Le point Physiopathologie

Hypothermie accidentelle

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Urg'Ara

Accident de SKI

Grade B Bassin
Choc hémorragique
Prise en charge médicale = OK

Probabilité de survie > 60%

T°= 36.6°c

Probabilité de survie < 20%

T°= 33.8°c

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AC dans un parc

Probabilité de survie 5O %

Image Passeport santé

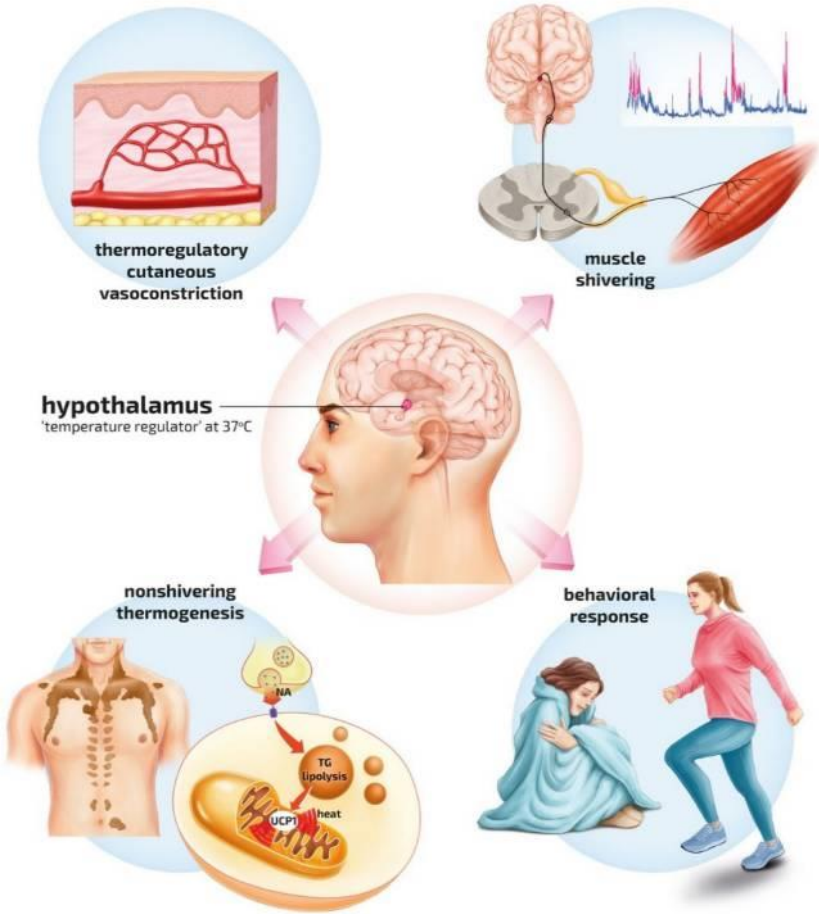
Probabilité de survie 1O %

Physiologie

Thermorégulation

Produire de la chaleur

Eviter de perdre de la chaleur



Paal 2022, Int J Env Public health

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Hypothermie Primaire

Baisse de Production de chaleur

- ✓ Age extrêmes
- ✓ Epuisement
- ✓ Pathologies neuro musculaires
- ✓ Malnutrition

Augmentation des Pertes de chaleur

- ✓ Brulés,
- ✓ Vaso dilatation (Alcool, médicaments)
- ✓ Iatrogène (transfusion, perfusion..)

Troubles de la thermo régulation

- ✓ Neurologiques (AVC, malformations)
- ✓ Métaboliques (hypopituitarisme, hypoglycémie ..)
- ✓ Etats de choc

Hypothermie Secondaire

Indice de refroidissement éolien
Températures ressenties en fonction de l'exposition au vent (°C)

Vitesse du vent (km/h)	0	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
	5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
	10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
	15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
	20	1	-5	-12	-18	-24	-31	-37	-43	-49	-56	-62	-68
	25	1	-6	-12	-19	-25	-32	-38	-45	-51	-57	-64	-70
	30	0	-7	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
	35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
	40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
	45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-68	-75
	50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-70	-76
	55	-2	-9	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
	60	-2	-9	-16	-23	-30	-37	-43	-50	-57	-64	-71	-78
	65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
	70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-73	-80
	75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
	80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

Risque faible | Risque modéré | Risque élevé | Danger

Exposition au vent

-2°c par heure (+ si vent fort)

Immersion dans l'eau froide

*-1° toutes les **3 min***

Pour une eau à 2°c - T°: 27°c en 30 min

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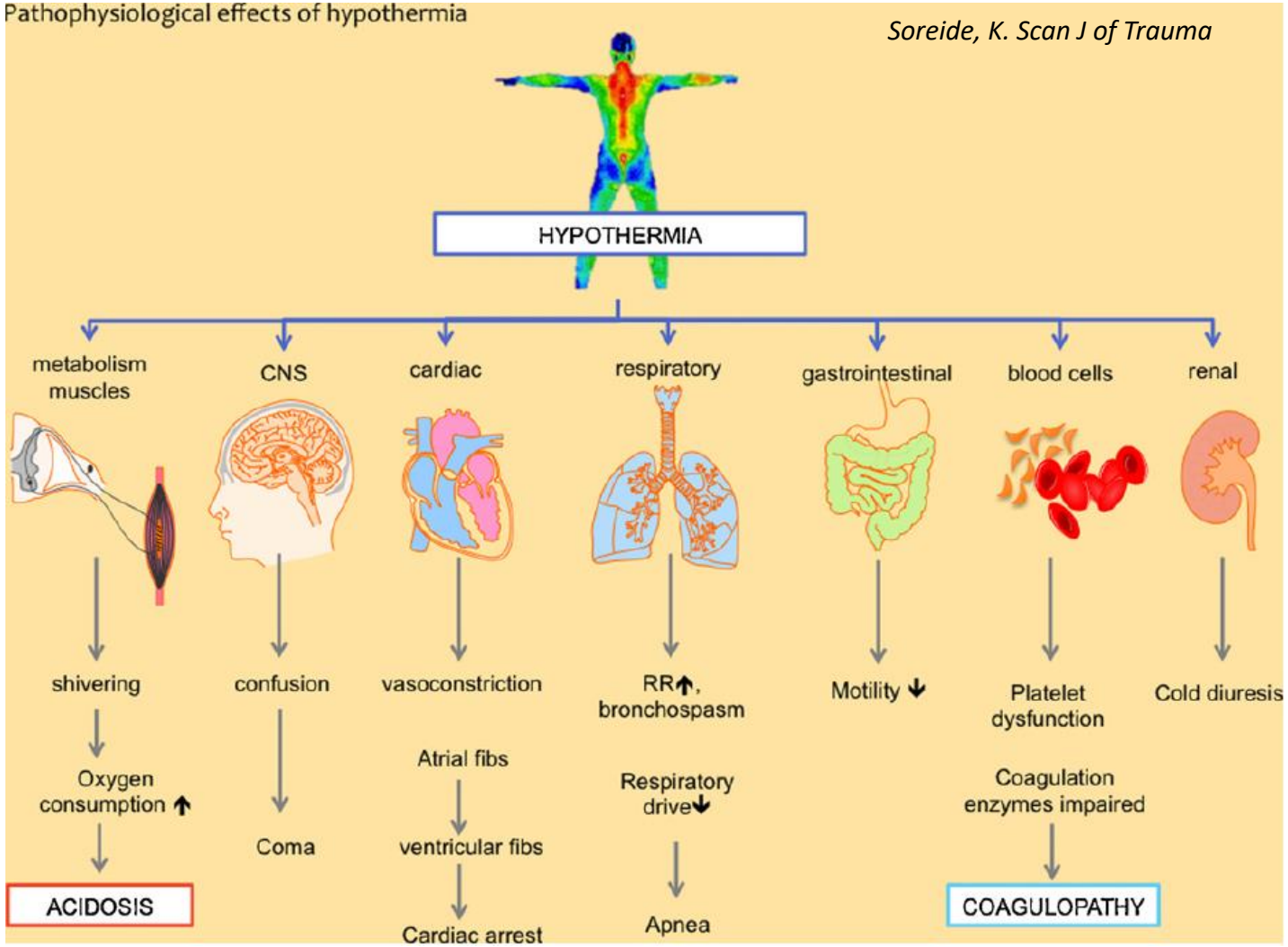
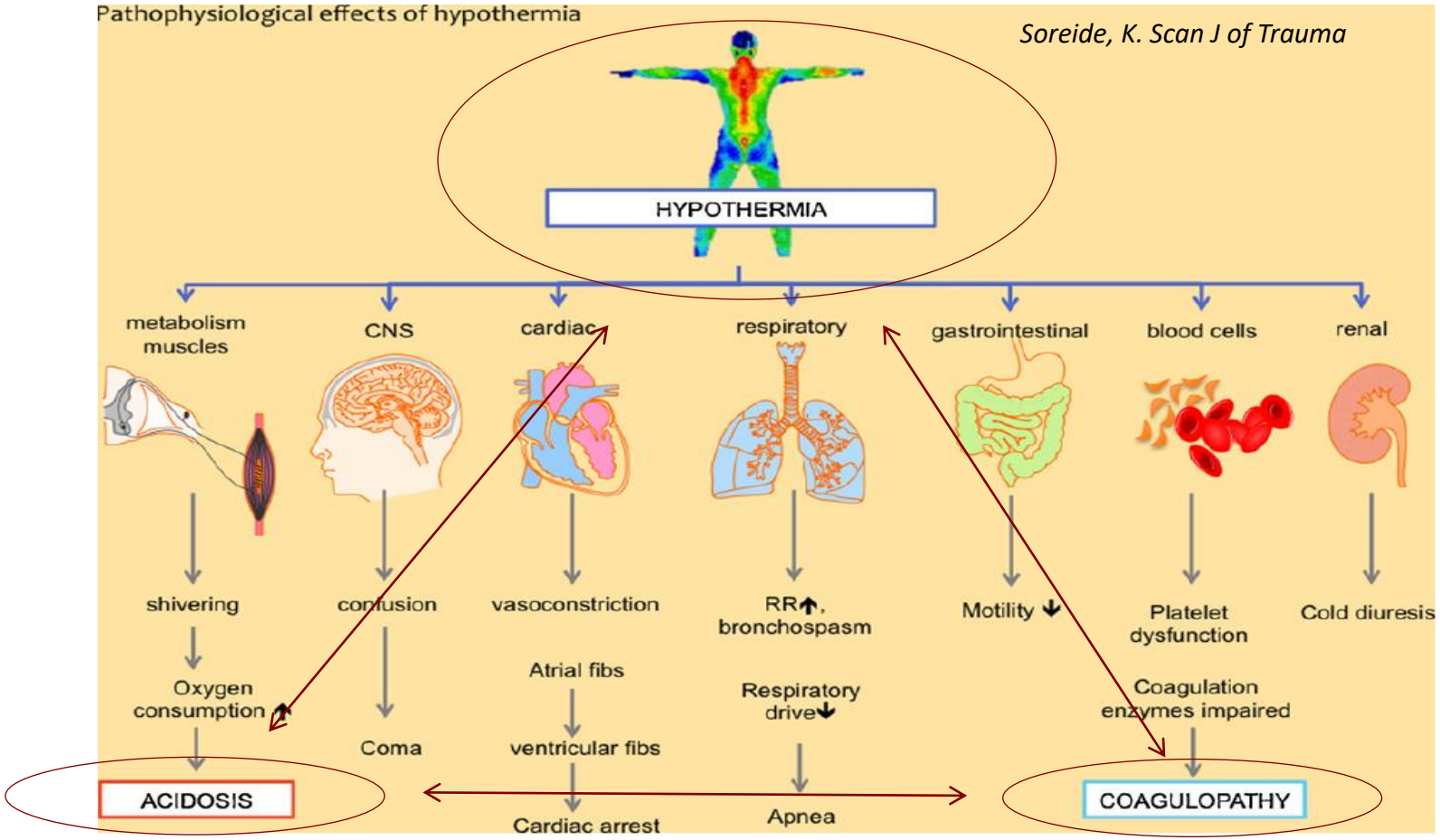


