Robert Bingham[i], Olivier Brissaud[j], Florian Hoffmann[k], Groa Bjork Johannesdottir[l], Torsten Lauritsen[m], Ian Maconochie[n]*

Extracorporeal life support

- E-CPR should be considered early for children with ED or IHCA and a (presumed) reversible cause when conventional ALS does not promptly lead to ROSC, in a healthcare context where expertise, resources and sustainable systems are available to rapidly initiate ECLS.
- Competent providers might also decide to perform E-CPR for OHCA in cases of deep hypothermic arrest or when cannulation can be done prehospitally by a highly trained team, within a dedicated healthcare system.

EXISTING RECOMMANDATIONS (3)

Out-of-hospital Pediatric Cardiopulmonary Arrest

In children, there are insufficient data to support the recommendation for the use of ECPR for out-of-hospital cardiopulmonary arrest events, either applied in the field (*e.g.*, trauma or remote retrievals of avalanche or drowning victims) or in the hospital after ongoing conventional CPR during transport.

rdio
uide

*, Osa

Reviewers: Asma Sahoo, Matteo Di Nardo#, Ravi Thiaga

ECPR Protocols

Organizations committed to providing ECPR have a local written protocol, a list of roles, responsibilities, ordered tasks, individual, or shared checklists, a process flow diagram, in place to enhance performance and minimize disruptive variability. Multiple tasks are accomplished simultaneously by different groups of individuals (see Tables 2 and 3).

1. Protocols include general patient selection and launch criteria, location of cannulation if not in the location of the cardiac arrest, instructions for transport, and CPR measures.
2. ECPR protocol should specify the role responsible for the completion of tasks and the order of completion.
3. A flow diagram or algorithm may contain key steps and "time-out" pauses to verify safety checks.
4. A target duration of time between event start time and time to attain full ECMO flows is important to preset; an individual must be responsible for documentation and timekeeping during the resuscitation and cannulation.
5. Each institution should protocolize the options of "stay and play" to cannulate at the location of the arrest event or "pack up and CPR on the go" to transport to the cannulation location.

PRESENTATION OF OUR E-CPR PROGRAM
in the Ile de France Region

Out of hospital
Pediatric cardiac arrest

In hospital but
Out of Pediatric ECMO Center

PICU
Necker Hospital

20 - 25 ECMO/year
ECMO V-A ++,
cardiac indications
mostly

PICU
Trousseau Hospital

45 - 50 ECMO/year
+ Mobile unit
V-V and V-A
ECMO, neonatal and
pediatric

Several calls per year for refractory pediatric cardiac arrest

- **Out of Hospital cardiac arrest**
- **In Hospital but out of ECMO center cardiac arrest**

Front Pediatr. 2018 Jun 6;6:152. doi: 10.3389/fped.2018.00152. eCollection 2018.

Establishing and Sustaining an ECPR Program.

Laussen PC[1], Guerguerian AM[2].

KEY POINTS OF OUR REFLEXION

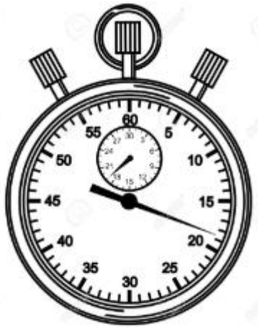
- STRICT SELECTION CRITERIA
- EFFICIENT AND EARLY ALERT SYSTEM
- WRITTEN ROLE ASSIGNMENT for each
- WRITTEN PROCEDURE about :
  - Organizing the room
  - Material needed
  - Cannulation techniques
- TRAINING PROGRAM

STRICT SELECTION CRITERIA
EXCLUSION CRITERIA

1. **No flow > 0 min, no witness**
2. **Delayed call and or a predictible time of arrival at the ECMO center >60 min**
3. Pre-existing severe or evolutive neurological disease
4. EtCO2 < 10 mmHg during conventional CPR
5. +/- Immunodeficiency

Discussion +++ in case of :
- Hypothermia
- Presence of life signs (spontaneous breathing…)

EARLY AND EFFICIENT SYSTEM OF ALERT



E-CPR is a RACE AGAINST TIME

GOAL = RUNNING ECMO at maximum M60-M90!

