

### Definition

$T_{core} < 35^{\circ}\text{C}$ . Mild:  $35-32^{\circ}\text{C}$ . Moderate:  $32-28^{\circ}\text{C}$ . Severe:  $<28^{\circ}\text{C}$ . Note therapeutic hypothermia may be used post-resuscitation, in traumatic brain injury +  $\uparrow$ ICP, and in various surgical ops.

### Risk factors

- Very old or very young
- Chronically ill, esp CVS disease
- Malnourished
- Trauma
- Underlying medical conditions, e.g. hypothyroidism, stroke, severe arthritis, Parkinson's disease, trauma, spinal cord injuries, burns
- Cold water immersion
- Exhaustion or immobility
- Intoxicated with EtOH/drugs
- Mental impairment, e.g. dementia

### Presentation

- Hypothermia usually occurs gradually. The patient is cold to touch, grey and cyanotic.
- *CVS*: init  $\uparrow$ HR & vasoconstrict then sinus brady or AF,  $\downarrow$ BP.  $\uparrow$ Risk VF  $<28^{\circ}\text{C}$ , asystole  $<25^{\circ}\text{C}$
- *Resp*: initially  $\uparrow$ RR then  $\downarrow$ RR  $\rightarrow$  hypercarbia & acidosis, eventual apnoea in sev. hypothermia
- *CNS*: loss of fine then gross motor skills, slurred speech, lethargy,  $\downarrow$ LOC, shivering lost between  $24-35^{\circ}\text{C}$ , rigidity, pupil dilation & areflexia below  $28^{\circ}\text{C}$ . Flat EKG at  $<19^{\circ}\text{C}$
- *Renal*: cold-induced diuresis (v.early sign),  $\downarrow$ GFR will  $\rightarrow$  ARF.  $\downarrow\uparrow\text{K}^+$
- *GIT*: intestinal motility  $<34^{\circ}\text{C}$ , ileus  $<28^{\circ}\text{C}$ . Pancreatitis & mesenteric venous thrombosis.
- *Haem*: thrombosis & coagulopathies

### Typical features:

- *Mild*: lethargy, apathy, confusion, shivering, loss of fine motor coordination
- *Mod*:  $\downarrow$ HR, AF/VF risk,  $\downarrow$ RR,  $\downarrow$ LOC (delirium, stupor), shivering stops,  $\downarrow$ reflexes,  $\uparrow$ pupils
- *Severe*: extreme  $\downarrow$ HR, asystole/arrhythmia,  $\downarrow\downarrow$ BP, dyspnoea/apnoea, coma, areflexia

### Investigations

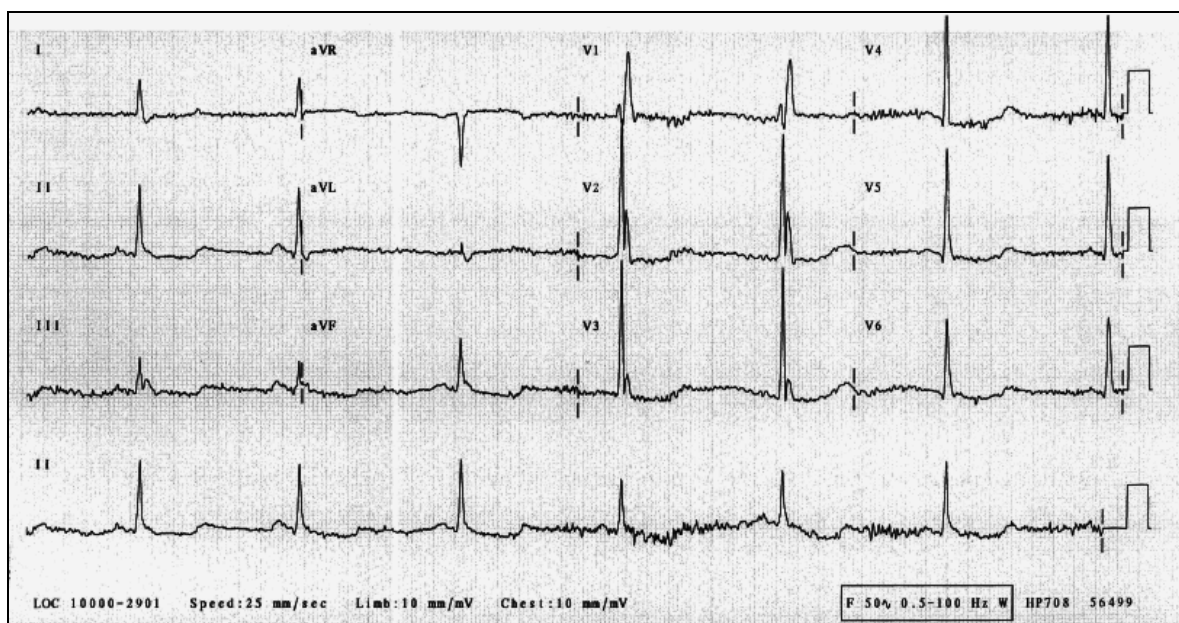
Low-reading thermometers, deep rectal or oesophageal.