Soreide, K. Scan J of Trauma

TRAUMA



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Le froid et le Traumatisé sévère

Augmente la mortalité

- 40% < 34°c
- 69% < 33°c
- 100% < 32°**c**

Balvers K et al (2016*)*
Hypothermia as a predictor for mortality in trauma patients at admittance to the intensive care unit. **J Emerg Trauma Shock 9:97–102**

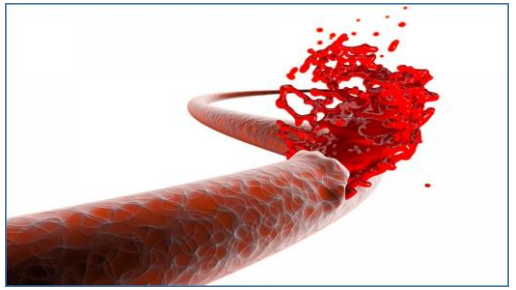
Vardon et al (2016)
Review Accidental Hypothermia in sever trauma patients. **Anesth. Crit Care Pain Med …**

Choc hémorragique et Hypothermie

-1°c = - 10% de fonction de coagulation

« a temperature lower than 34 °C was associated with a
greater inde- pendent risk of mortality of more than 80 % after controlling for differences in shock, coagulopathy, in- jury severity and transfusion requirements (OR 1.87; 95 % CI 1.18 to 3.0; P = 0.007) »

Spahn et al. Crit Care 2019



Reco EU Choc hémorragique

In order to optimise coagulation, we recommend early application of measures to reduce heat loss and warm the hypothermic patient to achieve and maintain normothermia. (Grade 1C)

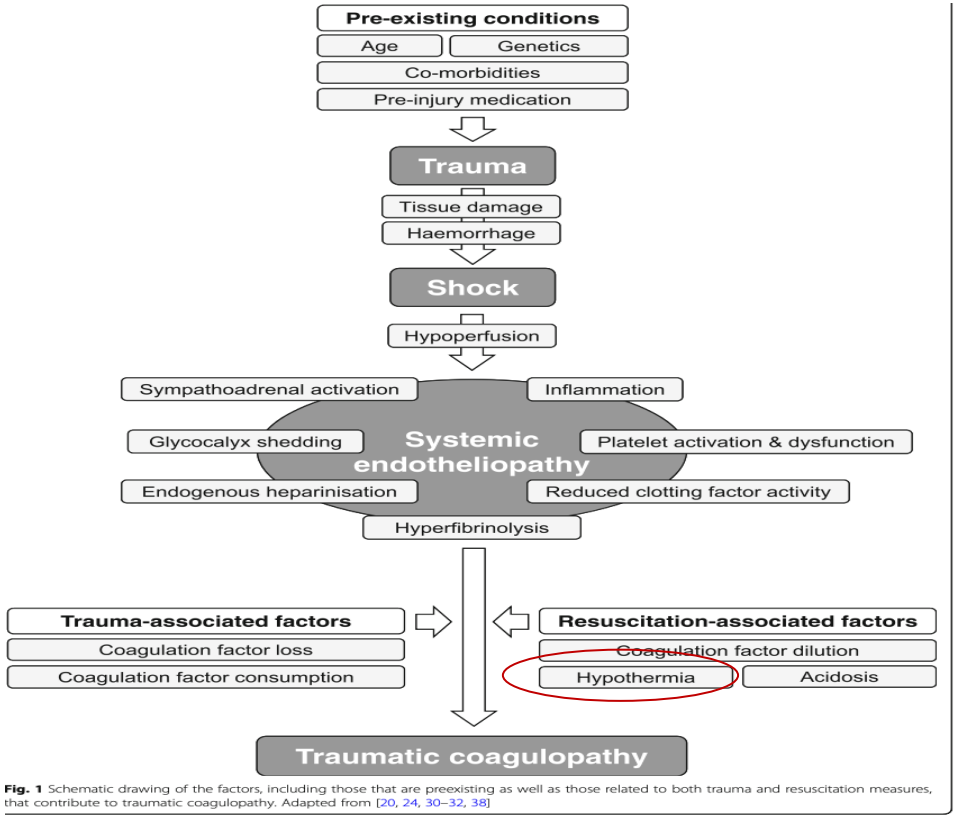
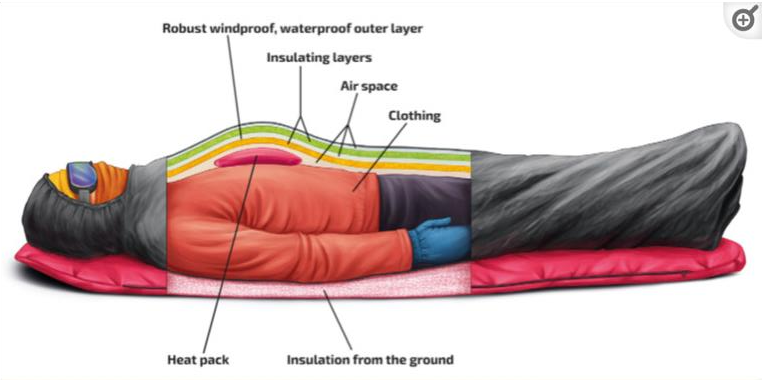


Fig. 1 Schematic drawing of the factors, including those that are preexisting as well as those related to both trauma and resuscitation measures, that contribute to traumatic coagulopathy. Adapted from [20, 24, 30–32, 38]

Spahn et al. Crit Care 2019

Poland 2018

Warm Chain of Survival



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Métabolisme cellulaire cérébral en hypothermie

(Ann Thorac Surg 2002;73:191–7)

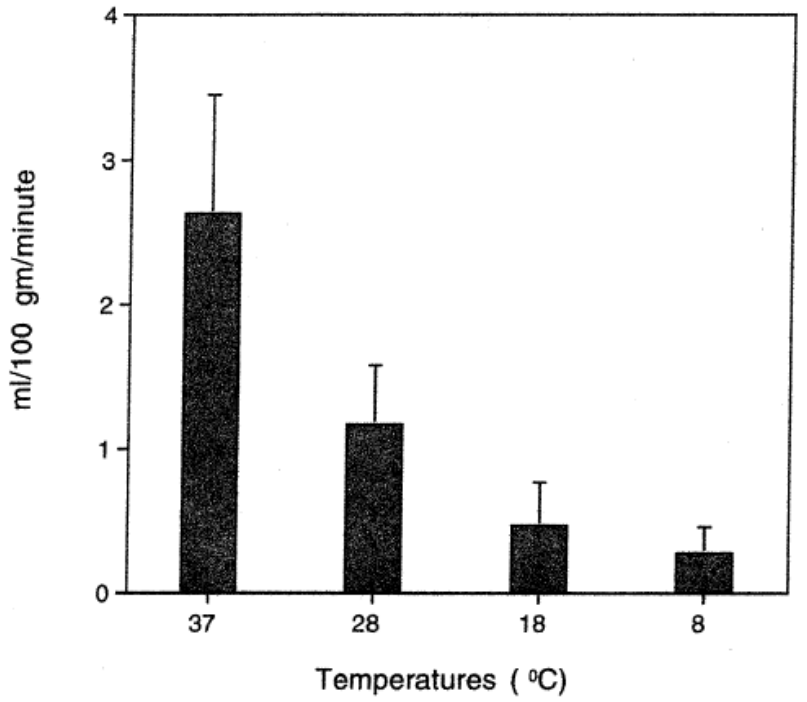

Fig 3. Cerebral oxygen consumption ($CMRO_2$) on cardiopulmonary bypass measured in all 12 pigs as described in the text. Data are from Table 3. When the percentage of base line $CMRO_2$ is calculated for each pig at each temperature, for the two groups of pigs combined mean percentage of base line $CMRO_2$ (95% confidence limits) is 50% (35%, 65%) of base line at 28°C; 19% (13%, 25%) of base line at 18°C; and 11% (6%, 16%) of base line at 8°C.

12 cochons

Refroidis de 37 ° c à 8 ° C + CPB

Mesure :

- Débit sanguin cérébral,
- Consommation O2,
- Résistances vasculaires cérébrales