Alert at M5 of the cardiac arrest = right after the first dose of epinephrine administrated

Mobile ECMO unit ? > 15 years

Scoop and run to the nearest ECMO center ? < 15 years

CARDIAC ARREST OUT OF HOSPITAL OR IN HOPITAL OUT OF ECMO CENTER
CHILDREN < 15 YEARS OLD

EARLY ALERT
At M5, after the first dose of adrenaline adminitsrated

UNIQUE CALL NUMBER
at the SAMU of Paris

No Flow = 0, witness present
AND immediate cardiac compressions
AND no pre-existing severe or evolutive neurological disease
AND EtCO2 > 10 mmHg during CPR

YES

NO

Possibility to arrive at an ECMO Center
(Necker or Trousseau)
At the latest at M60 ?

NO

CONVENTIONAL CPR
With a **pediatric SAMU team** if the first team on site was an adult SAMU team

YES

SCOOP & RUN
With the first SAMU team on site (pediatric or adult)
Goal = arrival at the latest at M60 at the closest ECMO Center (Necker ou Trousseau)

RECUPERATION

TRANSFER
TO THE NEAREST PICU

NO RECUPERATION
Discontinuation of CPR
Death on site

CARDIAC ARREST OUT OF HOSPITAL OR IN HOPITAL OUT OF ECMO CENTER
CHILDREN > 15 YEARS OLD

EARLY ALERT
At M5, after the first dose of adrenaline adminitsrated

UNIQUE CALL NUMBER
at the SAMU of Paris

No Flow = 0, witness present
AND immediate cardiac compressions
AND no pre-existing severe or evolutive neurological disease
AND EtCO2 > 10 mmHg during CPR

YES

NO

ADULT MOBILE ECMO UNIT of the SAMU 75 available ?

YES

NO

E-CPR ON SITE by the adult mobile ECMO unit of the SAMU 75

TRANSFER TO THE NEAREST ECMO CENTER
Necker or Trousseau

Possibility to arrive at an ECMO Center (Necker or Trousseau)
At the latest at M60 ?

NO

SCOOP & RUN
With the first SAMU team on site (pediatric or adult)
Goal = arrival at the latest at M60 at the closest ECMO Center
(Necker ou Trousseau)

CONVENTIONAL CPR
With a **pediatric SAMU team** if the first team on site was an adult SAMU team

