Medical

GROUP
NEET SS

Volume 2
2nd Edition

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HEAT EMERGENCIES

- Heat cramps to heat stroke
- Hypothalamus - 36 to 38° (96.8°F to 100.49F)
- Heat production, accumulation and dissipation
- Cellular metabolism and work of skeletal muscle
- Accumulation - radiation from sun
- Dissipation - radiation, conduction, convection and evaporation
- ANS - sweating and cutaneous / peripheral vasodilation

Conditions

- > 32.2 ° and 35% humidity - convection ineffective
- > 35° - radiation ineffective
- > 75% humidity - Evaporation ineffective
- > 40°C core body temperature - Thermal regulation fails

Physiological response to heat stress 00:05:12

- Dilation of blood vessels (skin blood supply 0.2 L/min to 8 L/min)
  - Tachycardia
  - (Arrhythmias, myocardial ischemia, exacerbation of CHF)
- Increased sweat production - Core temp > 37°C
- Decreased heat production
- Behavioral heat control

Medications Complicate the Normal response to Heat stress

- Anticholinergics
- Sympathomimetics (cutaneous vasoconstriction and inhibit sweating)
- Beta blockers
- CCBs
- Diuretics
- Phenothiazines (anticholinergic and deplete central dopamine)
- Alcohol (inhibit ADH secretion and blunts heat avoidance response)

Risk factors

- Elderly and young children
- Obesity
- Hyperthyroidism
- Pheochromocytoma
- Progressive systemic sclerosis
- Congenital absence of sweat glands

Acclimation

- Adaptation
- Physiological and biochemical adjustments
- Lowers the thermal set point in hypothalamus
- Sweating starts at lower core temp
- Increase aldosterone – sodium and water retention
- Heart rate decreases and exercise tolerance improves
- Over 7 days to several weeks
- De-acclimation - within 1 to 2 weeks

Pathophysiology 00:12:34

- SIRS (Systemic Inflammatory Response Syndrome)
- Coagulopathy
- MODS (Multi-Organ Dysfunction syndrome)
- Direct toxicity to cells
  - Acute phase reactants - inflammatory cytokines
  - Vascular endothelial injury
  - Denaturation of proteins
  - Interruption of cellular processes
  - Cell death
- If Temp > 41.6°C - cellular injury within hours
- If > 49°C - immediate cell death and tissue necrosis

Classification

- Classic Heat Injury
- Exertional Heat injury
- Confinement Heat Injury

Specific Heat Illnesses 00:15:37

- Minor
  - Heat edema
  - Prickly heat
  - Heat cramps
  - Heat exhaustion
- Major - Heat Stroke