- 6% par ° c perdu

50 % du niveau de base à **28° c**

19% du niveau de base à **18° c**

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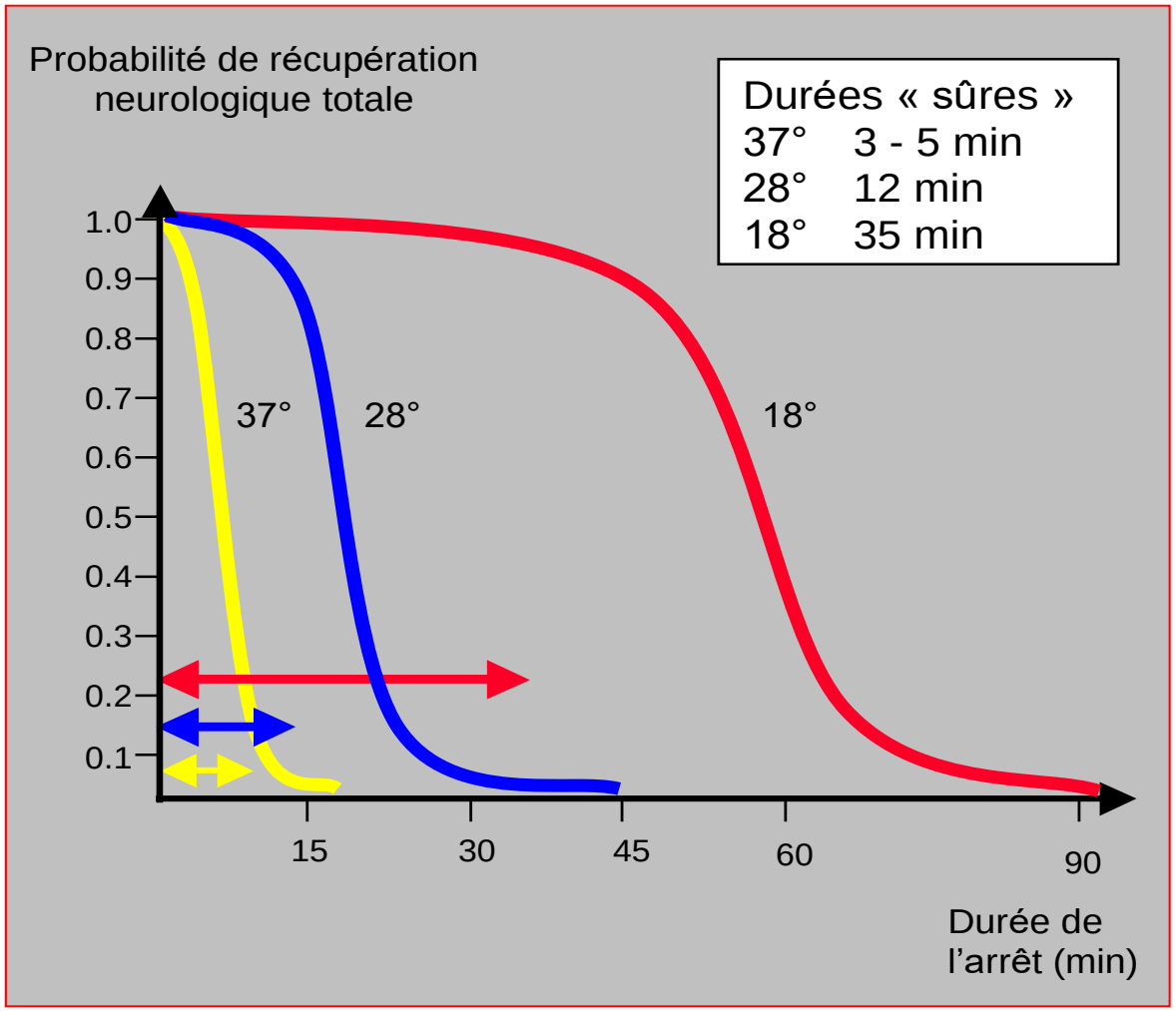
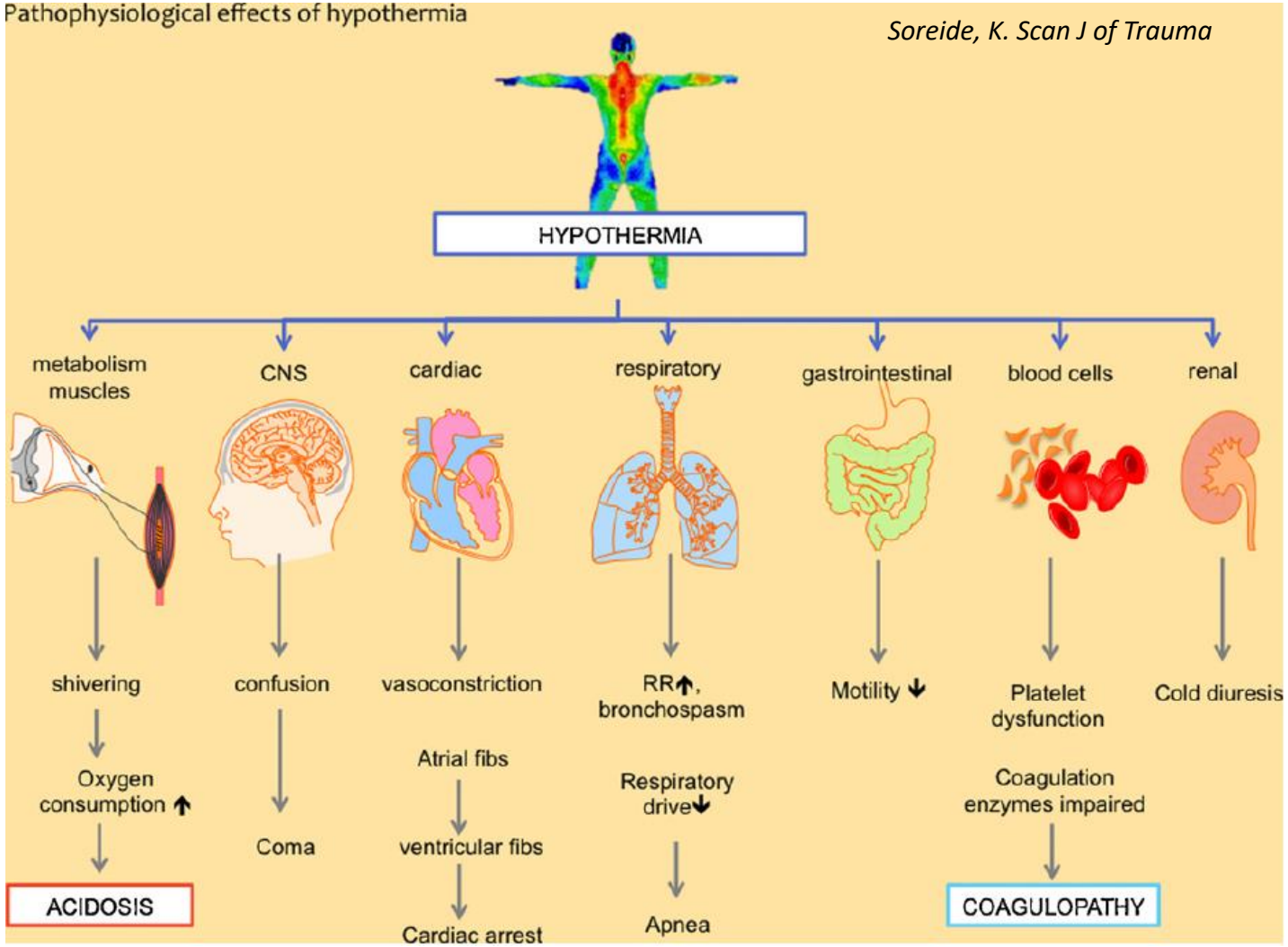


Figure 18.26 : Nomogramme d'une estimation de la probabilité de récupération neurologique complète après un arrêt circulatoire total à trois différentes températures du cerveau (d'après réf 126). Les durées dites sûres sont représentées par les flèches de couleur.



Soreide, K. Scan J of Trauma

Paramètres vitaux selon la Température

TABLE 3. EXPECTED VITAL SIGNS ACCORDING TO HYPOTHERMIA STAGE

Vital sign	*35°C*	*32°C*	*30°C*	*28°C*	*26°C*	*24°C*	*22°C*	*20°C*
Respiratory rate, breaths/min	20	18	17	16	15	14	13	12
Heart rate, beats/min	82	74	69	64	59	54	49	44
Systolic blood pressure, mmHg	139	126	118	109	100	91	83	74
GCS	15	13	11	9	8	6	4	3

https://www.hypothermiascore.org/vital-signs

Pasquier et al , HAMB (2020)

Température en fonction des Paramètres vitaux

Table 2 – Comparison between the original Swiss staging system for accidental hypothermia and the Revised Swiss System. AVPU – Alert, Verbal, Pain, Unresponsive.

	Original Swiss System [11] Clinical findings (estimated core temperature)	Revised Swiss System	Risk of hypothermic cardiac arrest
Stage 1	Clear consciousness with shivering (35–32 °C)	"Alert" from AVPU	Low
Stage 2	Impaired consciousness without shivering (32 –28 °C)	"Verbal" from AVPU	Moderate
Stage 3	Unconsciousness (28–24 °C)	"Painful" or "Unconscious" from AVPU **AND** Vital signs present	High
Stage 4	Apparent death (<24 °C)	"Unconscious"" from AVPU **AND** No detectable vital signs	Hypothermic cardiac arrest

	Stage 1	Stage 2	Stage 3	Stage 4
Clinical findings[a]	"Alert" from AVPU	"Verbal" from AVPU	"Painful" or "Unconscious" from AVPU **AND** Vital signs present	"Unconscious" from AVPU **AND** No detectable vital signs[b]
Risk of cardiac arrest[c]	**Low**	**Moderate**	**High**	**Hypothermic cardiac arrest**

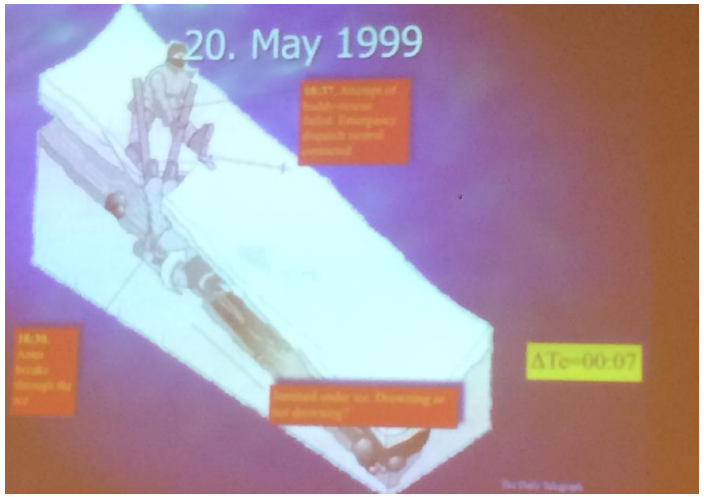
https://www.hypothermiascore.org/vital-signs

Musi et al , ICAR Recomandation Resuscitation (2021)

« Nobody is dead untill warm and dead »

Case report : le cas d'Anna Bagenholm

13.7 ° c record du monde de l'hypothermie accidentelle la plus profonde



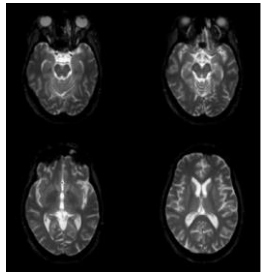
Lancet. 2000 Jan .Gilbert M, Busund R, Skagseth A, Nilsen PA, Solbø JP.

Never Give Up !

Tromso au nord de la Norvège
Ski de randonnée
Tombée dans un ruisseau
Sortie en AC
ECLS / CPB
Récupération complète

Neurologic Recovery From Profound Accidental Hypothermia After 5 Hours of Cardiopulmonary Resuscitation

Yvonnick Boue, MD[1,2,3]; Julien Lavolaine, MD[1]; Pierre Bouzat, MD, PhD[1,2,3]; Sophie Matraxia, MD[4]; Olivier Chavanon, MD, PhD[5]; Jean-François Payen, MD, PhD[1,2,3]



Critical Care Medicine
February 2014 • Volume 42 • Number 2

Femme 55 ans , épuisement dans la tempête en montagne.