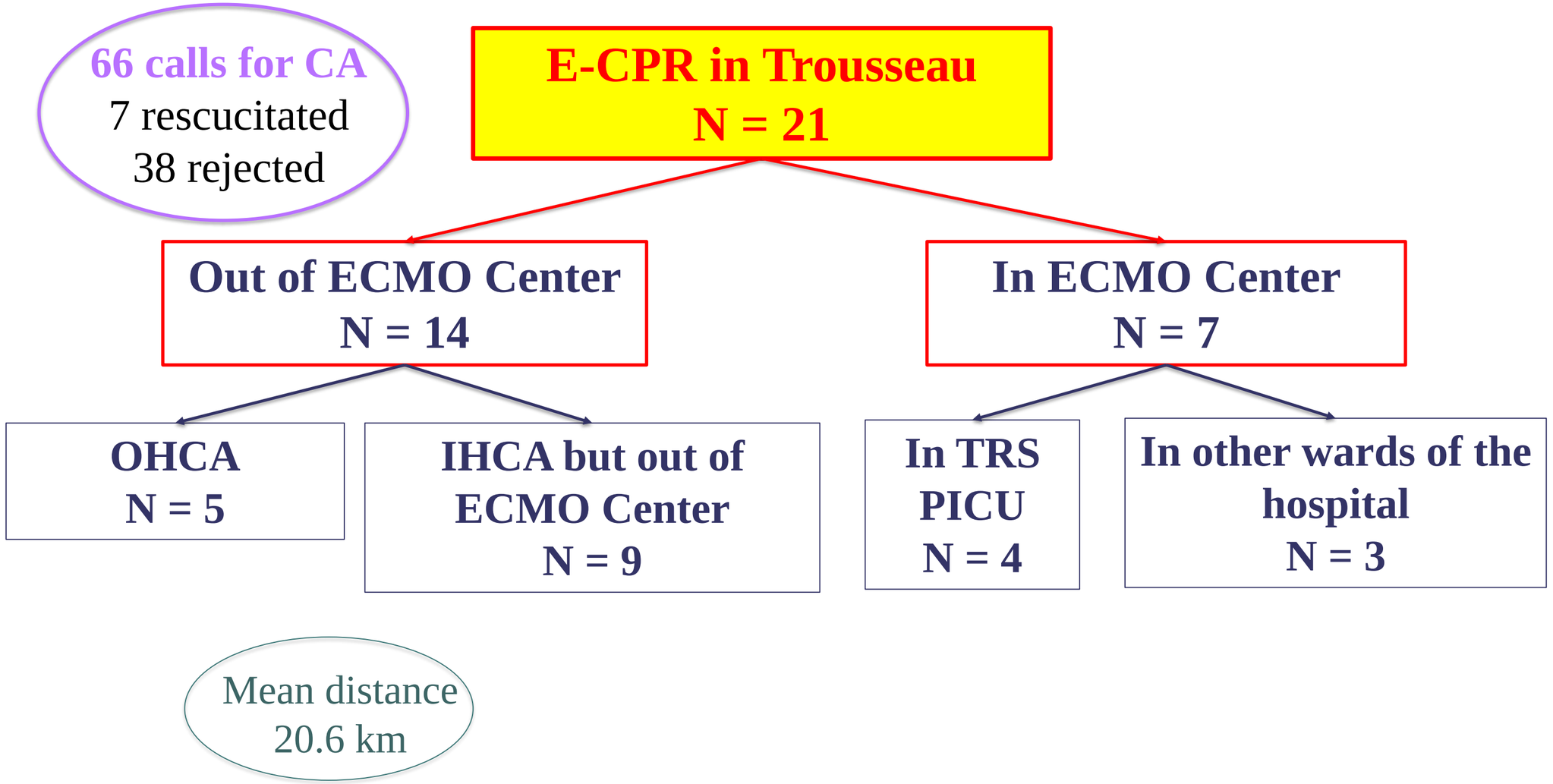
RECUPERATION

TRANSFER
TO THE NEAREST PICU

NO RECUPERATION
Discontinuation of CPR
Death on site

RESULTS OF OUR PROGRAM (1)

June 2021 – June 2024



RESULTS OF OUR PROGRAM (2)

June 2021 – June 2024

21 patients

Mean age : 33. 4 months = 2.7 years

- Newborns : 2
- < 1month : 3
- 1 month – 2 years : 8
- 2 – 6 years : 3
- > 6 years : 6

ETIOLOGIES

- CA at birth : 2
- Meconial spiration syndrome : 1
- Septic shock : 7
- Myocarditis : 3
- Cardiogenic shock on third degree AV block: 1
- Arrythmogenic righ ventricular cardiomyopahy: 1
- Anaphylactic shock : 1
- Drowning : 1
- Undetermined : 4

RESULTS OF OUR PROGRAM (3)

June 2021 – June 2024

21 patients

Mean CPR duration before decision of ECMO	**57 min** [5-192]
Mean canulation time	31min [10-80]
Mean neck surgical (n= 16)	34 min
Mean femoro-femoral in open Seldinger (n= 5)	15 min
Mean CPR duration to ECMO start	**86 min** [35-223]
Non started ECMO	2

RESULTS OF OUR PROGRAM (4)

June 2021 – June 2024

21 E-CPR

4 successful ECMO weaning
- 1 OHCA (drowning case)
- 2 E-CPR during complicated VV canulation in the PICU
- 1 IHCA but out of PICU