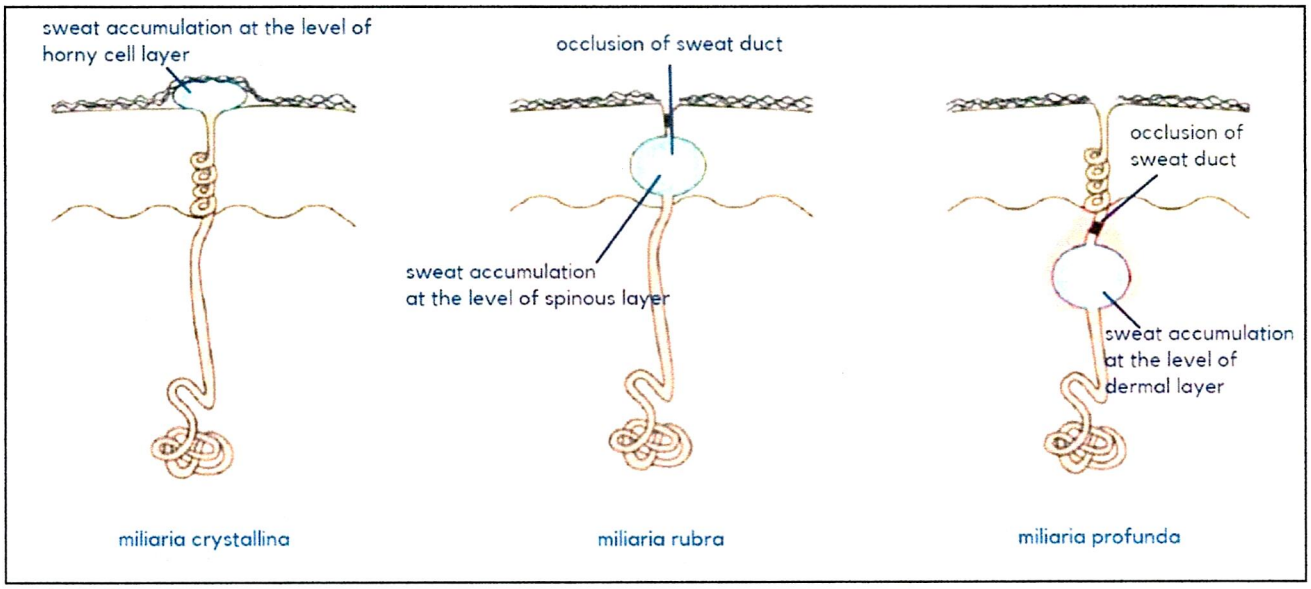
Heat Edema

- Edema of ankles, feet and hands
- First few days
- Cutaneous vasodilation and orthostatic pooling
- Increased aldosterone and ADH
- Self limited - few days
- No role for diuretics



Prickly Heat

- Lichen tropicus, Miliaria rubra or heat rash
- Pruritic, maculopapular and erythematous rash
- Over normally clothed areas
- Acute inflammation of the sweat glands
- Antihistamines, calamine, topical steroids Oral vitamin C
- Infection



Heat Cramps

- Painful, involuntary, spasmodic contractions
- Calves, thighs or shoulders
- Fluid replacement with water or hypotonic solution
- Non acclimated individuals
- Self-limited
- Rhabdomyolysis rare
- Relative deficiency of sodium, potassium or magnesium and fluid a muscle level
- Fluid and salt replacement (PO or IV) and rest in a cool environment

Heat Stress (Exhaustion)

- Salt and Water depletion
- Headache, nausea, vomiting, malaise, dizziness and muscle cramps
- Signs of dehydration - tachycardia and orthostatic hypotension or near syncope
- Rhabdomyolysis sometimes
- Hemoconcentration
- Hypernatremia if no fluid intake

Treatment - volume and electrolyte replacement and rest

- Mild - oral electrolyte solution
- Significant tissue hypoperfusion — rapid IV fluids

Heat Stroke 00:21:12

- High mortality
- Hyperthermia (40°C or >104°F) + AMS
- Absence of sweating is not a diagnostic criterion
- Cerebellum - highly sensitive
- Ataxia - early finding
- Any neurological abnormality
- Seizures are common - especially during cooling
- No diagnostic tests - large differentials

Differential Diagnosis of Heat Stroke	
Infection • Sepsis syndrome • Meningitis • Encephalitis • Malaria • Typhoid • Tetanus	**Neurologic** • Hypothalamic bleeding or infarct • Cerebrovascular accident • Status epilepticus
Endocrine • Thyroid storm • Pheochromocytoma • Diabetic ketoacidosis	**Toxicologic** • Anticholinergic toxidrome • Sympathomimetic overdose • Salicylate overdose • Serotonin syndrome • Malignant hyperthermia • Neuroleptic malignant syndrome • Withdrawal syndromes- alcohol and benzodiazepine withdrawal

Labs Investigations 00:23:55

- CBC
- Metabolic panel
- ABG--> metabolic acidosis
- Coagulation profile
- CPK
- Myoglobin level — Rhabdomyolysis
- Urinalysis
- ECG, CXR, CT head-->? cardiac and pulmonary complications
- Lumbar puncture

Management 00:24:48

- **Prehospital Care**
- Remove patient from hot environment
- GRBS if AMS
- Cooling
  - Remove clothes
  - Spray the patient with water and provide airflow over the patient
  - Place wet towels or sheets
  - Place ice on the patient
  - IV fluid bolus if hypotension
- Emergency Department Resuscitation
  - Immediate Cooling and appropriate support of organ systems
  - IV fluids
  - Inotropes if required
  - Monitor core temperature - rectal, bladder or esophageal
  - Cooling techniques