Risques avalanche ++

Arrivée des secours : signes de vie puis AC en FV

Échec CEE / Adrénaline (IO)

Alternance RCP (1 min) / No flow pour descente (1 min) jusqu'à l'ambulance

Total no flow 12 - 13 min

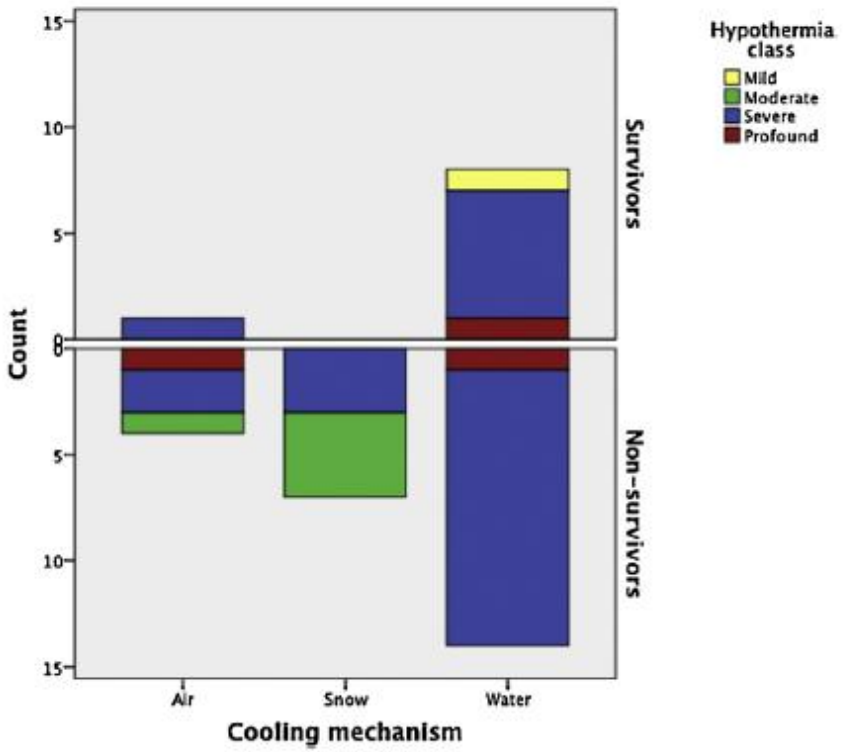
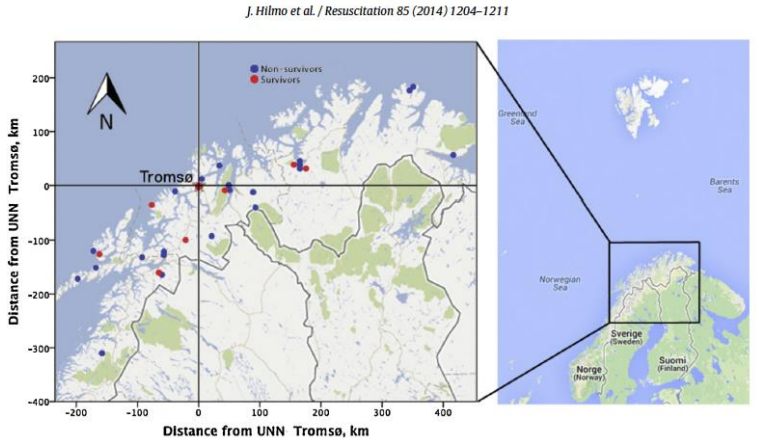


Fig. 2. Cooling mechanism and hypothermia classes in 34 patients with accidental hypothermic cardiac arrest admitted to the University Hospital of North Norway (UNN Tromsø) in the period 1985–2013.

34 Arrêt Cardiaque Hypothermique (Stade IV) 1985 – 2012

9 Survivants (tous après le cas Anna B)
8 Immergés dans l'eau dont 5 noyés (submersion)
Aucun avalanché hypotherme survivant



Une noyade (submersion) dans l'eau froide (< 6°) doit être réanimée

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- ✓ **Danemark, un Dragon boat chavire à 500 m du bord en hiver dans une eau à 2° c**
- ✓ **14 Victimes retrouvées immergées pendant 2 h, non noyées**
- ✓ **7 en AC**
- ✓ **7 avec activité circulatoire**

11.00	• 13 adolescents 2 adults leaves Praesto harbor in a dragon boat
11.22	• The boat capsizes during attempt to turn, and all occupants are immersed in 2ºC saltwater
12.43	• A 16 year old girl manage to swim ashore and alerts emergency services
13.10	• First unconscious victim rescued by emergency services
14.19	• First victim started on extracorporeal circulation
15.33	• Last of 7 victims with circulatory arrest started on extracorporeal circulation

Fig. 1. Time course of accident.

M. Wanscher et al. / Resuscitation 83 (2012) 1078–1084

Survie 100% dont 80 % avec état neurologique normal !

Table 1
Ustein style report of 14 victims. Victims #1–7 were recovered with circulatory arrest, victims #8–14 with spontaneous circulation.

Patient	Age (years)	Gender	Body mass index (kg/m^2)	Water temperature (°C)	Time to first EMS contact (min)	Glasgow coma scale	Airway intubation	Duration chest compression	Core temperature (°C)	First recorded rhythm
#1	15	Male	21,8	2	121	3	N	57	16,0	VF
#2	16	Male	18,4	2	121	3	N	56	20,2	VF
#3	15	Male	21,6	2	168	3	Y	65	18,4	Asystole
#4	16	Female	17,3	2	153	3	Y	88	15,5	PEA
#5	15	Female	24,0	2	168	3	Y	58	19,4	VF
#6	16	Male	22,7	2	108	3	Y	120	17,5	VF
#7	17	Male	21,6	2	108	3	Y	125	20,0	Asystole
Median (range)	16 (15–17)		21,1 (17,3–24,0)		121 (108–169)	3		65 (56–125)	18,4 (15,5–20,2)	
#8	16	Male	22,5	2	106	15	N	ND	34,2	Sinus
#9	16	Female	20,1	2	108	3	Y	1–2	23,0	PVC
#10	16	Female	24,7	2	91	15	N	ND	36,4	Sinus
#11	16	Female	22,9	2	104	12	N	ND	27,5	AFIB
#12	17	Female	26,8	2	96	15	N	ND	37,5	Sinus
#13	16	Female	27,7	2	113	15	N	ND	35,9	Sinus
#14	33	Female	22,5	2	96	12	N	ND	28,0	Sinus
Median (range)	16 (16–33)		23,8(20,1–27,7)*		104 (91–113)*	15 (3–15)*			28,0 (23,0–37,5)*	

Patient	Time to ECMO (min)*	pH	Lactate (mmol/l)		Temperature at ECMO termination	Duration of ECMO (min)	pH at ECMO stop	Length of hospital stay (days)	Glasgow coma scale at hospital discharge
#1	178	6,59	21,0	4,0	33,8	161	7,19	10	12
#2	179	6,62	18,0	3,6	32,9	149	7,15	10	15
#3	233	6,43	23,0	3,6	31,9	120	7,12	11	11
#4	241	6,61	24,0	4,0	36	245	7,30	10	15
#5	226	6,90	9,3	2,3	34	127	7,09	17	15
#6	228	6,52	22,0	3,6	35,4	109	7,18	11	14
#7	233	6,94	11,3	4,0	36,5	2614	7,38	10	15
Median (range)	226 (178–241)	6,61 (6,43–6,94)	21,0 (9,4–24)	3,6 (2,3–4,0)	34,0 (31,9–36,5)	149 (109–2614)	7,18 (7,09–7,38)	10 (10–17)	14 (11–15)
#8	ND	ND	ND	3,5	ND	ND	ND	2	15
#9	ND	7,00	4,7	4,2	ND	ND	ND	4	15
#10	ND	ND	ND	4,2	ND	ND	ND	2	15
#11	ND	7,27	0,9	4,3	ND	ND	ND	2	15
#12	ND	ND	ND	3,9	ND	ND	ND	1	15
#13	ND	7,33	0,9	3,8	ND	ND	ND	3	15
#14	ND	ND	ND	3,9	ND	ND	ND	2	15
Median (range)		7,27 (7,00–7,33)		3,9 (3,5–4,3)				2 (1–4)*	15

ECMO, extracorporeal membrane oxygenation; EMS, emergency medical services; N, no; ND, not done; PEA, pulseless electrical activity; PVC, premature ventricular contractions; VF, fine ventricular fibrillation; Y, yes.
* $p < 0,02$.

M. Wanscher et al. / Resuscitation 83 (2012) 1078–1084

M. Wanscher et al. / Resuscitation 83 (2012) 1078–1084

- ✓ **Automne : Un père et son fils en randonnée vers un refuge**
- ✓ Alerte par le fils : épuisés , le père (50 ans) raconte n'importe quoi

- ✓ Départ non médicalisé (secouristes seuls)
- ✓ Vent violent
- ✓ Difficultés d'accès
- ✓ **Contact : le père cesse de respirer à la première mobilisation**

Urg'Ara

- ✓ **Treuillage « one shot » : le père + un secouriste**
- ✓ RCP dans l'hélico : **No Flow 5 min**

- ✓ Relai med au CH de proximité
- ✓ Rythme : FV
- ✓ T° : 25°C
- ✓ **RCP mécanique > CHU > ECMO : Low Flow 2 h**

Urg'Ara

- ✓ **Examen : Pas de trauma, T° : 24,9°c**
- ✓ **Bio :** PH : 7.13 - Lactates : 7.46 – K^+: 3.71

- ✓ RACS
- ✓ Reprise de Cs
- ✓ Extubé à J2
- ✓ **Survie ad integrum à 3 mois**

Urg'Ara

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Quelques records publiés

- ✓ **No flow** le plus long : 70 min
- ✓ **Low Flow** le plus long : 6h30
- ✓ Record de T° (ACR), **13.7**°c pour une HT accidentelle et **9°C** pour une HT induite
- ✓ Record de T° (avec circulation spontanée) : **17°C**
- ✓ Le plus âgé réanimé avec succès : **95 ans**

Paal, Scan J. of trauma. Review 2015

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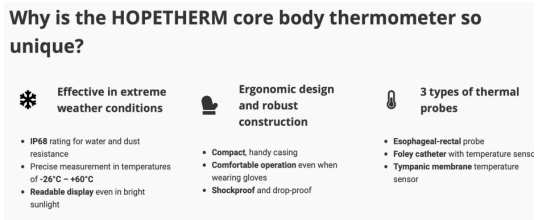
Séries compilées

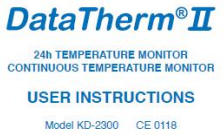
237 cas d'HT accidentelle en Arrêt cardiaque *(Survie CPC 1-2 : 30%)*

658 cas d'HT réchauffées par ECLS *(Survie CPC 1-2 : 40%)*

Pasquier, Resuscitation 2018
Saczkowskia, Resuscitation 2018

Mesurer





- ✓ **Compliqué pour les patients avec des signes vitaux**
- ✓ Conduit auditif externe (dégagé), proche des gros Vx
- ✓ Technique de **thermistance** uniquement
- ✓ Infra rouge / mercure ou autre **NON FIABLE**
- ✓ Oro pharynx à 8 cm de l'arcade dentaire = Possible

Why is the HOPETHERM core body thermometer so unique?

Effective in extreme weather conditions

- **IP68** rating for water and dust resistance
- Precise measurement in temperatures of **-26°C – +60°C**
- **Readable display** even in bright sunlight

Ergonomic design and robust construction

- **Compact**, handy casing
- **Comfortable operation** even when wearing gloves
- **Shockproof** and drop-proof

3 types of thermal probes

- **Esophageal-rectal** probe
- **Foley catheter** with temperature sensc
- **Tympanic membrane** temperature sensor

https://projektaed.com/hopetherm-core-body-temperature-monitor/


Temperature
HOUR
37,8° C
degree
cosinuss

- ✓ **Si Arrêt circulatoire**
- ✓ 1/3 moyen œsophage (en pré hospitalier)
- ✓ Sonde vésicale (intra hospitalier)

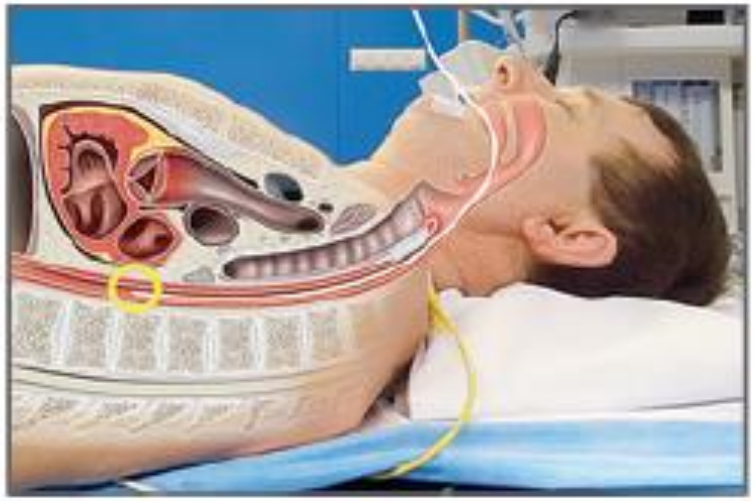


Figure 1. Position of the Esophageal Probe.

