Cardiac arrest:
Intensive care in prehospital setting

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MAQUET GETINGE GROUP

ZOLL

Boehringer Ingelheim

VYGON Value Life
PARADIGM SHIFT

A change from one way of thinking to another.
Goal of CPR?
What is the goal of the resuscitation?

FIRST 20 min

ROSC  High Quality CPR  Protect the brain
What is the goal of the resuscitation?

AFTER 20 min

ROSC  High Quality CPR  Protect the brain
E.C.P.R.

Extracorporeal Cardio Pulmonary Resuscitation
How does it work?
Cardiopulmonary resuscitation with assisted extracorporeal life-support versus conventional cardiopulmonary resuscitation in adults with in-hospital cardiac arrest: an observational study and propensity analysis

Yih-Shang Chen*, Jou-Wei Lin*, Hsi-Yu Yu, Wen-Je Ko, Jih-Shuin Jerng, Wei-Tien Chang, Wen-Jone Chen, Shu-Chien Huang, Nai-Hsin Chi, Chih-Hsien Wang, Li-Chin Chen, Pi-Ru Tsai, Sheoi-Shen Wang, Juey-Jen Hwang, Fang-Yue Lin

![Graph showing survival rates for extracorporeal CPR-M and conventional CPR-M groups for 1 year.](image)

**Figure 3:** Kaplan-Meier plot of the survival curves in the extracorporeal CPR-M and conventional CPR-M groups for 1 year.
ECPR indications for refractory cardiac arrest

Possible Indication

- Intoxication †
- Hypothermia † (≤ 32° c)
- Signs on life during CPR

Uncertainty

Refractory CA

No indication

Co-morbidity

NO FLOW duration

0-5 min

VF VT

LOW FLOW duration

ETCO₂ ≥ 10 mmHg AND Low-flow ≤ 100 min *

> 5 min or No Witness

Cardiac rhythm evaluation

Asystole Pulseless activity

ETCO₂ < 10 mmHg OR Low-flow > 100 min

French National guidelines
SFAR SRLF CFRC ...
B Riou et al 2009
51 OHCA, in Paris
30 min of ALS on scene
ECPR at admission
2 Survivors CPC 1/2

Disappointed…

Le Guen M et Al Crit Care Med 2011, 15 R29
Why?

Triage

Time

60 min
Hypothermia < 32°
=> K⁺ < 12 mmol
Intoxication
STEMI and others ?
Signs of life

- Movements
- Breath
- Gasp
- Pupils

=> Best selection criteria whatever the rhythms
Unfavorable Prognostic Factors

Asystolie

+ No signs of life

PPV death
100%

$IC_{95} [90;100]$
RCA after 20 min of CPR with AED

- Signs of life during CPR at the time of decision
  - Or Hypothermia (T<32°)
  - Or Intoxication or general anesthesia

Consider ECPR*

No major comorbidity

Witnessed CA and immediate CPR (no flow<5 min)

ASYSTOLE

Initial Rhythm

- VF-VT
- PEA

EtCO2 at ECPR decision >10 mmHg

ECPR in less than 60 min (acceptable 100 min)

- Age < 55 YO
- No Flow <30 min + Hospital arrival <120 min after CA

Classical ALS

Consider NBHD

Consider ECPR

* ECPR ASAP but no maximal delay
Low Flow influence

N=135

Chen YS. Etal. CCM 2008

Wengenmayer et al. Critical Care 2017)
Duration of Resuscitation Efforts and Functional Outcome After Out-of-Hospital Cardiac Arrest
When Should We Change to Novel Therapies?

Joshua C. Reynolds, MD, MS; Adam Frisch, MD, MS; Jon C. Rittenberger, MD, MS;
Clifton W. Callaway, MD, PhD

Après 16,1 minutes RCP => 1% de survivants
Golden hour for ECPR

N=133

Survivors

The University of Minnesota refractory ventricular fibrillation (VF) protocol mobilizes patients with failed initial resuscitation with ongoing cardiopulmonary resuscitation (CPR) to enter the cardiac catheterization laboratory (Cath Lab) where extracorporeal life support (ECLS) is implemented as a bridge to coronary angiography, intervention, and recovery. The program has identified that 86% of the patients had severe coronary artery disease. Survival to hospital discharge was 45%. Historical control subjects treated with the previous standard of care had access to the hospital only after return of spontaneous circulation (ROSC) was achieved and, as such, survival was poor. AHA = American Heart Association; ECMO = extracorporeal membrane oxygenation; PCI = percutaneous coronary intervention; VT = ventricular tachycardia.