    Goal — reduce core temp to 39°C (102.2°F)

Different Methods of cooling 00:28:10

Cooling Method	Advantages	Disadvantages	Recommendations
Evaporative cooling	Provides effective cooling Readily available Practical Well tolerated	Can cause shivering Less effective in humid environments Makes it difficult to maintain electrode positions	Strongly recommended
Immersion cooling	Provides effective cooling	Can cause shivering Poorly tolerated Not compatible with resuscitation settings	Recommended
Ice packs on neck, axillae, and groin	Practical Can be added to other cooling methods	Cooling times longer than other modalities Poorly tolerated	Can be used as adjunct cooling method
Cardiopulmonary bypass	Provides fast and effective cooling	Invasive Not readily available Setup is labor intensive	Recommended in severe or resistant cases when available
Cooling blankets	Easy to apply	Have limited cooling efficacy Impede use of other cooling methods	Not recommended when other methods available
Cold water gastric, urinary bladder, rectal, or peritoneal lavage	Advocated to cool the core when cardiopulmonary bypass not desirable or possible, however, efficacy not validated	Invasive Labor intensive May lead to water intoxication Human experience is limited	Effectiveness and safety not established

Makkah cooling unit:



Complications of Heat Stroke 00:31:18

	Early	Late
Vital signs	Hypotension	
	Hypothermic overshoot	
	Hyperthermic rebound	
Muscular	Rhabdomyolysis	
Neurologic	Delirium/coma	Cerebral edema
	Seizure	Encephalopathy
		Persistent neurologic deficit
Cardiac	Heart failure	Myocardial injury
Pulmonary	Pulmonary edema	Acute respiratory distress syndrome.
Renal	Oliguria	Renal failure, rhabdomyolysis
GI		Intestinal ischemia or infarction
		Pancreatic injury
		Hepatic dysfunction
Metabolic	Hypokalemia	Hypokalemia
	Hyperkalemia	Hyperkalemia
	Hypernatremia	Hypernatremia
Hematologic		Thrombocytopenia
		Disseminated intravascular coagulation

HYPOTHERMIA

- Classification of Hypothermia
- Paradoxical undressing
- Rescue collapse
- Cold diuresis
- ECG changes - Osborne J waves
- Treatment
- After drop
- Pseudo-rigor mortis & declaration of death

Classification of Hypothermia 00:01:50

- Primary v/s Secondary
- Based on core body temperature and clinical classification

Stage	Clinical Symptoms	Typical Core Temperature	Treatment
Mild (HT I)	Conscious, shivering	35 - 32°C	Warm environment and clothing, warm sweet drinks, and active movement (if possible) HT I patients with significant trauma or comorbidities or those suspected of secondary hypothermia should receive HT II treatment
Moderate (HT II)	Impaired consciousness* (may or may not be shivering)	< 32 - 28°C	Active external and minimally invasive rewarming techniques (warm environment; chemical, electrical, or forced air heating packs or blankets; warm parenteral fluids) Cardiac and core temperature monitoring Minimal and cautious movements to avoid dysrhythmias Full-body insulation, horizontal position, and immobilization
Severe (HT III)	Unconscious*, vital signs present	< 28°C	HT II management plus: Airway management as required Preference to treat in an ECLS center, if available, due to the high risk of cardiac arrest Consider ECLS in cases with cardiac instability that is refractory to medical management Consider ECLS for comorbid patients who are unlikely to tolerate the low cardiac output associated with HT III
Hypothermic cardiac arrest (HT IV)	Vital signs absent	Cardiac arrest is possible below 32°C : the risk increases. substantially below 28°C and continues to increase with ongoing cooling	CPR and up to three doses of epinephrine and defibrillation (further dosing guided by clinical response) Airway management Transport to ECLS Prevent further heat loss (insulation; warm environment; do not apply heat to head) Active external and minimally invasive rewarming (see HT II) during transport is recommended but controversial; do not apply heat to head

