

# Accidental Hypothermia

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# Case

- 29y/o F, falls into a frozen creek while skiing
- • Trapped under the ice, immersed in flowing water, has an air pocket
- • Becomes unconscious after 40 minutes
- • Extricated after 80minutes: lifeless, asystolic, CPR started
- • 1 hour flight to hospital
- • Arrive in hospital after 130 min downtime after 90min of CPR

- On Arrival: K 4.3, pH 6.6, PaO<sub>2</sub> 65, PaCO<sub>2</sub> 77, Temp 14.4 degrees C, asystole
- Femoral AV Cardiopulmonary Bypass (CPB) started 40 min after arrival (130 min CPR)
- 13.7 degrees C lowest core temp measured (2 min after starting CPB)
- Vfib 10 min after starting CPB

- Spont conversion to pulsatile rhythm 15 min after CPB
- CPB stopped after 179 minutes, Temp 36 oC
- ECMO started 4hrs later and cont for 5 days
- 28 day ICU stay complicated by:
  - • Renal failure requiring dialysis
  - • Coagulopathy
  - • Ischemic colitis
  - • ICU Polyneuropathy
  - • Slow return to work as a radiology resident ~6 months later (prev orthopedic resident)

# Accidental Hypothermia

- Objectives
- Who is cold and dead
- Resus/Treatment in hypothermia

# Accidental Hypothermia

- Definition - An involuntary drop in core body temperature below 35 degrees celsius

# Accidental Hypothermia

- Properly calibrated, low reading thermometers required
- Variability in recorded temperature secondary to body site, perfusion and environmental temperature
- In an intubated patient, insertion of thermistor probe in the lower third of the esophagus is preferred

# Accidental Hypothermia

- Rectal probes should be inserted to a depth of 15cm.
- Readings may lag in core temperature during rewarming.
- When accurate temperature readings not feasible, management guiding by swiss staging system



Table 2. Staging and Management of Accidental Hypothermia

Stage	Clinical Symptoms	Typical Core Temperature†
HT I	Conscious, shivering	35 to 32°C
HT II	Impaired consciousness, not shivering	<32 to 28°C
HT III	Unconscious, not shivering, vital signs present	<28 to 24°C
HT IV	No vital signs	<24°C

# Accidental Hypothermia

- Prehospital Care
- Careful handling
- BCLS/ACLS
- Passive and active external rewarming
- Transport

# Accidental Hypothermia

- Careful check for signs of life/pulse for 60 sec then CPR if none present
- Persistent breathing or movement = watchful waiting
- Advanced airway management if indicated

# Accidental Hypothermia

- IV fluids should be warmed to 38-42 degrees celsius
- Considerable volume of fluid is often required because of volume loss with cold diuresis
- Vasopressors may be used to treat vasodilatory hypotension (caution Re: arrhythmia, peripheral tissue perfusion)

# Accidental Hypothermia

- Inhospital treatment
- Pt stable circulation, active external and minimally invasive rewarming
- When CVP access required, tip of catheter (and guide wire) far from heart

# Accidental Hypothermia

- ECMO/CPB
- Support resp./cardiac oxygenation
- VA - usually right common femoral vein for extraction, right femoral artery for infusion
- VV - usually right common femoral vein for extraction, right internal jugular for infusion
- Also can put dual lumen catheter in right internal jugular (drain from SVC/IVC, return to right atrium)