*Bloods*: FBC, UEC, ABG (don't correct for T), coags, BSL, CMP, amylase, CK  $\pm$  Trop  $\pm$  TFT/Cortisol

*Imaging*: CXR (aspiration, APO), CT (underlying cause)

*ECG*: Bradycardia, AF common, also AV block, re-entrant arrhythmias  $\rightarrow$  PEA, VF, or asystole.

$\uparrow$ PR,  $\uparrow$ QTc,  $\uparrow$ QRS, Osborn 'J' waves  $<32^{\circ}\text{C}$ , non-specific ST/T changes:



## Management

*Prehospital:* Passive rewarming usually already commenced

*Initial management:*

- Remove any wet clothes, prevent further cooling, handle gently.
- Resus: ABCs ± CPR, O<sub>2</sub>, IVC, Temp & cardiac monitoring, consider IDC & NG
- Fluids: often dehydrated. If able - warm sugary drink, otherwise warmed IVF + dextrose.
- Treat arrhythmias:
  - Sinus brady & AF are regarded as physiological and should revert with warming.
  - Cardiac drugs, pacing and defibrillation are not usually effective <30°C and may be withheld after single dose until rewarmed above this T.
  - **Bretylium** can be effective for VF but no longer available!
  - **Dopamine** is the only inotropic agent known to be effective in hypoT.
  - **MgSO<sub>4</sub>** may be helpful.

*Rewarm:*

- Endogenous Rewarming: for mild hypoT only, requires endogenous thermogenesis and warm & dry env. Exercise improves rate. 0.5-2°C/hr.
- Passive External Rewarming: for mild hypoT. Blankets + warm/dry env. 0.5-2°C/hr.
- Active External Rewarming: for mild-mod hypoT. Warmed blankets, radiant heater, forced heated air (Bair Hugger). Shouldn't cause significant hypoBP. 2°C/hr.
- Active Core Rewarming: for sev. hypoT. Warmed humidified O<sub>2</sub> (42-46°C), warmed IV fluids (40-42°C), left pleural lavage, cardiopulmonary bypass, (peritoneal lavage, bladder, gastric lavage less effective). Up to 10°C/hr.

Technique	Temp rise/hr (°C)
Endogenous rewarming	1
Warm/humidified air	1.5
Forced warm air blanket (Bair Hugger)	1-2
Peritoneal lavage (6L/h)	2-3
Hot bath	4-10
Extracorporeal bypass	10

*Treat underlying injuries or disorders:* e.g. trauma, diabetes, sepsis, drug or alcohol ingestion.

## Prognosis

- Confirming death may be difficult as patients can appear dead. Rewarm first to >35°C
- Features suggestive that non-salvageable: T<7°C or <15°C with no ROSC for >2h, pH<6.5, K<sup>+</sup>>10, severe coagulopathy, clots in heart on bypass or unable to get venous return.
- Mild hypothermia is not associated with significant morbidity or mortality.
- Mortality is in the order of 20% in cases of moderate hypothermia.
- Lowest successful survival from accidental hypoT = 13.7°C.

## Frostbite

**Frostnip:** Shortlived superficial freezing reversible with rewarming, no residual swelling.

**Frostbite:** Superficial (1<sup>st</sup> & 2<sup>nd</sup> deg) - upper layers of skin, hyperaemia, oedema, clear blisters

Deep - full thickness, underlying tissue necrosis, bloody blisters, digit loss expected.

**Mx:** Immediate rewarming unless risk of refreezing. Ideally active (40-42°C circulating water), don't rub or massage. Analgesia. ADT. ABx if infected. Blister removal controversial. Surgery.

**Cx:** Wound infection, tetanus, gangrene, sensory loss, tissue loss, amputation.