Acute Mountain Sickness

Alan West 3rd December 2014
Sick climber at 4000m

What is wrong with this climber?
How would you treat this? Patient?
50 Male porter at 4000m

**Signs**
- Airway clear
- RR 40 Crackles
- HR 130
- BP 130/90
- SPO2 80%

**Symptoms**
- Breathlessness
- Haemoptysis
- Nausea
- Fatigue
- Headache
Objectives

• Introduce Acute Mountain Sickness (AMS)
• Discuss prevention
• Define High Altitude Pulmonary Oedema as per Oxford Handbook of Expedition and Wilderness Medicine.
• Define High Altitude Cerebral Oedema as per Oxford Handbook of Expedition and Wilderness Medicine.
• Discuss Treatments
• Q&A
• Summary
Acute Mountain Sickness

• Describes a collection of symptoms typically beginning 6-8 hours after arrival at altitude above 2500m (7500ft)

• The pathogenesis of AMS is poorly understood.

• Risk factors include:
  • Assent to fast for adequate acclimatization
  • Previous history of AMS
  • Pre-existing illness and lack of appropriate fitness
Why?

- Increase in Altitude = Decrease in Barometric pressure = Hypobaric Hypoxia
- Pulmonary Hypertension
- Brain Swelling
- Fluid maldistribution
- Alteration in Blood Brain Barrier
Signs and Symptoms of AMS

• Headache
• Anorexia, Nausea and vomiting
• Dizziness and sleep disturbance
• Fatigue
• Tachycardia
Lake Louise Criteria

Acute Mountain Sickness (AMS)

- Lake Louise Criteria
  - Headache after recent gain in altitude plus one of:
    - Anorexia, nausea, vomiting
    - Fatigue or weakness
    - Dizziness or lightheadedness
    - Sleep disturbance
<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Headache</strong></td>
<td>No headache</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mild headache</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate headache</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe headache, incapacitating</td>
<td>3</td>
</tr>
<tr>
<td><strong>Gastrointestinal symptoms</strong></td>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Poor appetite or nausea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate nausea &amp;/or vomiting</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe nausea &amp;/or vomiting</td>
<td>3</td>
</tr>
<tr>
<td><strong>Fatigue &amp;/or weakness</strong></td>
<td>Not tired or weak</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mild fatigue/ weakness</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate fatigue/ weakness</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe fatigue/ weakness</td>
<td>3</td>
</tr>
<tr>
<td><strong>Dizziness/lightheadedness</strong></td>
<td>Not dizzy</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Mild dizziness</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate dizziness</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe dizziness, incapacitating</td>
<td>3</td>
</tr>
<tr>
<td><strong>Difficulty sleeping</strong></td>
<td>Slept as well as usual</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Did not sleep as well as usual</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Woke many times, poor sleep</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Could not sleep at all</td>
<td>3</td>
</tr>
</tbody>
</table>

**TOTAL SCORE:**
Treatment

Mild
- Do not ascend further
- Rest
- Simple Analgesia and Antiemetic

Moderate – Severe
- Descent
- Oxygen
- Acetazolamide (Diamox) 250mg po
Acetazolamide (Diamox)

• Carbonic anhydrase inhibitor
• Increases Renal excretion of Bicarbonate
• Makes blood more acidotic
• Increase in respiratory rate and depth
• Increase O₂
Acute Mountain Sickness
Differential Diagnosis

- Dehydration
- Hypothermia
- Exhaustion
- Respiratory infection
- Hyperventilation syndrome
- Psychiatric disorders
- Drug intoxication
- Carbon monoxide poisoning (as from tent heaters or stoves)
High Altitude Pulmonary Oedema

• HAPE is a serious form of high altitude illness in which there is movement of fluid from the intravascular to extravascular space in the alveoli.