Paradoxical undressing 00:05:13

- Shivering mechanism
- Peripheral vasoconstriction

Rescue collapse 00:08:40

- Immersion cases
- Aka Post Rescue/circum-Rescue / Peri Rescue Collapse

Cold diuresis 00:11:08

- Hypothermic Environment → peripheral vasoconstriction → kidney perfusion ↑ → tachycardia → ↑ cardiac output → Diuresis → Hypovolemia

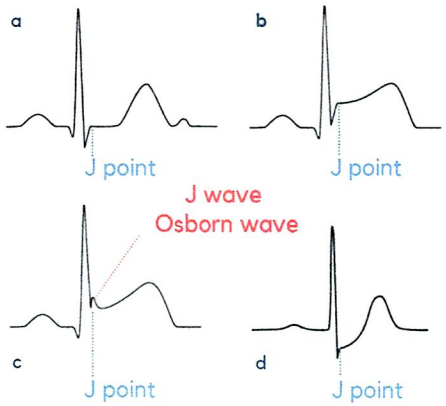
ECG changes 00:11:51

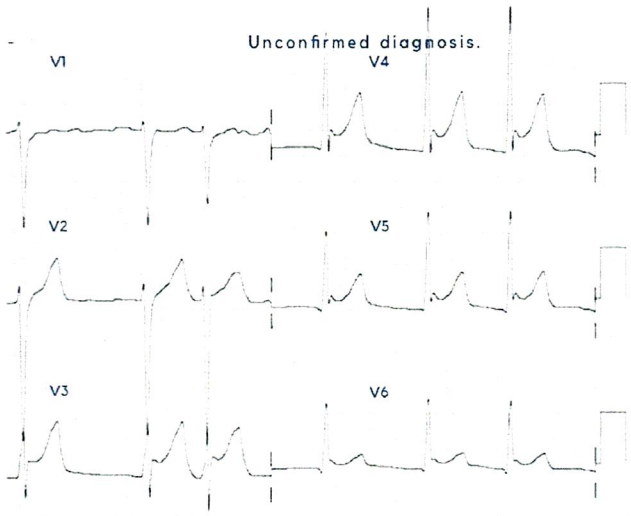
- Most specific - Osborne J waves
- PR prolongation, QRS Widening, QTC prolongation
- Atrial arrhythmias, Tachyarrythmia, Ventricular Tachyarrythmia, Bradyarrhythmias

Osborn J wave

- The Osborn wave (J wave) is a positive deflection seen at the J point in precordial & true limb leads.

- These changes will appear as a reciprocal, negative deflection in aVR and V1.





Other conditions where J-waves +ve

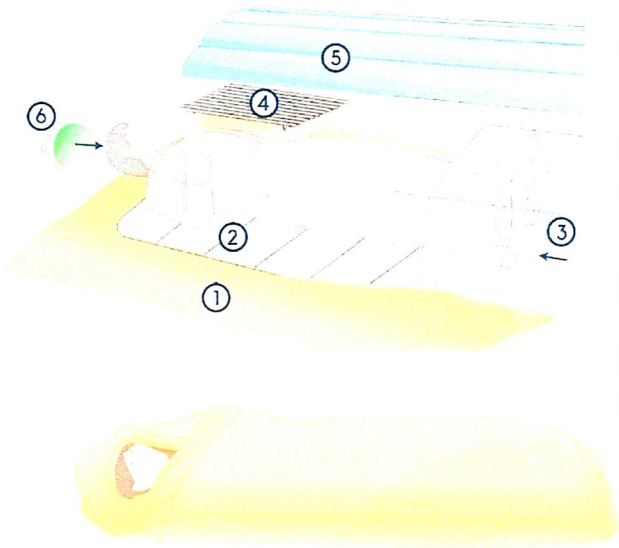
- Hypercalcaemia
- Acute myocardial ischaemia
- Takotsubo cardiomyopathy
- Left ventricular hypertrophy due to hypertension
- Normal variant and early repolarization
- Neurological insults such as intracranial hypertension, severe head injury, and subarachnoid hemorrhage
- Severe myocarditis
- Brugada syndrome
- Le syndrome d'Haïssaguerre (idiopathic VF)