Pasquier, NEJM (2021),
vidéo in clinical medecine

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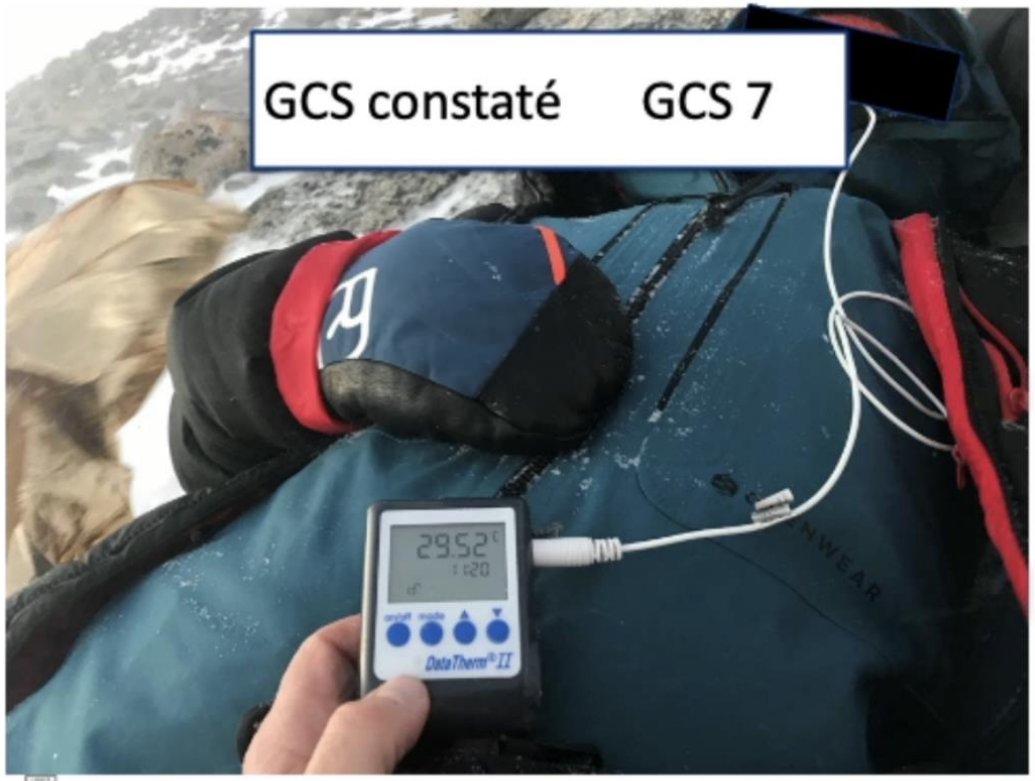
Estimation de la clinique d'après la température



https://www.hypothermiascore.org/vital-signs

Pasquier et al , HAMB (2020)

HOPE
Hypothermia Outcome Prediction after ECLS

Pasquier et al , HAMB (2020)

TABLE 3. EXPECTED VITAL SIGNS ACCORDING TO HYPOTHERMIA STAGE

Vital sign	*35°C*	*32°C*	*30°C*	*28°C*	*26°C*	*24°C*	*22°C*	*20°C*
Respiratory rate, breaths/min	20	18	17	16	15	14	13	12
Heart rate, beats/min	82	74	69	64	59	54	49	44
Systolic blood pressure, mmHg	139	126	118	109	100	91	83	74
GCS	15	13	11	9	8	6	4	3

Vital signs

Hypothermia is defined as a drop in core temperature below 35°C. This calculator provides an estimate of the expected vital signs based on the core temperature in patients with accidental hypothermia.

The estimate is based on a retrospective study including 216 patients with accidental hypothermia. In this study, core temperature was positively and significantly associated with each of the four vital signs. These results allow estimation of the vital signs to be expected for a given level of hypothermia when the core temperature is known. This should not be considered a substitute for clinical judgment or assessment.

Temperature (in Celsius)	29.5
Validate / submit	Submit

Expected vital signs: (Values have been rounded to the nearest unit)

Respiratory rate (min^{-1})	17
Heart rate (min^{-1})	68
Systolic blood pressure (mmHg)	115
Glasgow Coma Score	11

https://www.hypothermiascore.org/vital-signs

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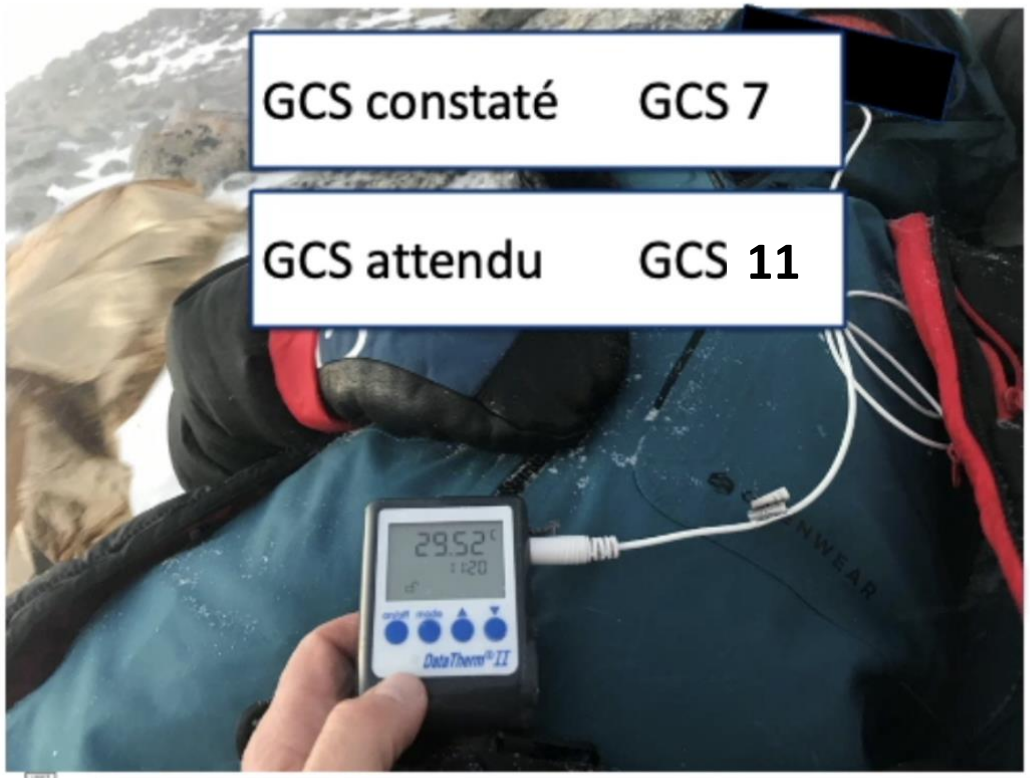
Estimation de la clinique d'après la température



CHUV

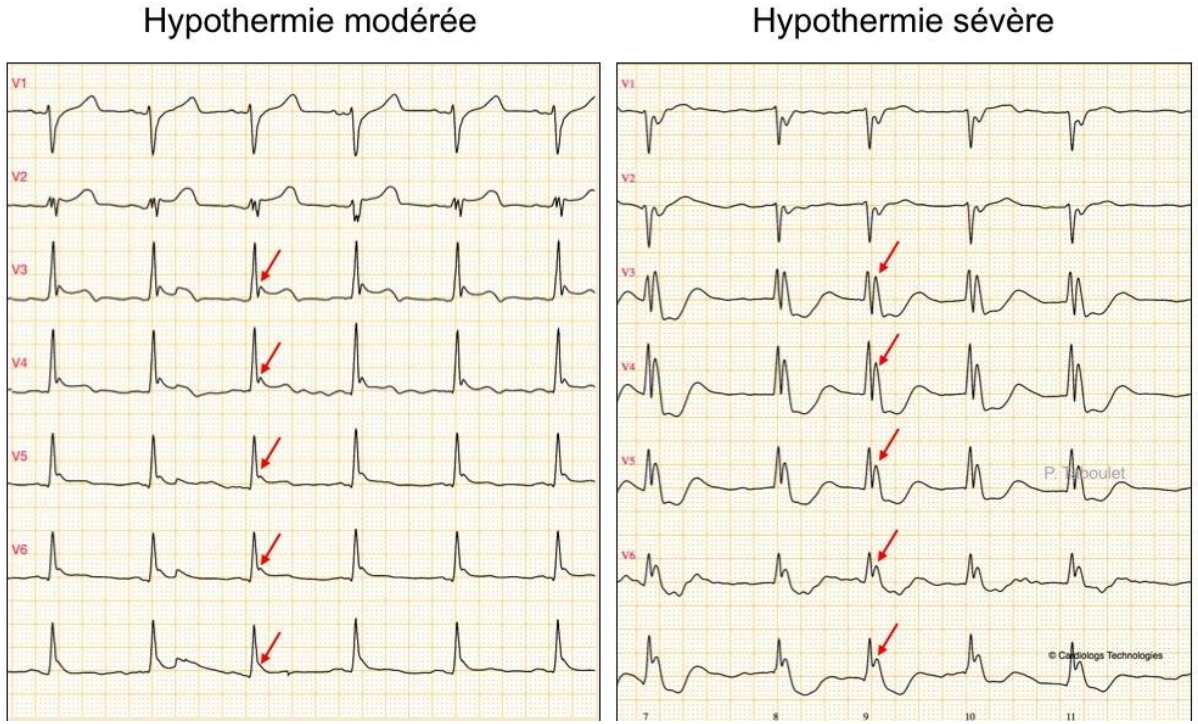
https://www.hypothermiascore.org/vital-signs

Pasquier et al , HAMB (2020)

Dextro : 2,02 mmol/l

Hypothermie et Cardio-Vasculaire

Onde J d'Osborn



- ✓ Baisse du débit cardiaque (dysfonction myocardique)
- ✓ Troubles de conduction
- ✓ à 30 °c : risques de FV (excitabilité myocardique et perméabilité conservée)
- ✓ à 17°c disparition du risque de FV