2 survivors
with favorable neurological outcome

2 deaths before discharge
- 1 not correlated to the ECMO
- 1 from severe neurological damage due to the CA

RESULTS OF OUR PROGRAM (4)

June 2021 – June 2024

14 E-CPR
Out of ECMO center

→ **1 survivor**
Drowning case with severe bradycardia due to deep hypothermic state

Explanations of those results

- Late alert
- Late arrival of the patients at the ECMO center
- Difficulties in having the correct and precise hours of the CA to be sur of the zero No flow
- Pathophysiology of CA in children vs CA in adult +++

Psychological impact on the team

Risk that could be taken for the other patients of the ward during E-CPR

Program stopped for OHCA
(except drowning cases or arrythmia)

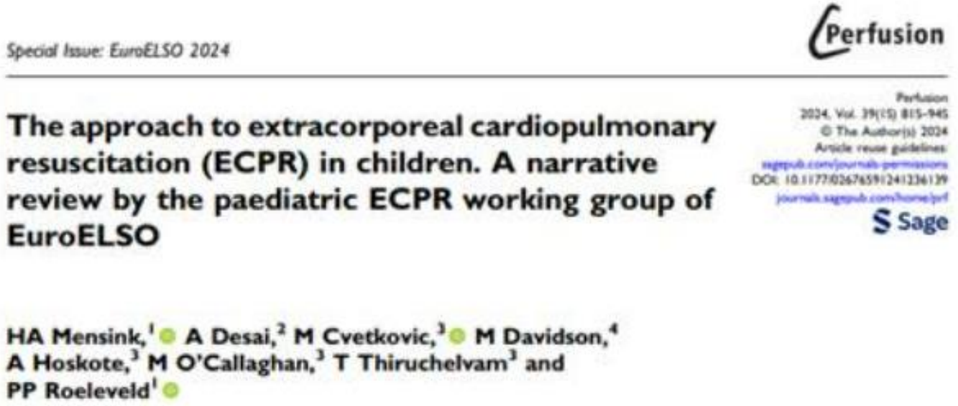
Even more strict selection criteria ?
+++ on the underlying cause of the CA (ex : septic shock)

CONCLUSION

CONCLUSION

Should we canulate out of hospital refractory cardiac arrests in children ?

From our own experience : No



Special Issue: EuroELSO 2024

Perfusion

The approach to extracorporeal cardiopulmonary resuscitation (ECPR) in children. A narrative review by the paediatric ECPR working group of EuroELSO

Perfusion
2024, Vol. 39(1S) 815-945
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HA Mensink,[1] A Desai,[2] M Cvetkovic,[3] M Davidson,[4] A Hoskote,[3] M O'Callaghan,[3] T Thiruchelvam[3] and PP Roeleveld[1]

ECPR for OHCA

In children, there are insufficient data to support the recommendation for the use of ECPR for out-of-hospital cardiopulmonary arrest.[10,40] In the ELSO-registry, only 3% of ECPR is OHCA.[11] In an OHCA situation often a combination of risk factors for worse outcome are present (i.e. delayed start of CPR, suboptimal quality CPR, asystole, non-cardiac causes, long pre-arrest phase, or unwitnessed arrest).[53] Following the current evidence and guidelines, ECPR for OHCA should probably be limited to specific protocols in more experienced centres, preferably in research settings. Exceptions can be made for children with hypothermia without asphyxia, in which the brain is protected by hypothermia before going into cardiac arrest. Adults with hypothermic cardiac arrest due to non-asphyxial hypothermia have improved neurologic outcomes when treated with ECPR compared to patients with asphyxia hypothermic cardiac arrest.[95] In cases of drowning, water temperature, body temperature and heart rhythm should be considered before deciding for ECPR. In an ELSO-registry analysis of 247 patients receiving ECMO following a drowning event, only 23% of patients who were cannulated during CPR survived to hospital discharge, in patients who did not experience a cardiac arrest the survival was 71%.[96]

BUT … Is pre-hospital canulation for pediatric OHCA an option ?

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