

Hypothermia stage IV

Which patients to rewarm?

The **HOPE** score

Dr Mathieu PASQUIER

Emergency Department, Lausanne University Hospital, Switzerland
ICAR 20.10.2018 Chamonix Mont-Blanc

Hypothermia IV => prehospital



Hypothermia stage IV =
Hypothermia and cardiac arrest

Potential for good outcome

“No one is dead until warm and dead”

Hypothermia IV => hospital



Does this patient may survive with proper treatment ?

ExtraCorporeal Life Support (ECLS) rewarming



Hypothermia IV => hospital



Service des urgences



Potassium

High

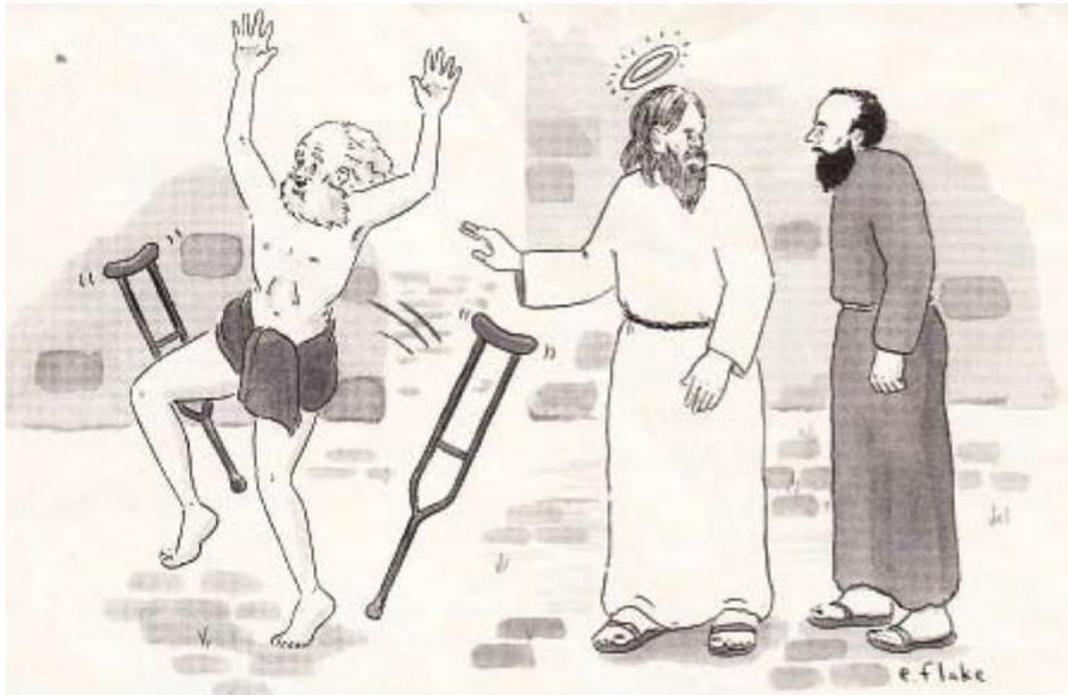
Low



ExtraCorporeal Life Support (ECLS) rewarming



Potassium triage: validated?



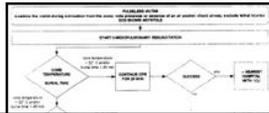
“Yeah, but good luck getting it peer-reviewed.”

Medical Theory

1994



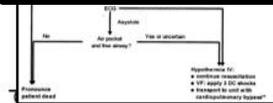
1996



2015



A self-fulfilling prophecy is a prediction that directly or indirectly causes itself to become true



What are the problems?



- ❄ Dichotomous approach based on sequential single variables (temperature, potassium)
- ❄ The evidence level is low
- ❄ The risk of bias is high
- ❄ Unique in emergency medicine to decide with one single biological parameter of life vs death
- ❄ A lot of potential prognostic factors or confounder in other ECLS studies are not included in the actual model

Key question



How can we better decide at hospital admission which hypothermic cardiac arrest patient would most benefit from ECLS rewarming?

=> Focus on the hospital decision



Service des urgences

Main goals:

- 1) to collect retrospectively enough cases of CA patients rewarmed with ECLS
- 2) to build a score to predict survival



Contents lists available at ScienceDirect

Resuscitation

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



Clinical paper

Hypothermia outcome prediction after extracorporeal life support for hypothermic cardiac arrest patients: The HOPE score[☆]



Mathieu Pasquier^{a,*}, Olivier Hugli^a, Peter Paal^b, Tomasz Darocha^c, Marc Blancher^d, Paul Husby^e, Tom Silfvast^f, Pierre-Nicolas Carron^a, Valentin Rousson^g

^a Emergency Department, Lausanne University Hospital, Lausanne, Switzerland

^b Department of Anesthesiology and Intensive Care Medicine, Hospitaller Brothers Hospital, Paracelsus Medical University, Strubergasse 21, 5020 Salzburg, Austria

^c Severe Accidental Hypothermia Center, Department of Anaesthesiology and Intensive Care, Medical University of Silesia, 055, Poniatowskiego 15, Katowice, Poland