Hospital Resuscitation Checklist: 00:18:30

- Cardiac monitor and careful handling
- Core temperature monitoring (esophageal, rectal, or bladder)
- If cardiac arrest, ventricular dysrhythmia, core temp <28°C, or unstable:
  - Do not stop resuscitation; seek expert consultation
  - Potential for good outcome despite prolonged resuscitation; ideally transfer to ECMO center if indicated
- Minimally invasive rewarming:
- Hypothermia burrito (see below; preference for forced air warming blankets)
- +/- Bladder lavage
- (3-way Foley, 40°C saline, 2-4 L/h by gravity)
- [confirm volume in = volume out, will invalidate bladder and rectal temperature measurements]
- IV fluid resuscitation (crystalloid, 38-42°C):
  - Titrate fluids to clinical volume status (avoid over resuscitation)
  - 10-20 mL/kg (~1 L) to start (may be reasonable)
  - Additional 10-20 mL/kg per ~3°C core temp increase (may be required)
- Hypothermia is NOT a contraindication to airway management
- Avoid hyperoxia (Titrate Fio, to 92%-98%)
- If central venous access is required, keep the tip of the catheter (and guidewire) far from the heart (femoral, shallow internal jugular, or shallow subclavian)
- Avoid vasopressors during early resuscitation (relative hypotension may be physiologic depending on core temperature; consider expert consultation)

Hypothermia burrito

Minimally Invasive Rewarming: (hypothermia burrito)



1. Outer wind and waterproof wrap +/- reflective tarp (prehospital only)
2. Insulation or heating pad
3. Replace wet clothes if practical: otherwise wrap patient in plastic
4. Forced air, chemical, or electrical heating device(s)"
5. Insulating blanket
6. Insulate the head

To avoid Burns, keep heating device temperatunes -40°C
in cardiac arrest, do not apply heat to the head follow warm oxygenated blood to rewarm the brain centrally)

Criteria for ECLS Rewarming in Severe Hypothermia (HT III) Endorsed by the International Commission for Mountain Emergency Medicine

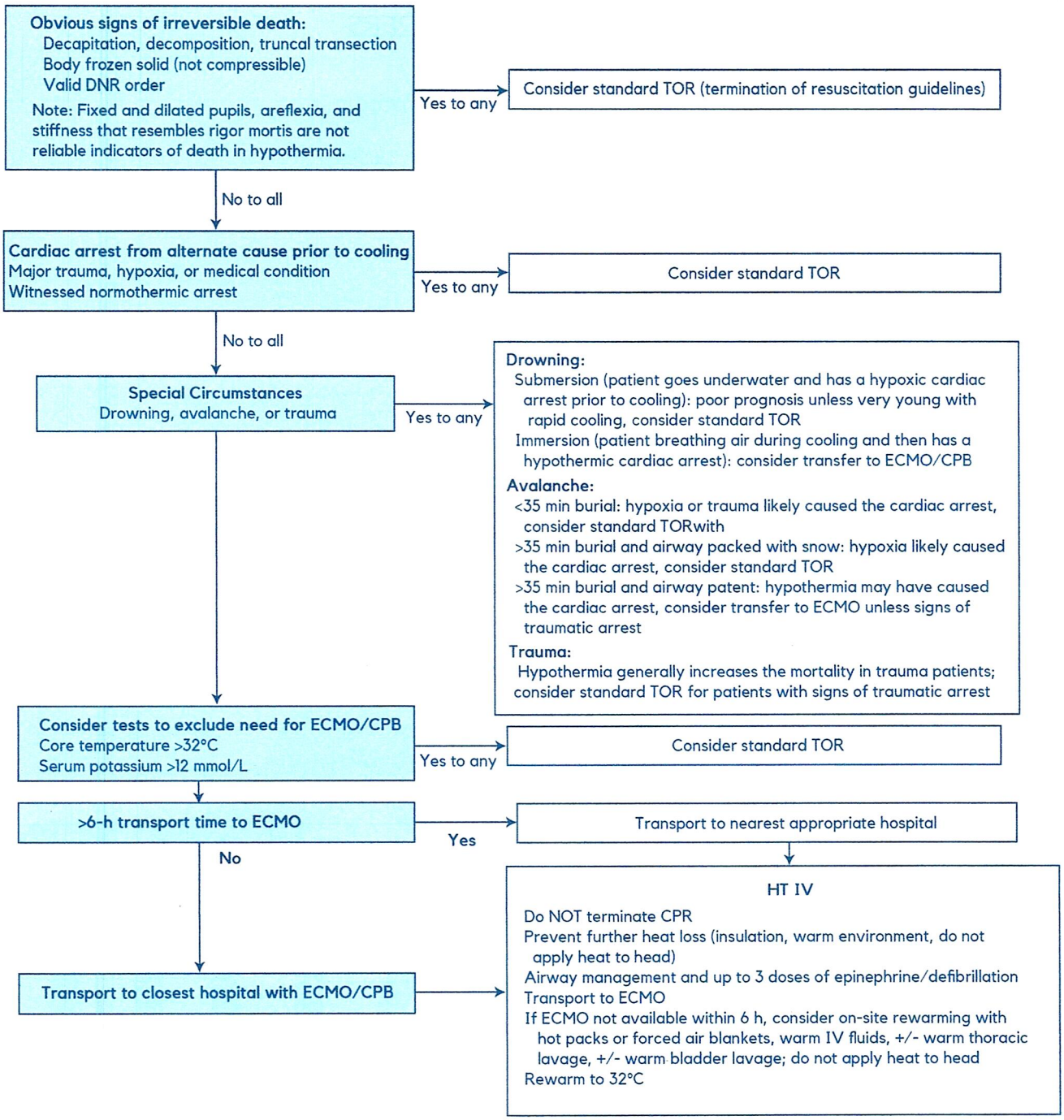
- Failure to improve with external active and minimally invasive rewarming methods
- Life-threatening dysrhythmia
- Hypotension (systolic blood pressure <90 mm Hg)
- Respiratory failure
- Refractory acidosis