# Accidental Hypothermia

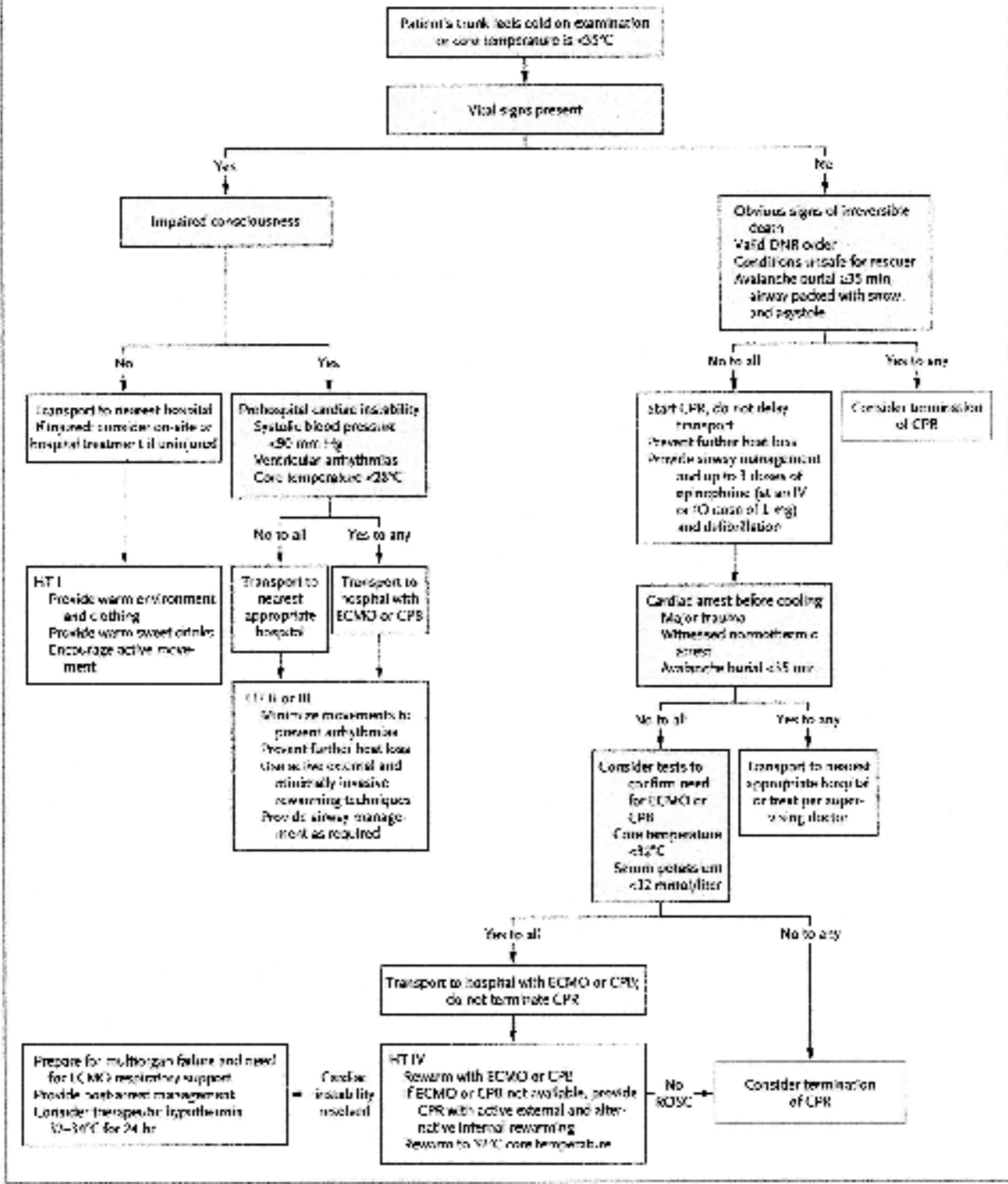
- should be considered for pts who don't respond to medical therapy
- When signs of life and vital signs absent

Table 3. Effectiveness of Rewarming Techniques.

Technique	Rewarming Rate °C/hr	Indication
<b>Without cardiac support</b>		
Warm environment and clothing, warm sweet drinks, and active movement <sup>2</sup>	2 (dependent on metabolic rate) <sup>2</sup>	HT I
Active external and minimally invasive rewarming (warm environment; chemical, electrical, or forced-air heating packs or blankets; and warm parenteral fluids) <sup>21-23,12</sup>	0.1-3,4	HT II or III; III with cardiac stability
Peritoneal dialysis <sup>24</sup>	1-3	Uncertain
Hemodialysis <sup>25</sup>	2-4 <sup>*</sup>	Uncertain
Thoracic lavage <sup>24,22</sup>	3 <sup>*</sup>	HT IV when ECMO or CPB not available
Venovenous ECMO <sup>22</sup>	4 <sup>*</sup>	Uncertain
<b>With cardiac support</b>		
Venoarterial ECMO <sup>24</sup>	5 <sup>*</sup>	HT III with cardiac instability or HT IV
CPB <sup>2</sup>	9 <sup>*</sup>	HT III with cardiac instability or HT IV when ECMO not available

\* Value is approximate.





# Accidental Hypothermia

- Modified vs Standard Life Support
- European Resuscitation Council recommend modified approach
- up to 3 defibrillations, with epinephrine withheld until core temp. higher than 30 degrees celsius and with the interval between doses doubled until core temp higher than 35 degrees celsius

# Accidental Hypothermia

- AHA guidelines state may be reasonable to consider vasopressor during cardiac arrest according to standard ALS algorithm with rewarming
- Hence the administration of up to three doses of medication and defibrillation is likely to be reasonable with further dosing guided by clinical response

# Accidental Hypothermia

- Serum Potassium
- Severely elevated potassium level is considered a marker of hypoxia before cooling and is associated with non survival
- 10 -12 mmol per litre as the cutoff above which CPR is considered futile
- 8mmol per litre in adults who have been buried in a avalanche

# Accidental

## Hypothermia

- Avalanche Burial without vital signs
- Max cooling rate in completely buried adult was measured at 9 degrees C per hr
- Burial time less than 35 min, life threatening hypothermia unlikely
- Trauma, hypoxia should be suspected if absent vital signs
- If exceeds 35 min, the airway is packed with snow, pt asystolic, limey hypoxia preceded hypothermia

# Accidental Hypothermia

- If greater than 35 min, airway not blocked, severe hypothermia should be suspected, pt treated
- Core temp can be used to estimate burial time (32 degrees C correlates with time more than 35 min)

# Accidental Hypothermia

- Drowning without vital signs
- Immersion in cold water (body was exposed to cold water but pt able to breathe)
- Likely body cooled before onset of hypoxia and cardiac arrest
- Survival without neurologic impairment possible, resus should proceed

# Accidental Hypothermia

- submersion in cold water (body exposed and pt unable to breath)
- Poor outcomes
- +/- resus based on clinical impression



# References

- Brown DJA, Brugger H, Boyed J, Paal P. Accidental Hypothermia. New England Journal of Medicine. 2012;20:1930-1938.
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