Pharmacologic Protocol:
Zone 1
* Aspirin 81 mg x4
* Clopidogrel 600 mg
* Nitroglycerin 0.4 mg SL
* Heparin loading dose
  60 Unit(u)/kg (max 4000 u)
* Infusion 12 u/kg/hr
  (max 1000 u/hr)
* Beta-blocker Lopressor
  5 mg IV q 5 mins x3

Zone 2
Zone 1 protocol with the addition of
* ½ dose tenectaplaste
CPR Quality???
Security ?
Aviability
But not so easy...
Nancy’s exemple

<table>
<thead>
<tr>
<th></th>
<th>Total N=46</th>
<th>Before OSCAR-ECLS* Period (n=14)</th>
<th>OSCAR-ECLS Period (n=32)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No and low flow times prior to catheterization laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Flow (min)</td>
<td>0 (0 - 2)</td>
<td>2 (0 - 5)</td>
<td>0 (0 - 2)</td>
<td>0.057</td>
</tr>
<tr>
<td>No Flow + Delay to hospital (min)</td>
<td>67 (55 - 78)</td>
<td>80 (71 - 88)</td>
<td>60 (51 - 72)</td>
<td></td>
</tr>
<tr>
<td>Elapsed time to ECLS implantation (minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time from collapse to call Emergency Dispatcher Centre</td>
<td>0 (0 - 3)</td>
<td>3 (1 - 4)</td>
<td>0 (0 - 2)</td>
<td>0.002**</td>
</tr>
<tr>
<td>Time from call to arrival on site</td>
<td>14 (8 - 15)</td>
<td>12 (8 - 16)</td>
<td>15 (8 - 15)</td>
<td>0.43</td>
</tr>
<tr>
<td>Time on site</td>
<td>26 (22 - 40)</td>
<td>48 (40 - 54)</td>
<td>24 (20 - 28)</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>Transfer time</td>
<td>15 (10 - 20)</td>
<td>20 (14 - 22)</td>
<td>15 (9 - 18)</td>
<td>0.033**</td>
</tr>
<tr>
<td>Time from hospital arrival to ECLS implantation</td>
<td>19 (15 - 20)</td>
<td>19 (19 - 19)</td>
<td>18 (12 - 24)</td>
<td>0.73</td>
</tr>
<tr>
<td>Total time</td>
<td>86 (71 - 98)</td>
<td>99 (90 - 107)</td>
<td>80 (65 - 94)</td>
<td>0.0007**</td>
</tr>
</tbody>
</table>
European city with MICU
Transport-duration, median = 57 min

Asian city with Paramedics,
median time OHCA to ECPR = 57 min

In cities, distance is not the only factor influencing the delay…

Poppe et al. Resuscitation 91(2015) 131-6
Horizontal and Vertical limits of load and go strategy
Level of care for CA

What is the level of care during transportation?
Percutaneous

• San Diego at ER
• Step by step:
  • Stage 1: Venous and arterial lines
  • Stage 2: Guidewire replacement
  • Stage 3: ECPR
• Failure rate
• Anatomic variation
• Ultra sound per CA => no flow ...

Fig. 1. Case series patient flow diagram (ROSC, return of spontaneous circulation; RORS, resolution of refractory shock; ECLS, extracorporeal life support; ED ECPR, emergency department initiated extracorporeal cardiopulmonary resuscitation).

Bellezzo et coll Resuscitation 83 (2012) 966–970
ECPR Cannulation
femoral cutdown
ECPR Cannulation femoral cutdown
ECPR Cannulation femoral cutdown
Figure 3: Example of insertion of ECPR by non surgeon

Venous cannula

Artery cannula

Retrograde shunt to avoid ischemia of the leg

Venous cannula
ECPR Cannulation femoral cutdown
Failure rate: 7.4%

No difference between in and prehospital insertion
Prehospital ECPR: examples in Paris

On the road

Subway

Supermarket

Lamhaut et coll. PREHOSPITAL EMERGENCY CARE 2017
Le peuple guidant la liberté

Le radeau de la méduse
Figure 3: Effect of an aggressive strategy for refractory cardiac arrest by the different part of this step.

Protocol = Pre-hospital ECPR + Epinephrine ≤ 5 mg + Direct angiography

Survival

- Selection - Protocol -: 3%
- Selection + Protocol -: 19%
- Sélection + Protocole +: 38%
Helicopter

- CA with No flow: 0 min
- Alert – Take off: 18 min
- Alert – Pump activation: 50 min
- Low flow: 83 min
- Outcome Survivor CPC 1
University of Minnesota to design 'super ambulances' to hasten treatment of cardiac arrest

Equipped with enough technology to be a small hospital, a super ambulance could hasten treatment and improve patients' survival odds.
Resuscitation Team Leader
- Manage ALS
- Liaison with ECPR Team
- Discussion with family
- Assist ECPR Doctor

Resuscitation Nurse/Paramedic 1:
- Ventilatory support
- Medication
- Time keeping and flow of ALS process

Resuscitation Nurse/Paramedic 2:
- Manage scene
- Operate Mechanical CPR
- Supports ALS or BLS processes

ECPR Doctor:
- Patient selection with Team Leader
- Oversees implementation
- Establish cannulation

ECPR Paramedic/Nurse 2:
- Management of ECPR equipment
- Assist ECPR Doctor

ECPR Nurse 1:
- Prepare ECPR device
- Set up infusions for post ECPR phase

ECPR Nurse 2:
- Management of ECPR equipment
- Assist ECPR Doctor

BLS and ALS equipments
ECPR equipments

Hutin et coll Resuscitation
Photo 1: Prehospital ECPR Organization

Credit: SMACC Force Berlin

Hutin et coll Resuscitation
Selective Aortic Arch Perfusion (SAAP catheter)
SELECTIVE AORTIC ARCH PERFUSION (SAAP)
Early use of REBOA at RLH in ED Trauma Bay

Zone III REBOA for pelvic crush injuries
Prehospital REBOA Zone 1
ECPR and REBOA Course
Une nouvelle chaine de survie
Rescue Team course in Paris

www.paris-rescue-team.com

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