After-drop 00:25:25

- After-drop, the continued fall of deep body temperatures during rewarming after hypothermia, is thought to endanger the heart by further cooling from cold blood presumed to be returning from the periphery

Pseudo-rigor mortis & declaration of death 00:27:07

- Notably, in severe hypothermia, clinical musculoskeletal manifestations may present as increased muscle tone, shivering, rigidity or pseudo-rigor mortis, paravertebral spasm, and opisthotonos. This pseudo-rigor mortis or cold stiffening must not be mistaken for true rigormortis


Obvious signs of irreversible death:
Decapitation, decomposition, truncal transection
Body frozen solid (not compressible)
Valid DNR order
Note: Fixed and dilated pupils, areflexia, and stiffness that resembles rigor mortis are not reliable indicators of death in hypothermia.
Yes to any
Consider standard TOR (termination of resuscitation guidelines)
No to all
Cardiac arrest from alternate cause prior to cooling
Major trauma, hypoxia, or medical condition
Witnessed normothermic arrest
Yes to any
Consider standard TOR
No to all
Special Circumstances
Drowning, avalanche, or trauma
Yes to any
Drowning:
Submersion (patient goes underwater and has a hypoxic cardiac arrest prior to cooling): poor prognosis unless very young with rapid cooling, consider standard TOR
Immersion (patient breathing air during cooling and then has a hypothermic cardiac arrest): consider transfer to ECMO/CPB
Avalanche:
<35 min burial: hypoxia or trauma likely caused the cardiac arrest, consider standard TORwith
>35 min burial and airway packed with snow: hypoxia likely caused the cardiac arrest, consider standard TOR
>35 min burial and airway patent: hypothermia may have caused the cardiac arrest, consider transfer to ECMO unless signs of traumatic arrest
Trauma:
Hypothermia generally increases the mortality in trauma patients; consider standard TOR for patients with signs of traumatic arrest
Consider tests to exclude need for ECMO/CPB
Core temperature >32°C
Serum potassium >12 mmol/L
Yes to any
Consider standard TOR
>6-h transport time to ECMO
Yes
Transport to nearest appropriate hospital
No
HT IV
Do NOT terminate CPR
Prevent further heat loss (insulation, warm environment, do not apply heat to head)
Airway management and up to 3 doses of epinephrine/defibrillation
Transport to ECMO
If ECMO not available within 6 h, consider on-site rewarming with hot packs or forced air blankets, warm IV fluids, +/- warm thoracic lavage, +/- warm bladder lavage; do not apply heat to head
Rewarm to 32°C
Transport to closest hospital with ECMO/CPB