^d SAMU 38, Pôle Urgences – Médecine Aiguë, CHU de Grenoble, BP 217, 38043 Grenoble Cedex 09, France

^e Department of Anesthesia and Intensive Care, Haukeland University Hospital, 5021 Bergen, Norway

^f Department of Anaesthesiology, Intensive Care and Pain Medicine, University of Helsinki and Helsinki University Hospital, PO Box 340, 00029 Helsinki, Finland

^g Institute of Social and Preventive Medicine, Lausanne University Hospital, route de la Corniche 10, 1010 Lausanne, Switzerland

Methods



- ❄ Systematic literature review of retrospective cohort studies
- ❄ Hospital unpublished data
- ❄ Patients in hypothermic cardiac arrest with ECLS rewarming
- ❄ Consecutive cases of a time interval
- ❄ Primary outcome : survival to hospital discharge
- ❄ Main goal : to build a score predicting survival

Population (derivation cohort)



286 patients



Population (derivation cohort)



Table 1

Univariate associations between potential predictors and survival. All predictors apart the rewarming method were significantly associated with survival.

	Overall (n = 286)	Survivors 106/286 = 37%	Non-survivors 180/286 = 63%	P value
Continuous potential predictors, median (IQR)				
Age (years)	35 (16–55)	40 (18–56)	29.5 (13–54)	0.035
Temperature (°C)	24 (22–27)	23 (21–25)	25 (22–28)	< 0.001
Potassium (mmol/L)	4.7 (3.6–6.6)	3.8 (3.1–4.65)	5.8 (4.0–8.0)	< 0.001
CPR duration (min)	120 (85–169)	106 (64–165)	120 (90–169)	0.013
Categorical potential predictors, n (%)				
Gender				
Female				
Male				
Mechanism				
Exposure			98/283 = 35%	
Immersion			40/283 = 14%	
Submersion			94/283 = 33%	
Avalanche			51/283 = 18%	
Cardiac rhythm				
Asystole				
Ventricular fibrillation				
PEA				
CA Circumstances				
Unwitnessed				
Witnessed CA	85/250 = 34%	48/85 = 56%	37/85 = 44%	
Type of ECLS				P = 0.228
CPB	201/286 = 70%	70/201 = 35%	131/201 = 65%	
ECMO	85/286 = 30%	36/85 = 42%	49/85 = 58%	

Mechanism

Exposure

98/283 = 35%

Immersion

40/283 = 14%

Submersion

94/283 = 33%

Avalanche

51/283 = 18%

} 51% asphyxia

There were 9 missing values (3 for the survivors, 6 for the dead) for the potassium and 16 for CPR duration (5 for the survivors, 11 for the dead). CA denotes Cardiac Arrest, CPB Cardiopulmonary Bypass, CPR Cardiopulmonary Resuscitation, ECLS Extracorporeal Life Support ECMO Extracorporeal Membrane Oxygenation, PEA Pulseless Electrical Activity.

❄️ **37% survivors to hospital discharge (106/286)**

❄️ **84% survivors with good neurological outcome**

Multivariable analysis



- Score **HOPE** =
Hyperthermia Outcome Prediction after ECLS
- Age
 - Gender
 - Mechanism
 - Potassium
 - Temperature
 - Witnessed cardiac arrest
 - Initial cardiac rhythm
 - Low flow
 - Type of ECLS

The HOPE score



Swisscom 21:03 97%

urg-admin.ch

Hypothermia Outcome Prediction after ECLS

Hypothermia Outcome Prediction after Extracorporeal Life Support for Hypothermic Cardiac Arrest Patients. The HOPE Score.

Mobile Version

The HOPE score is the result of an international collaborative project initiated and led by the Emergency Department of the University Hospital of Lausanne, Switzerland.

The HOPE score provides a prediction of the

Swisscom 21:04 97%

urg-admin.ch

Age (in years)

Gender

Male Female

Hypothermia

with asphyxia (head fully covered by water or snow)

without asphyxia (immersion, outdoor or indoor cold exposure)

CPR duration (min)

Swisscom 21:05 97%

urg-admin.ch

Serum Potassium (mmol/L)

