Hypothermia, Heat Stroke and Drowning

Swiss staging, rewarming and hypothermic arrest, cooling heat stroke, drowning and frostbite for emergency and critical care exams

HYPOTHERMIA: STAGING AND SIGNS

ERC 2025: stage by signs only without a low-reading esophageal or epitympanic probe.

SWISS STAGE	PICTURE	CORE °C
I	Conscious, shivering	35–32
II	Impaired consciousness; shivering fades or stops	32–28
III	Unconscious, vital signs present	28–24
IV	No vital signs; may still be rescued	Below 24

- Shivering usually means 30 °C or warmer (Paal 2022)
- ECG: bradycardia, long intervals, J (Osborn) waves, shivering artifact; AF, then VF or asystole
- Cold alone arrests the heart only below 30 °C (32 °C if old or ill)
- Cold diuresis; labs run at 37 °C understate the coagulopathy

HANDLING, AFTERDROP, REWARMING

- Horizontal, gentle, no exertion: movement can trigger VF (rescue collapse doubles deaths)
- Cut off wet clothes, insulate, vapor barrier; heat packs on chest and back
- Afterdrop: the core keeps cooling after rescue; warm the trunk, not the limbs
- Ventilate at a normal rate, never fast: hypocarbia lowers the VF threshold of the cold heart (NASEMSO)

Bladder or gastric lavage adds 1 °C/h or less; thoracic lavage if no ECLS.

METHOD	RATE (PAAL 2022)	USE
Passive: insulation, shivering	0.5–4 °C/h	Stage I
Active external: forced air, heat pads	0.5–4 °C/h	Stage II–III, with IV fluid at 38–42 °C
Hemodialysis or CRRT	1.5–3 °C/h	Perfusing; no ECLS
ECLS (VA-ECMO)	4–10 °C/h possible; aim 1.5–5 (AHA 2025)	Arrest or unstable

HYPOTHERMIC CARDIAC ARREST

- Check pulse and breathing up to 1 min (ERC 2025, NASEMSO). No pulse but an organized rhythm on the monitor: NASEMSO says do not start CPR, keep monitoring (compressions can trigger VF; if it degrades to asystole, start CPR). Asystole, VF or VT: CPR
- Below 30 °C: one shock (AHA 2025) or up to 3 (ERC 2025), then no more until 30 °C
- No epinephrine below 30 °C (AHA, ERC); ERC: one amiodarone 300 mg for VF, epinephrine every 6–10 min at 30–35 °C
- Below 28 °C, if CPR can't be continuous: 5 min on, up to 5 off (10 below 20 °C; ERC 2021)
- ECLS center if arrested, HR under 45, SBP under 90, ventricular arrhythmia or below 30 °C (ERC 2025)
- HOPE 10% or more selects ECLS (ERC; AHA 2025 2a); old cutoff K above 12 mmol/L

SAFETY Nobody is dead until warm and dead, except lethal injury, a frozen, incompressible chest, or avalanche burial over 60 min with a blocked airway and asystole.

HEAT EXHAUSTION OR HEAT STROKE?

FEATURE	HEAT EXHAUSTION	HEAT STROKE
Core temperature	Usually under 40 °C	Over 40 °C; treat on suspicion
Mental status	Intact	Confusion, ataxia, seizures, coma
Skin	Sweaty	Hot; may still sweat (exertional)
Who	Anyone in heat	Exertional: young, active. Classic: older adults in heat waves
First step	Shade, rest, oral fluid about 1 L/h; IV saline if vomiting	Cool immediately

COOLING HEAT STROKE

- Cool first, transport second; rectal or esophageal temperature (NATA 2015)
- Whole-body ice-water immersion (1–5 °C), stirred, head held up (AHA and SCCM 2025)
- At least 0.15 °C/min: below 39 °C within 30 min; stop at 38.5–39 °C (AHA 2025: 38.6)
- No ice tub: tarp-assisted ice water or tepid water (8–17 °C); spray, fans, ice packs are slower
- Benzodiazepines for shivering, agitation, seizures; cautious isotonic fluid
- No antipyretics (harm liver and clotting); no dantrolene (SCCM 2025, strong)
- Then watch CK, K, AKI, DIC, liver (peaks day 3–4), low glucose

EXAM TIP Exams: over 40 °C plus CNS dysfunction is heat stroke; cooling speed decides survival (NATA 2015: no deaths in over 2,000 exertional cases immersed within 30 min).

DROWNING

- Hypoxia causes the arrest: ventilate first (ERC 2025: 5 breaths with 100% O_2, then 30:2; AHA 2025: CPR with breaths, oxygen)
- No abdominal thrusts or draining water; expect vomiting
- Spinal precautions only for diving, high-impact trauma or injury signs (neck injury in 0.5%)
- Shockable rhythms are rare (2–12%): CPR with breaths before the AED; dry the chest
- Alert and hypoxemic: CPAP or NIV; intubated: PEEP, lung-protective volumes
- Fresh and salt water act alike; no routine antibiotics or steroids; observe mild symptoms 4–6 h (Merck)
- Submersion of 5 min or less predicts a good outcome, over 25 min death (Quan 2016); WMS 2024 may stop after 30 min submerged above 6 °C, 90 if colder

FROSTBITE AND NONFREEZING COLD INJURY

- Treat hypothermia first; never rub; thaw only if refreezing is impossible
- Rewarm in circulating 37–39 °C water about 30 min; opioids for pain (WMS 2024)
- Ibuprofen, tetanus, elevation; drain clear blisters, leave hemorrhagic ones
- Deep injury: tPA within 24 h or iloprost (Aurlumyn, FDA 2024) within 72 h; bone scan guides
- Amputation waits weeks for demarcation. Electrical and lightning injury: see Burns
- Immersion (trench) foot: prolonged wet cold above freezing (under 15 °C): numb, pale, swollen, then mottled or blue after rewarming; passive rewarming at room temperature, elevate, sterile dressings; treat hypothermia or frostbite first (Merck)

Sources (29) are listed with links at icubasics.com/sheets/environmental-emergencies.html. For education and exam preparation only. Not medical advice; follow current guidelines and your institution's protocols. ICU Basics is an independent study aid not affiliated with any certifying body.