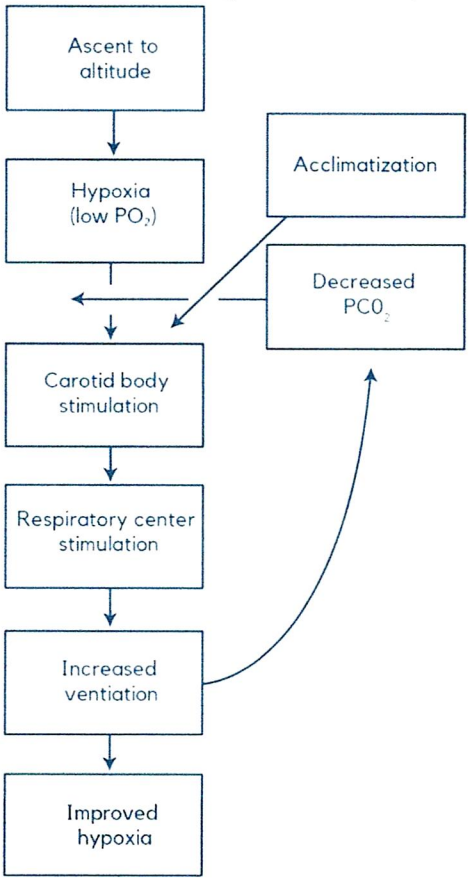
HIGH ALTITUDE DISORDERS

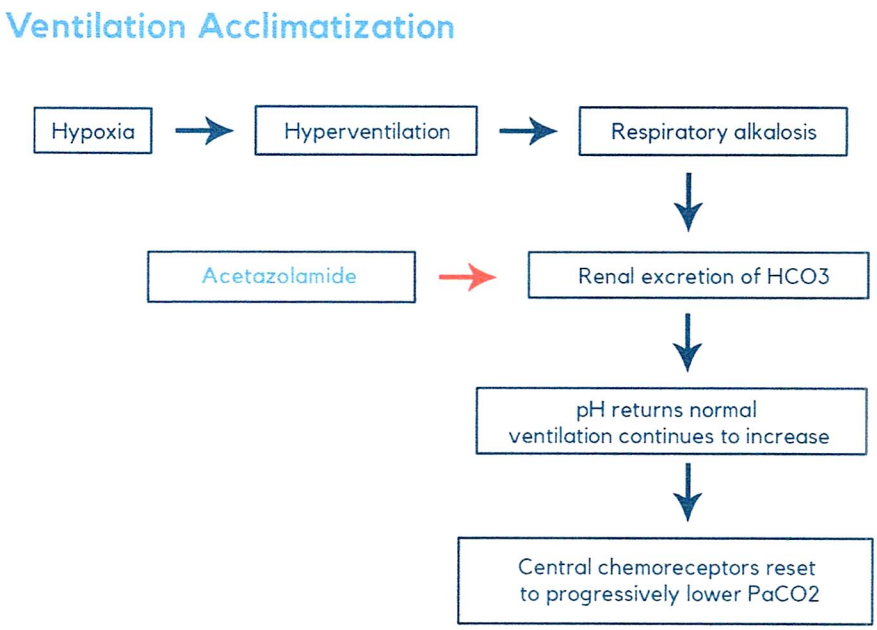
Introduction - 00:00:50

- Hypoxia: Main problem or culprit
- Partial pressure of oxygen is low in high altitudes → Decreased oxygenation
- Grading of altitude:
  - Intermediate altitude - 5000 to 8000 ft
  - Decreased exercise performance & increased alveolar ventilation
  - Acute Mountain Sickness (AMS) - 7000 to 8000 ft
  - High Altitude - 8000 ft (2440m) to 14000 ft - marked hypoxemia
  - Very high altitude - 14000 to 18000 ft
  - Extreme altitude > 18000 ft