Serum potassium level at admission

Temperature scale

Celsius Fahrenheit

Temperature

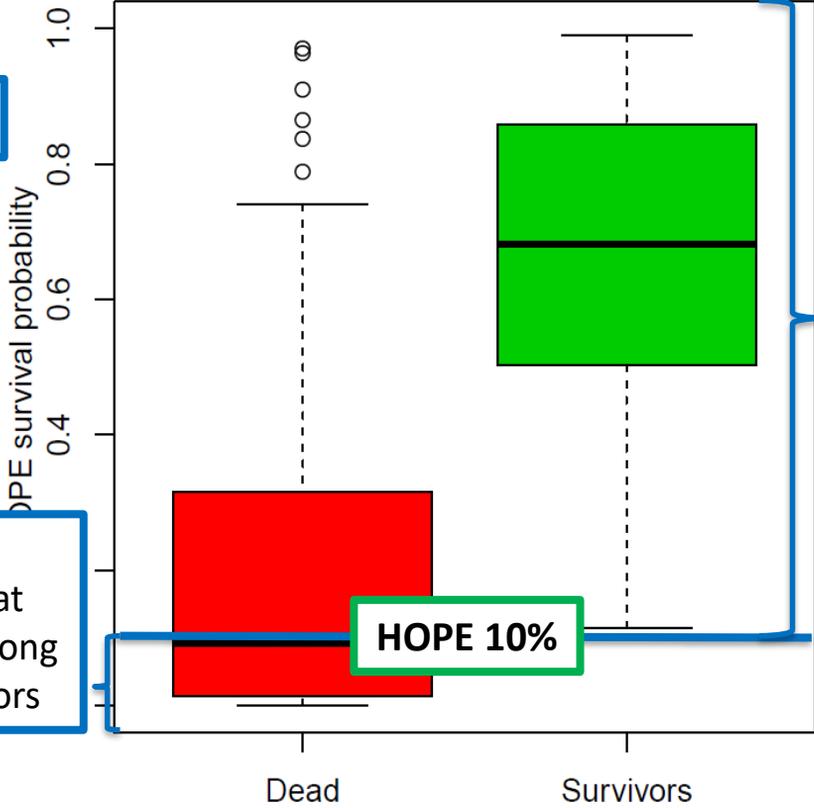
[-> Click here to get the HOPE survival probability <-](#)

reset

www.hypothermiascore.org

Specificity

51%



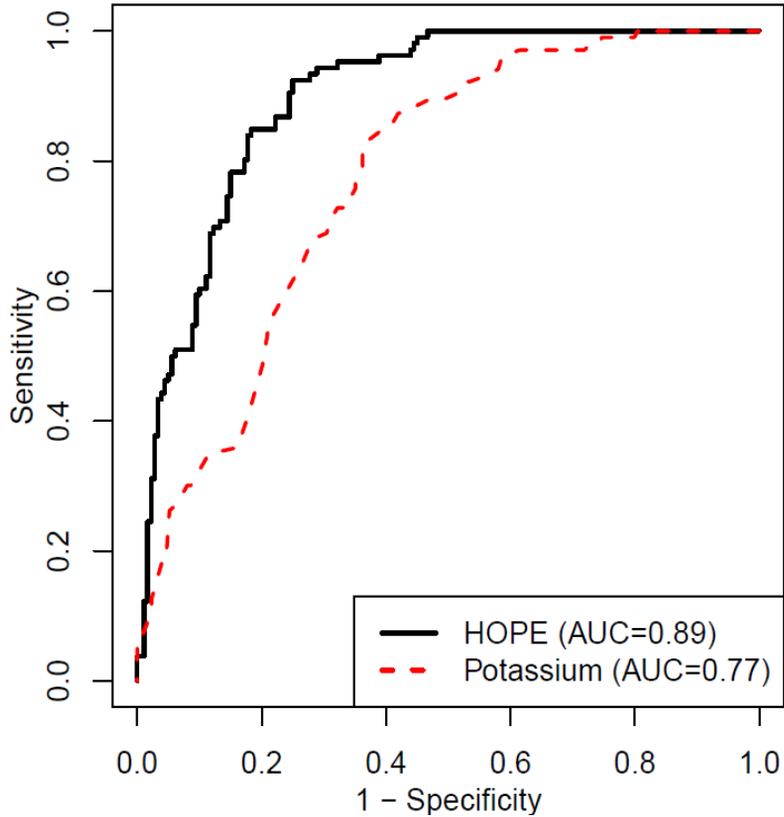
Specificity = probability that HOPE < 10% among the non-survivors

Sensitivity = probability that HOPE ≥ 10% among the survivors

Sensitivity

100%

HOPE vs potassium



HOPE clinical usefulness



Potassium	>12	≤ 12	
	5	58	37
	Rewarming not indicated	Futile rewarming (non-survivors)	Successfull rewarming (survivors)
	32	31	37
HOPE	< 0.10	≥ 0.10	

- ❄ Bootstrapping
- ❄ Year of data collection
- ❄ Origin of the data
- ❄ Hospital (lack of statistical evidence for a “center effect”)

Population (validation cohort)



❄ N=>100 cases

❄ Published or unpublished

❄ Results: validation is OK

❄ Publication end 2018

Discussion



- ❄ Multivariate outcome prediction
- ❄ Six independent survival prediction parameters
- ❄ Paradigm shift from dichotomous to multivariable outcome prediction
- ❄ Tool for meaningful ECLS rewarming
- ❄ Improved discrimination between good and poor outcome

Conclusion



HOPE score

-  Performs better than potassium alone
-  Avoids futile rewarming attempts (↓overtriage)
-  Helps motivating ECLS teams for cases with potential for good outcome (↓undertriage)

HOPE score

-  Internally validated
-  Externally validated
-  Beware of “extreme cases”



mathieu.pasquier@chuv.ch