Tveita et al. Artic University Tromso 2018

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Hypothermie et EtCO2

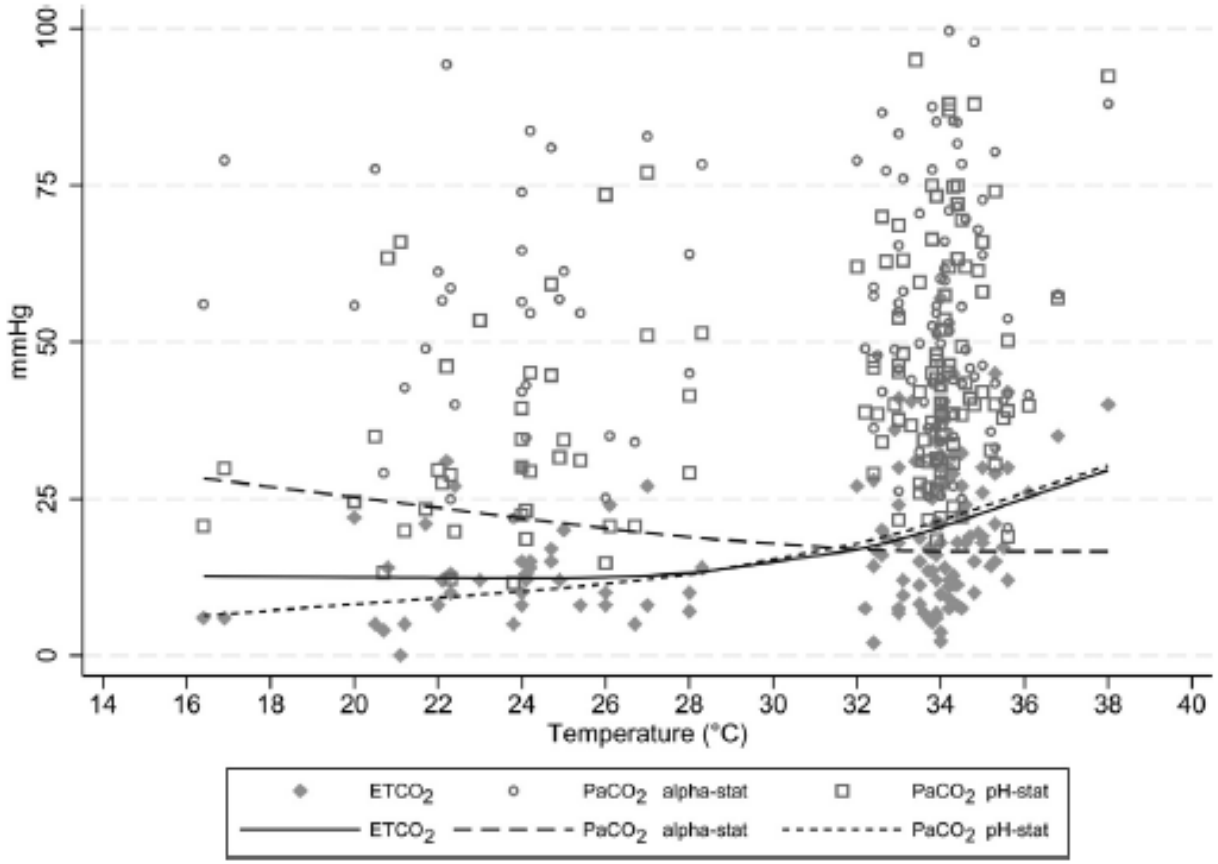

Fig. 2 – Relationship between $ETCO_2$ or $PaCO_2$ (alpha-stat or pH-stat) and temperature at hospital admission for cardiac arrest patients. The dots represent the unadjusted data. The two dashed lines represent the $PaCO_2$ (alpha-stat or pH-stat) adjusted for age, witnessed cardiac arrest, CPR duration and initial shockable rhythm.

Tomasz Darocha, Resuscitation 2022

Hypothermie et EtCO2

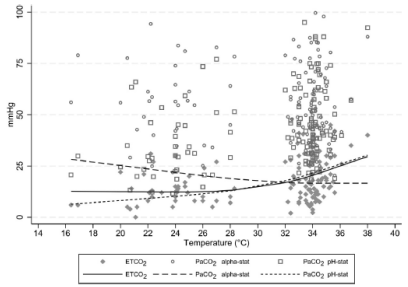

Fig. 2 – Relationship between $ETCO_2$ or $PaCO_2$ (alpha-stat or pH-stat) and temperature at hospital admission for cardiac arrest patients. The dots represent the unadjusted data. The two dashed lines represent the $PaCO_2$ (alpha-stat or pH-stat) adjusted for age, witnessed cardiac arrest, CPR duration and initial shockable rhythm.

Table 1 – Characteristics of the study population. CA: cardiac arrest; CPR: cardiopulmonary resuscitation; IQR: interquartile range; SD: standard deviation.

	Missing	Overall (n = 131)	Hypothermic CA (n = 39)	Normothermic CA (n = 92)	p-value
Overall characteristics					
Age (years), mean (SD)	0	51 (13)	56 (15)	49 (12)	0.01
Sex male, n (%)	0	110 (84)	29 (74)	81 (88)	0.10
Initial shockable rhythm, n (%)	29	81 (79)	4 (40)[a]	77 (84)	0.01
Witnessed cardiac arrest, n (%)	25	96 (91)	32 (82)	64 (96)	0.06
CPR duration (min), median (IQR)	1	100 (80–125)	135 (81–180)	95 (79–108)	0.01
Temperature (°C), mean (SD)	29	30 (5)	24 (3)	34 (1)	<0.001
Blood gas analysis					
$ETCO_2$ (mmHg), median (IQR)	0	15 (10–27)	12 (8–15)	18 (12–30)	<0.001
$PaCO_2$ alpha-stat (mmHg), median (IQR)[b]	29	56 (42–77)	57 (43–81)	53 (41–70)	0.15
$PaCO_2$ pH-stat (mmHg), median (IQR)[c]	0	40 (30–57)	30 (21–45)	43 (35–62)	<0.001
pH, mean (SD)	0	7.02 (0.22)	6.96(0.23)	7.04 (0.21)	0.06
PaO_2 (mHg), median (IQR)	0	98.7 (60.8–217)	66 (51–89)	137 (78–225)	<0.001
HCO_3 (mmol/L), median (IQR)	8	12 (9–16)	11.5 (10–15)	12.5 (9–17)	0.52
Potassium (mmol/L), mean (SD)	5	4.7 (1.7)	4.9 (2.4)	4.6 (1.2)	0.34
Haemoglobin (g/L), median (IQR)	12	122(110–141)	115 (99–143)	123 (111–140)	0.20
Lactate (mmol/L), median (IQR)	1	13 (9–16)	10 (7–15)	13 (9–17)	<0.01

[a] The initial CA rhythm was available for only 10/39 of the hypothermic patients.
[b] Because of missing data for the temperature in 29 patients, the original values measured with the pH-stat $PaCO_2$ method could not be estimated to correspond to alpha-stat $PaCO_2$ values.
[c] Includes 31 patients with alpha-stat $PaCO_2$ These values were converted to pH-$PaCO_2$.

- Survie : 20/39 (**52 %** des Hypothermes) Vs 17/92 (**18 %** des normothermes)
- 9/20 (45%) des survivants d'un AC hypotherme avaient une EtCO2 < 10

L'ETCO2 ne doit pas être utilisée comme critère d'arrêt de la réanimation dans un AC lié à une hypothermie accidentelle

Tomasz Darocha, Resuscitation 2022

Hypothermie et Potassium (K+)

Review

The impact of hypothermia on serum potassium concentration: A systematic review

Sarah Buse[a], Marc Blancher[b], Damien Viglino[b], Mathieu Pasquier[c], Maxime Maignan[b], Pierre Bouzat[d], Thorsten Annecke[a], Guillaume Debaty[b,*]

Resuscitation 118 (2017) 35–42

- *Etudes expérimentales (animal)*
- *Cases series, Cases reports*

Le froid et la membrane cellulaire

↘ **K+**

Hypo kaliémie à la phase initiale

Diminution globale de l'activité métabolique
(**pompe Na/ K tp ase**)
Shift intra cellulaire (K+ vers l'intra cellulaire)
Stimulation Béta 2 adrénergique (idem)
Effet stabilisateur de membrane (pas de sortie de K+)

Good Outcome…

Durée d'exposition au froid

Hyper kaliémie à la phase tardive

Lyse cellulaire , mort cellulaire
(Trouble de la perméabilité membranaire)

↗ **K+**

Bad Outcome…

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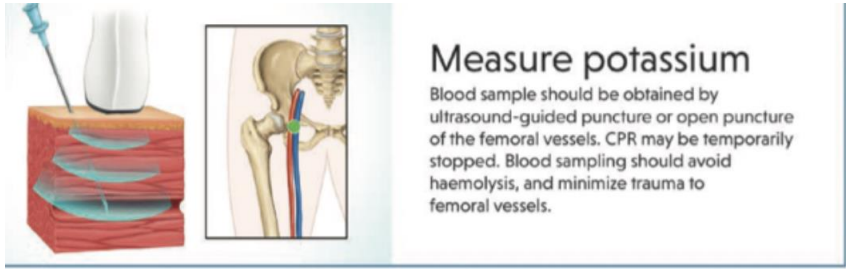
Table 2 Summary of potassium values according to the sampling sites and analytical method used

	Median (IQR)	Mean ± SD	Range
Blood gas analyser			
Central venous ($n = 12$)	4.36 (3.09–7.57)	5.66 ± 3.76	2.2–14.6
Femoral artery ($n = 14$)	4.75 (3.71–11.2)	7.09 ± 4.46	2.5–15
Peripheral venous ($n = 12$)	4.55 (3.65–7.4)	5.77 ± 3.23	2.6–13
Central laboratory			
Central venous ($n = 11$)	3.8 (3.1–6.4)	4.95 ± 2.84	2.1–11.3
Femoral artery ($n = 11$)	4.8 (4.04–10.3)	7.05 ± 5.08	3–19
Peripheral venous ($n = 11$)	4.2 (3.4–6.4)	5.72 ± 4.25	2.3–17.2



Intra-patient potassium variability after hypothermic cardiac arrest: a multicentre, prospective study

M. Pasquier[1*], M. Blancher[2], S. Buse[2], B. Boussat[2], G. Debaty[2], M. Kirsch[3], M. de Riedmatten[4], P. Schoettker[5], T. Annecke[6] and P. Bouzat[7]

Scan J. of Trauma, Resc. and Emerg. Med. 2019

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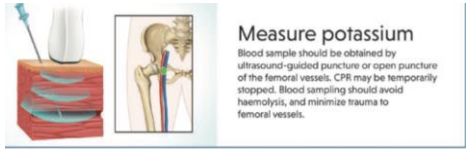
Table 1 Overall characteristics of the included patients ($n = 15$). *A* asystole, *CA* cardiac arrest, *CPC* Cerebral Performance Category, *CPR* cardiopulmonary resuscitation, *ECLS* extracorporeal life support, *F* female, *M* male, *NA* not available (including haemolysis), *PEA* pulseless electrical activity, *ROSC* return of spontaneous cardiac circulation, *VF* ventricular fibrillation