• It is often preceded by AMS

• Typically 2 to 4 days after arrival at altitude
HAPE

• Is a non-cardiogenic pulmonary oedema related to altitudinal hypoxia
• Can be fatal if patient is unable to descend
• Occurs in 1 to 2% of patients quickly ascending to > 12,000 feet
• Can occur even in well fit and acclimatized individuals
Signs and Symptom's

- Decreased exercise intolerance
- Cough
- Haemoptysis
- Chest pain
- Low spo2
- Crackles on auscultation
- Tachycardia and Tachypnoea
HAPE
Treatment

- Descent
- O₂
- Portable Hyperbaric Chamber
- Nifedipine 20mg po
- Treatment of coexistent AMS
Nifedipine

- Calcium channel blocker
- Prevents Pulmonary Hypertension
High Altitude Cerebral Oedema

- HACE is a potentially fatal form of AMS where the brain swells leading to raised intracranial pressure.
HACE

Symptoms
• Headache
• Nausea
• Confusion
• Disorientation
• Hallucination

Signs
• Ataxia
• Focal neurological deficits
• Hypoxia
• HAPE
• Coma
• Death
Treatment

• Immediate descent
• O₂
• Dexamethasone 8mg po
• Medevac if possible
• Treat for HAPE if necessary
• Gamow bag if no airway compromise
Dexamethasone

- Glucocorticoid steroid
- Anti-inflammatory
- Reduces swelling
Portable hyperbaric bag
Gamow Bag

- Can simulate 500m descent in 5 – 10 minutes
- Can’t do anything to casualty while they are in bag
- Claustrophobic
- ALWAYS descend after using bag
References

- Dexamethasone for the prevention of acute mountain sickness: systematic review and meta-analysis.
- Tang E³, Chen Y², Luo Y³.
- Risk determinants of acute mountain sickness in trekkers in the nepali himalaya: a 24-year follow-up.
- McDevitt M¹, McIntosh SE², Rodway G³, Peelay J⁴, Adams DL⁵, Kayser B⁶.
- AltitudeOmics: the integrative physiology of human acclimatization to hypobaric hypoxia and its retention upon reascent.
- Subudhi AW¹, Bourdillon N², Bucher J³, Davis C⁴, Elliott JF, Eutermoster M⁴, Evero O⁴, Fan JL⁵, Jameson-Van Houten S⁴, Julian CG⁴, Kark J⁴, Kark S⁴, Kayser B², Kern JP³, Kim SE, Lathan C⁴, Laurie SS³, Lovering AT³, Paterson R⁴, Polaner DM⁷, Ryan BJ⁶, Spira JL⁹, Tsao JW¹⁰, Wachsmuth NBP¹¹, Roach RC⁴.
- High altitude pulmonary edema (HAPE) in a Himalayan trecker: a case report.
- Shrestha P, Pun M, Basnyat B⁴.

Thursday, 11 December 2014
THANK YOU AND ANY QUESTIONS
Environmental Emergencies

Drowning

By Davitt Ward
Objectives

- Understand the definition of Drowning
- Identify the primary cause of Drowning
- Demonstrate in groups how to treat a drowning casualty
- Understand the methodology of how a drowning casualty should be retrieved from the water
Warning

Presentations contains some graphic pictures and footage
History
History
History
History
History
Epidemiology

- 500,000 deaths
- 0.7% of all deaths worldwide
- Excluding floods, tsunamis, and accidents
Epidemiology

- Ireland 143 deaths (2012)
- UK 700 deaths per year
- USA 6500 deaths per year
Epidemiology

Ireland 2012 (143 deaths)

• Accident to watercraft drowning – 1
• Water-transport related drowning – 4
• Diving or Jumping – 1
• In the bath – 2
• Swimming pool – 1
• Lakes – 12
• Fall into natural water – 17
• Other specified – 2
• Unspecified - 21
• Self intentional – 49
• Drowning undetermined intent - 33
Risk categories?