Physiology and Pathophysiology - 00:03:00

1. Ventilation Acclimatization
   - Increased ventilation
   - Ventilatory acclimatization takes 4 to 7 days
   - PCO2 - completeness of acclimatization
   - Acetazolamide
   - Chronic hypoxia - low respiratory drive – higher risk





2. Blood
   - Increased erythropoietin within hours
   - Increased red cell mass over days to weeks
   - No role in initial acclimatization
   - Chronic mountain polycythemia - weeks to months
   - Increase in 2,3 DPG levels - shifts ODC to right
   - Respiratory alkalosis - shifts ODC to left

3. Fluid Balance
4. Cardiovascular system
   - SV decreases, HR increases - CO maintained
   - BP increases slightly (increased sympathetic tone)
   - Pulmonary vasoconstriction
     - Increased pulmonary vascular resistance & pulmonary artery pressure
   - HAPE
   - Cerebral blood flow increases transiently
5. Exercise capacity
   - Drops dramatically
   - 10% for every 1000m altitude gain above 1500m
6. Limits to Acclimatization
   - Results in weight loss, lethargy, poor quality sleep, weakness, headache.
7. Sleep at High Altitude
   - Frequent nighttime awakenings
   - Cheyne-Stokes respiration - apneic pauses
   - Extreme altitude > 20 seconds
   - Improve with acclimatization and acetazolamide

High Altitude Syndrome- 00:12:25

- Acute Hypoxia
- Acute Mountain Sickness (AMS)
- HAPE
- HACE
- Retinopathy
- Cerebral Edema
- Sleeping problems
- A group of neurologic syndromes
  - Fundamental Etiology - Hypoxia
  - Rapid ascent in unacclimatized persons
  - Response to descent and oxygen

Acute Hypoxia

- Setting of sudden and severe hypoxic insult
- Signs and symptoms
  - Dizziness
  - Lightheadedness
  - Dimmed vision
  - Loss of consciousness (SaO2 50% to 60%, PaO2 <30mmHg)
- Treatment
  - Oxygen
  - Rapid descent
  - Correction of underlying cause

Acute Mountain Sickness (AMS)

- More gradual and less severe hypoxic insult
- Headache, Nausea, Vomiting, Dizziness, Fatigue & Sleep disturbances
- Rate of ascent and sleep altitude
- Genetic susceptibility

- Obesity
- Pathophysiology
- Hypobaric hypoxia - Cerebral vasodilation - Vasogenic edema

AMS - Clinical Features

- Recent ascent > 2000m (6560ft)
- On arrival - light headedness and slightly breathless
- Characteristic symptoms - 1 to 6 hours later (can delay for 1 to 2 days)
- Headache - bifrontal, worsens with exertion, bending over or performing Valsalva maneuver
- GI-anorexia, nausea, vomiting
- Lassitude and weakness
- Irritable, sleepiness, deep inner chill

Lake Louise Acute Mountain Sickness (AMS) Self-Questionnaire	
Headache No headache-0 Mild headache1 Moderate headache-2 Severe headache, incapacitating-3	Score
GI symptoms No symptoms-0 Poor appetite or nausea-1 Moderate nausea or vomiting-2 Severe nausea and vomiting, incapacitating-3	Score
Fatigue/weakness Not tired or weak at all-0 Mild fatigue or weakness-1 Moderate fatigue or weakness-2 Severe fatigue or weakness, incapacitating-3	Score
Dizzy/lightheadedness No dizziness/lightheadedness-0 Mild dizziness/lightheadedness-1 Moderate dizziness/lightheadedness-2 Severely light-headed, fainting/passing out-3	Score
Difficulty sleeping Slept well-0 Did not sleep as well as usual-1 Woke many times, poor night's sleep-2 Could not sleep at all-3	Score
Total symptom score	
"Diagnosis of AMS requires headache plus 1 or more of the above symptoms. Mild AMS: score of 2-4 Moderate AMS: score of 5-9 Severe AMS: score of 10-15	

- Vitals usually normal, SaO2 normal or slightly low & Local rales (20%)
- May last hours to days to weeks
- Ataxia or altered level of consciousness – HACE