Patient	#1	#2a	#3	#4a	#5b	#6	#7	#8	#9	#10	#11b	#12	#13	#14	#15
Age	87	32	44	52	57	45	53	41	76	74	49	64	25	35	61
Gender	F	F	M	M	F	M	M	F	M	M	M	M	M	F	F
Asphyxia CA[a]	No	No	No	Yes	No	No	No	NA	No	No	No	No	Yes	No	No
No-flow duration (min)	0	10	0	180	0	NA	NA	NA	NA	1	5	0	18	0	0
Initial core temperature (°c)	25.0	24.0	25.0	24.7	24.1	11.0	8.0	25.6	17.0	26.0	25.0	19.9	24.0	24.3	28.3
First recorded rhythm	VF	A	VF	NA	VF	A	A	NA	A	A	VF	A	A	PEA	VF
CPR duration (low flow min)	10	78	215	38	43	NA	NA	165	99	54	145	117	87	45	55
Blood gas analyser															
Central venous potassium	3.5	NA	4.5	NA	NA	10.0	14.6	5.9	9.2	2.2	4.9	3.5	4.2	2.6	2.7
Peripheral venous potassium	4.25	NA	4.9	NA	3.0	10.4	13.0	6.4	8.4	3.9	NA	3.6	5.1	2.6	3.7
Arterial potassium	3.70	14.80	4.5	11.2	4.6	11.8	15.0	5.5	9.8	4.9	3.7	4.2	NA	2.5	2.9
pH	7.3	6.4	6.9	NA	7.1	7.0	6.9	NA	6.9	7.0	7.1	7.2	NA	7.2	7.3
Arterial lactates	11.2	22.5	3.5	16.1	4.9	12.9	8.6	18.2	9.6	5.0	8.6	6.9	NA	3.7	2.2
Central laboratory															
Central venous potassium	3.4	NA	NA	NA	3.8	11.3	NA	6.4	9.0	2.1	4.7	3.3	4.2	3.1	3.1
Peripheral venous potassium	4.6	NA	NA	NA	4.2	NA	17.2	6.4	9.1	2.3	3.4	3.5	5.5	3.0	3.7
Arterial potassium	4.0	NA	NA	NA	4.9	13.3	19.0	6.4	10.3	4.3	4.8	4.2	NA	3.0	3.3
Outcome															
ECLS	No	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ROSC	Yes	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No	Yes	Yes	Yes	No
Survival at hospital discharge	No	No	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes
CPC at 3 months for survivors	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1	1	1	1	1
HOPE Score	96%	17%	28%	1%	96%	NA	NA	NA	13%	NA	54%	74%	22%	98%	85%

[a]cases not eligible for analysis of primary outcome because of missing data
[b]cases for which missing data for blood gas analysis of either central or peripheral potassium were replaced by central laboratory data



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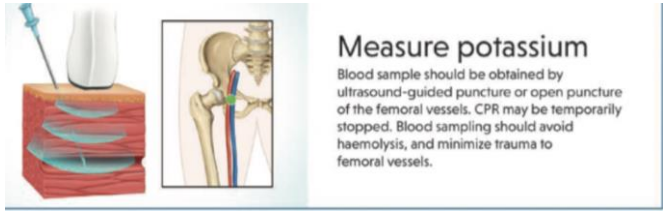
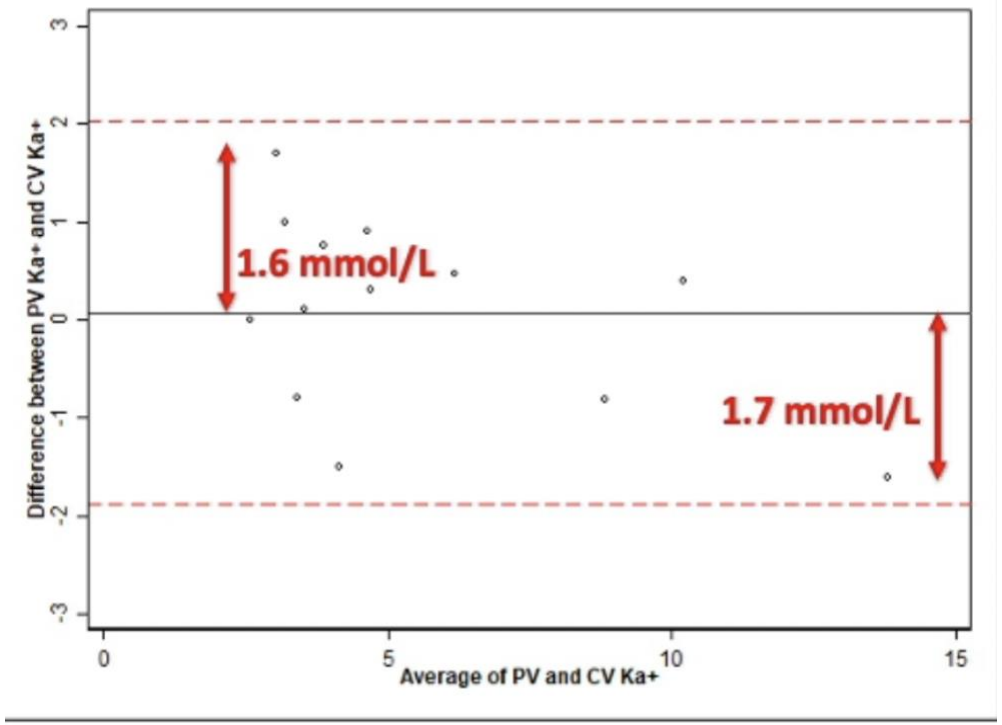




- ✓ Prélèvement échoguidé
- ✓ Veine fémorale
- ✓ Analyse sur le gazomètre

Intra-patient potassium variability after hypothermic cardiac arrest: a multicentre, prospective study

M. Pasquier[1*], M. Blancher[2], S. Buse[2], B. Boussat[2], G. Debaty[2], M. Kirsch[3], M. de Riedmatten[4], P. Schoettker[5], T. Annecke[6] and P. Bouzat[7]

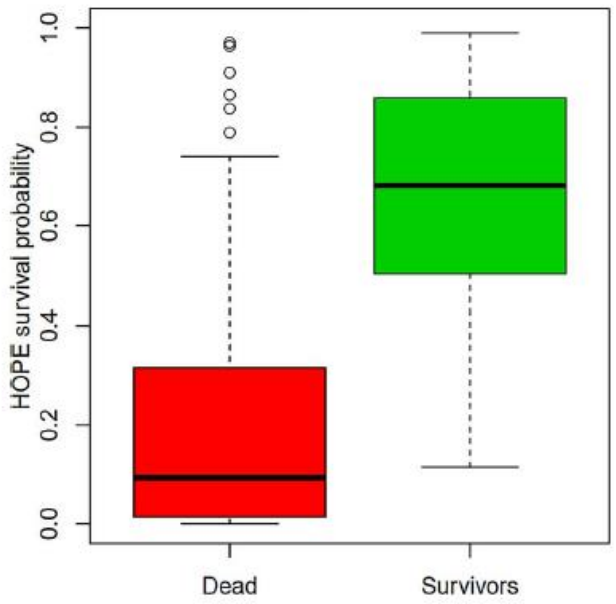
Scan J. of Trauma, Resc. and Emerg. Med. 2019

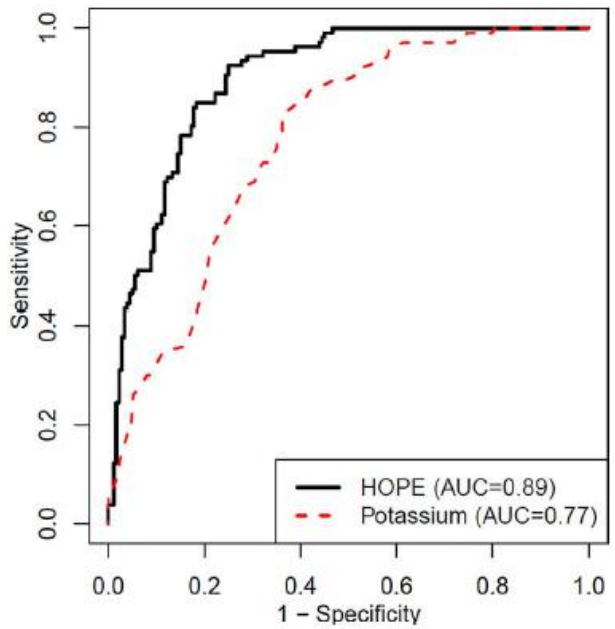
HOPE

Hypothermia Outcome Prediction after ECLS

www.hypothermiascore.org

1. Age
2. Genre
3. Asphyxie (O/N)
4. Durée RCP
5. Kaliémie
6. T°





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]

Resuscitation 126 (2018) 58–64

Urg'Ara

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CHU GRENOBLE ALPES

Initial management in accidental hypothermia related cardiac arrest before ECLS cannulation