- Toddlers
- Teenagers
- Young Adults
- Male
Toddlers

- Toilets
- Bathtubs
- Buckets
- Swimming Pools
Teenagers

- Bravado
- Depression
Young Adults

- 40% Alcohol
- Bravado
- 75% Boat accidents
Young Adults
Young Adults
Young Adults
Complicating Factors?

- Head & Spinal injury Trauma
- Hypothermia
- Seizures
- Syncope
Definitions

“Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid”
Definitions

- 60 years of drowning literature
- 33 different definitions for drowning
Definitions

• Drowning
  Death within 24 hours of the incident

• Near-Drowning
  Survival for at least 24 hours after the incident
Definitions

Pre-Hospital it’s more practical to use the term “Submersion incident” as it encompasses both

• The term Submersion incident implies no particular outcome of the patient at the scene

• Prevents confusion
Clinical Paper

Drowning related out of Hospital Cardiac arrest: Characteristics and outcomes  January 2013
Cohort Study, Kylie Dyson, Et Al

Methods

• Victoria Ambulance Cardiac arrest registry for all OHCA with a precipitating event of drowning attended by EMS between October 1999-December 2011
Results

- EMS attended 336 drowning related OHCA
- 260 were adults – 70% male
- 45% in summer
- Resuscitation was attempted on 154
- Of these 41 survived to hospital
Clinical Paper

Results

• 12 (8%) of these survived to discharge

• 5 Adults 7 Children

• No survivors when EMS took longer than 12 minutes
Clinical Paper

![Bar chart showing the frequency of different cardiac rhythms: Asystole, PEA, VF, Unknown. The chart indicates a significantly higher frequency of Asystole compared to other rhythms.]
Clinical Paper

Conclusion
• Rates of OHCA caused by drowning are comparable to other OHCA

More likely to survive
• If not in Salt water
• Had a quick EMS response
• Found in a shockable rhythm
Group Exercise
Group Exercise

If was in a lake would you do anything different?
Pathophysiology

- Aspiration of water
- Dilution of Surfactant
- Diminished gas transfer
- Alveoli collapse

| Higher pressure may be required for ventilation because of poor compliance resulting from pulmonary oedema |
Pathophysiology

Laryngospasm

• Water entering the lungs stimulates the laryngeal cords

• Asphyxiation

• Hypoxia

• Loss of consciousness
Pathophysiology

- Primary cause of all injury and death associated with drowning?
  Hypoxia

- Pulmonary edema results in the loss of the surfactant that reduces surface tension

- Alveolar collapse
Pulmonary Surfactant

- Active lipoprotein naturally produced
- Foamy fatty liquid
- Acts like grease within the lungs
- Reduces alveolar surface tension, increasing lung compliance
- Without it the lungs would stick together
Cause

Cardiac
The tank is full, the engine is broken
Cause

Drowning
Engine is fine, Tank is empty,
Saltwater v Freshwater

- Theoretical differences
- Pre-Hospital not clinically significant during resuscitating a patient
Saltwater v Freshwater

- Require 11ml of water per Kg of body weight to produce significant blood problems (1.3 pints)
- 22 ml/Kg required to create electrolyte problems (2.6 pints)
- Both types can lead to pulmonary injuries
Treatment

- If Hypoxia is the primary injury in drowning, how do we treat it?
Inadequate Ventilations
Basic Life Support

Clinical Practice Guidelines
ADVANCED PARAMEDIC

SECTION 4
MEDICAL EMERGENCIES

Basis Life Support – Adult

Pulse check – pulse check after 2 minutes of CPR to potentially perfusing system

Reference: ICOM Guidelines 2013

October 2014

68
Submersion Incident

Clinical Practice Guidelines
ADVANCED PARAMEDIC

SECTION 6
TRAUMA

Submersion Incident

- Submersion Incident
- Remove completely & immediately
- Complete emergency resuscitation
- Rescue

- Transport to hospital
- Inform the police

Reference: Guidelines for Submersion Incidents, Emergency Medicine, University Hospital Limerick, 2006.
Treatment

21 > 0

• Longer pulse check
Return to Group Exercise
Group Exercise

If was in a lake would you do anything different?
Winching a drowning Casualty
Post Rescue Collapse
History of after-drop

- The Dachau experiments reported deaths occurring after victims had been removed from cold water.