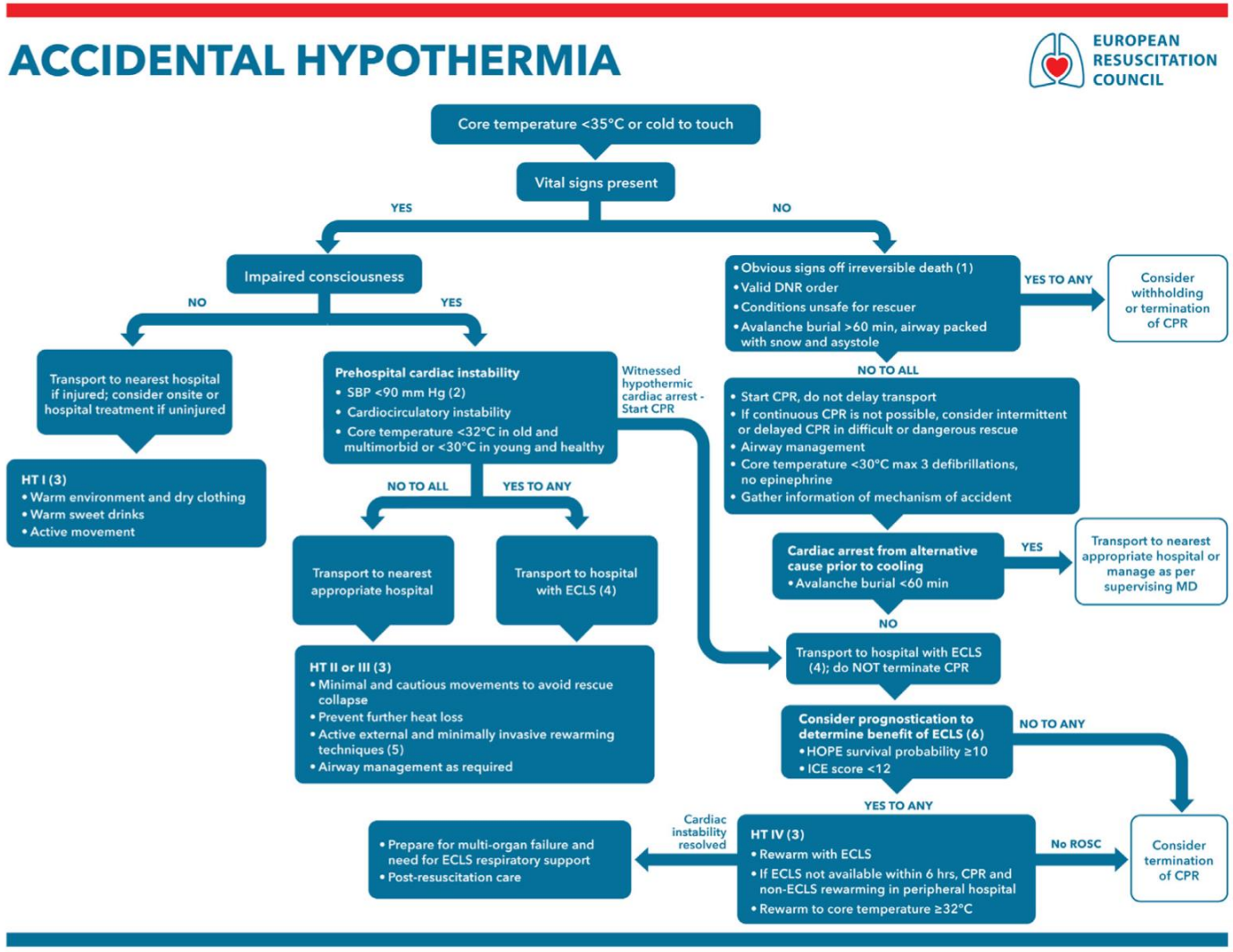
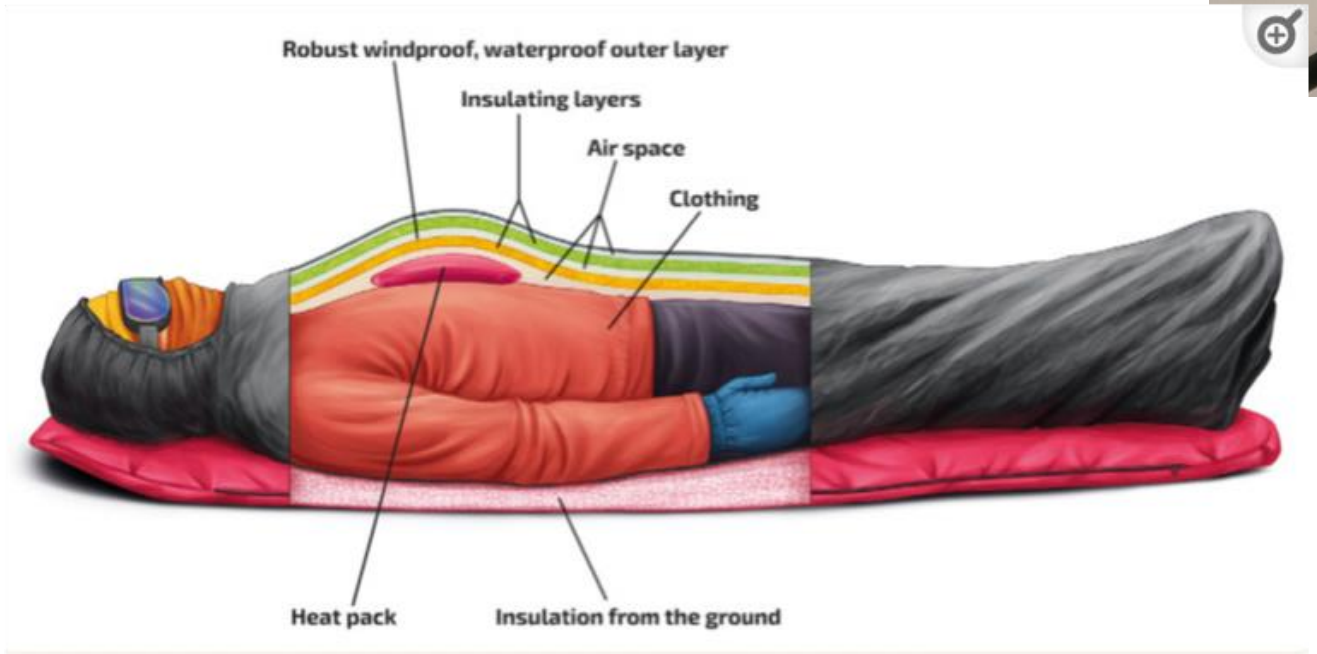


Fig. 5 – Management in accidental hypothermia.[4,5] (1) Decapitation; truncal transection; whole body decomposed or

Isoler



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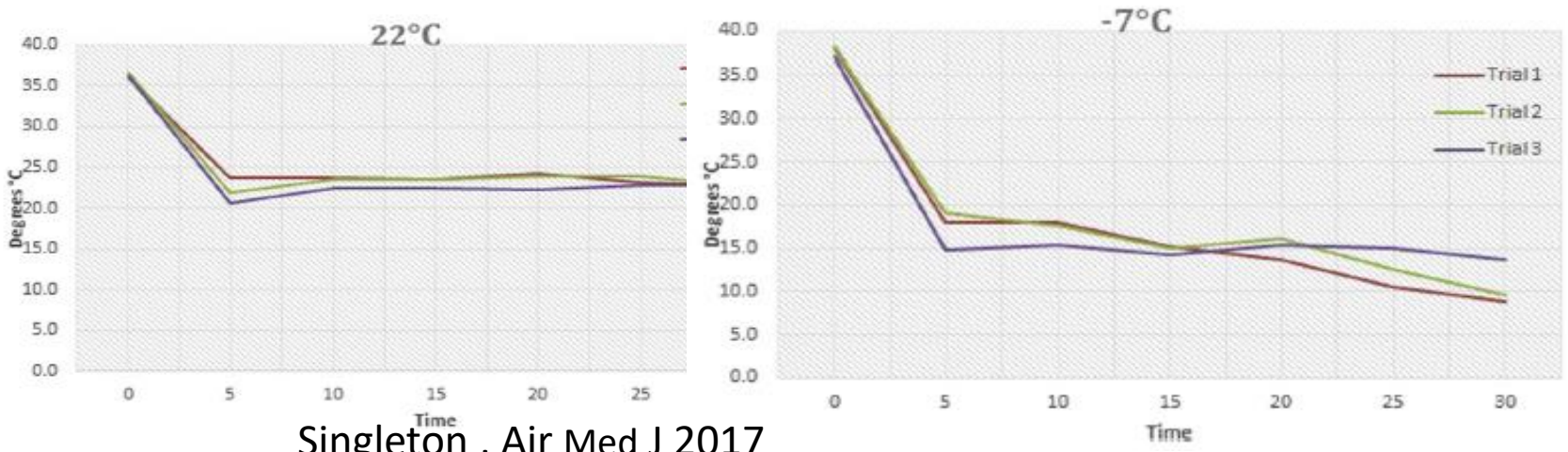
CHU Grenoble Alpes

Réchauffer

Marc Blancher
CHU Grenoble Alpes

Réchauffer les solutés (pour ne pas aggraver le refroidissement)



Singleton , Air Med J 2017

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Poursuivre le réchauffement à l'arrivée

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CHU Grenoble Alpes

Hypothermie stade IV (état de mort apparent)

Rien ne ressemble plus à un mort qu'un hypotherme stade IV

- ✓ Rigidité, trismus
- ✓ Mydriase bilatérale
- ✓ Froideur
- ✓ Lividités

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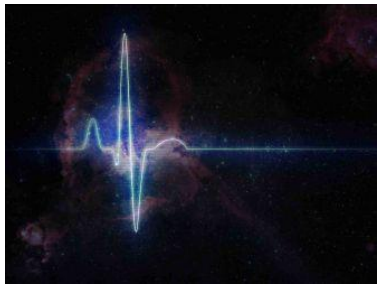
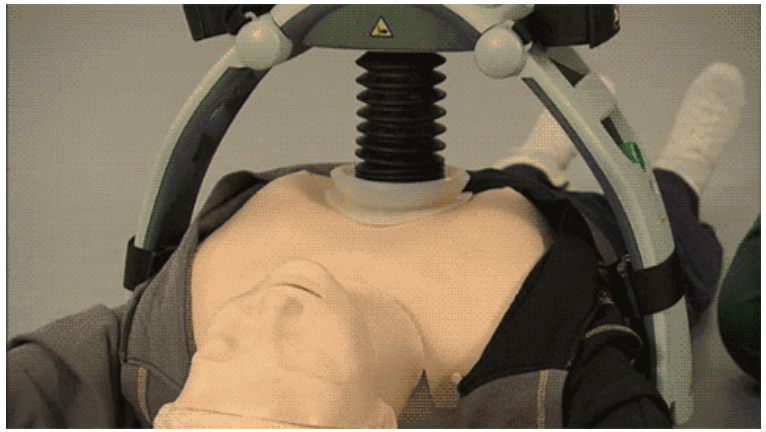


Chercher un rythme

Massage cardiaque continue



Transfert Hospitalier

Pas de limites de No Flow

Pas de limites de Low Flow

Pas de limite de T°

Reco ERC AC 2021, Resuscitation 2021

Initial management in accidental hypothermia related cardiac arrest before ECLS cannulation

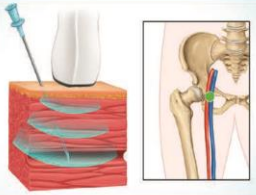
1

Continue CPR

2

Measure core temperature (usually esophageally)

3



Measure potassium

Blood sample should be obtained by ultrasound-guided puncture or open puncture of the femoral vessels. CPR may be temporarily stopped. Blood sampling should avoid haemolysis, and minimize trauma to femoral vessels.

4

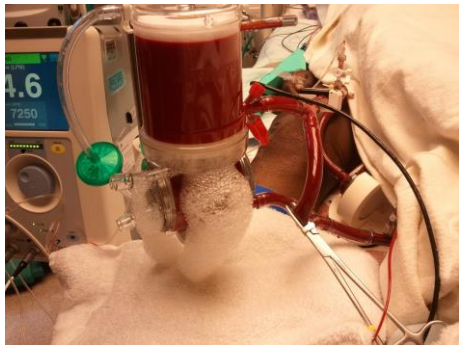
HOPE

Hypothermia Outcome Prediction after ECLS

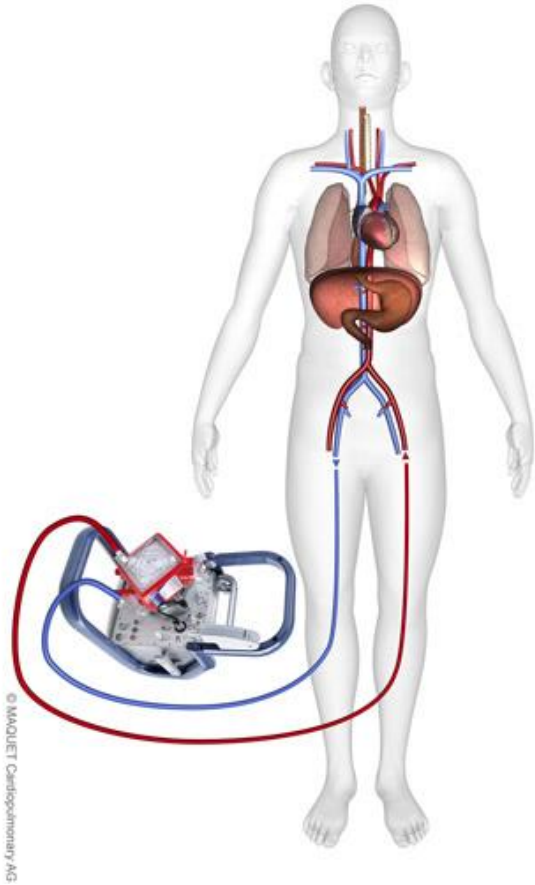
Use the HOPE estimated survival probability to assess indication for ECLS rewarming

www.hypothermiascore.org

HOPE > 10



ECMO



Reco ERC AC 2021, Resuscitation 2021

Urg'Ara

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CHU Grenoble Alpes

Conclusion

- Aggravation majeure chez les traumatisés sévères
- Excellents pronostic pour les AC hypothermes
- **Y penser et c'est gagné !**
- Lutter contre la perte de chaleur en pré hospitalier
- Hope score comme critère de triage pour les AC

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