- If a victim was within 2 degrees Celsius of a lethal core temperature on removal the after-drop would bring the core temp to the lethal level.

- They attributed after-drop, as return of cold blood from the peripheral circulatory system when re-warming.

- After-drop is typically 1-2 degrees, and the Dachau experiments showed that death occurred at around 25 degrees.
Post Rescue Collapse

Dr Frank Golden
Circum-Rescue Collapse: Collapse, sometimes fatal, associated with rescue of immersion victims

F. St.C. Golden, G. R. Hervey and M. J. Tipton

INTRODUCTION
It has long been known, though it is still not always appreciated, that...
Post Winching brief

Winching brief
Heading
Height
Hazards
Entry
Exit
Emergencies

Downwash brief
Double strop lift
Conclusion

• Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid

• Hypoxia is the primary cause of Drowning

• Were possible lift casualties horizontally (consider c-spine)

• Safety first
Scene Safety

1. **Voice** - Seek assistance and Get Help. Instruct someone else or call 999 or 112.

   "Don’t worry. Help is on the way.
   Use your voice to calm the person in trouble and issue instructions to assist them to a place of safety.

2. **Reach** - Use a Branch, Coat or your arm to reach out.

3. **Throw** - Throw anything that floats. Such as a ring buoy, life belt or throw rope.
THANK YOU AND ANY QUESTIONS
Environmental Emergencies
Accidental Hypothermia
Objectives

• Identify who is at risk of developing hypothermia (predisposing conditions)

• Identify patients with hypothermia (Recognise hypothermia & know classification)

• How to manage (a hypothermic patient)

• Transport (to appropriate facility)
Scenario
Historical Perspective
Its Cold Outside
Central Statistics Office

VSA08: Deaths Occurring by Sex, Cause of Death, Age at Death and Year

Unit: Number

Download file as... Edit table Graphics

Pivot Line Chart

Comma Separated (*.csv)

Codes in separate columns

Incl. Footnotes

Deaths Occurring (Number) by Age at Death, Cause of Death, Sex and Year

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 331 Exposure to excessive natural cold
| Both sexes     | 7    | 7    | 14   | 6    | 9    |

2007 to 2011 are based on the number of deaths occurring in the year.

2012 data are provisional and are based on the number of deaths registered within the year as opposed to occurring in the year.
Elderly couple found in flat died from hypothermia

Sarah Stack

A COUPLE found huddled together in a senior citizens complex died from hypothermia and continuing health problems, it emerged tonight.

Peggy Mangan died of hypothermia, court hears

Pensioner who died while walking her dog Casper, died of hypothermia after falling into ravine
Be Vigilant and Informed

Physical and social causes of hypothermia

In this article...
- Risk factors for hypothermia
- National and local prevention strategies
- Role of the nurse in identifying risk, signs and symptoms

5 key points
- Hypothermia is defined as a core temperature of 35°C or below.
- It is difficult to estimate the role of hypothermia in

Author: Julie Dufek is lead nurse for safeguarding adults and mental capacity act and lecturer practitioner at Central London.

Publisher: European Centre for Disease Prevention and Control (ECDC), Stockholm, Sweden

Impact factor 4.65
Heat Loss

Body heat loss - 
"Hypothermia"

Radiation
Respiration
Evaporation
(Wetness)

Convection
(Weather)

WIND AND WETNESS TAKE AWAY BODY HEAT FASTER THAN IT CAN BE PRODUCED.
**Heat Loss**

**Convection** heat loss occurs when air or water in contact with our skin (known as the boundary layer) is warmed, then moves away and is replaced by cool air. In perfectly still air or water, heat loss is insignificant, but as soon as movement is introduced, loss is significant—in air this is called “wind chill.” The simplest remedy is to wear windproof clothes.

**Conduction** heat loss results when substances in direct contact with the body transfer heat energy away. When you sit on highly conductive surfaces like rock, ice, or metal, they conduct heat away from the body until—given enough time—the temperatures equalize. Cold water and wet clothing have the same effect.

Heat Loss

Evaporation heat loss occurs when water on the skin changes from a liquid to a gas. This process consumes about 580 calories of heat per gram of water, which explains why sweating is such an effective means of cooling...and why it’s so hard to stay warm when you are wet.

Radiation is direct emission or absorption of heat energy. The human body, being warm, continuously radiates heat to nearby solid objects that have a cooler temperature. The body can also gain large amounts of heat through radiation, by absorbing heat from the sun or a fire.
Hypothermia

Definition

Hypothermia occurs when core body temperature is < 35°C

http://lifeinthefastlane.com/ccc/hypothermia/
Pathophysiology

**FIG 1. AUTONOMIC PHYSIOLOGICAL MECHANISMS**

- **Hypothalamic heat loss centre activated**
- **Dilation of cutaneous blood vessels (radiation)**
- **Activation of sweat glands (evaporation)**
- **Body temperature ▼ to normal range**

**Normal range body temperature 35.6°C-38.2°C**

- **Body temperature ▲ to normal range**
- **Vasoconstriction of cutaneous blood vessels causing blood to be shunted to deeper-lying organs to ▼ heat loss to the environment**
- **Hypothalamic heat promotion centre activated**
- **Additional heat produced by skeletal muscles twitching (shivering)**

Adapted from: Manen and Hoehn (2010)
Hypothermia Classified

Accidental or Intentional

Primary or Secondary

By degree of hypothermia
ground too cold!
Levitation powers activate!
Swiss System

- I – clearly conscious and shivering (35-32°C)
- II – impaired consciousness without shivering (32-28°C)
- III – unconscious with vital signs (28-24°C)
- IV – absence of vital signs (24-13.7°C)
- V – death due to irreversible hypothermia (CBT < 13°C).
Degree of Hypothermia

• Mild 32-35°C
• Moderate 28-32°C
• Severe < 28 °C
Physiologic effects of hypothermia

- **Neurologic**
  - Poor fine motor skills
  - Poor muscle coordination
  - Difficult speech
  - Amnesia
  - Confusion
  - Stupor
  - Coma
  - No voluntary movement
  - Unresponsive to pain

- **Cardiovascular**
  - Tachycardia
  - Dysrhythmias
  - J waves
  - Hypotension
  - Severe hypotension
  - Asystole

- **Gastrointestinal**
  - Decreased motility
  - Depressed liver function
  - Decreased motility
  - Ischemic pancreatitis
  - Illus
  - Gastric ulcers

- **Musculoskeletal**
  - Uncontrollable shivering
  - No shivering
  - No shivering

- **Respiratory**
  - Tachypnea
  - Depressed rate
  - Pulmonary edema

- **Renal**
  - Cold diuresis
  - Low output
  - No output

- **Skin**
  - Pale
  - Cool
  - Flushed
  - Pale
  - Cyanotic
  - Cyanotic

- **Vascular**
  - Vasoconstriction

*Red = mild (91.4°F–95°F [33°C–35°C]); green = moderate (85.2°F–89.6°F [29°C–32°C]); blue = severe (< 85.2°F [< 29°C]).*
Characteristics of Hypothermia

<table>
<thead>
<tr>
<th>STATE</th>
<th>CORE TEMPERATURE °C (°F)</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>35 (95)</td>
<td>Urine temperature 34.8°C; increased shivering thermogenesis; increase in metabolic rate</td>
</tr>
<tr>
<td></td>
<td>34 (93.2)</td>
<td>Amnesia and dysarthria develop; normal blood pressure; maximum respiratory stimulation</td>
</tr>
<tr>
<td></td>
<td>33 (91.4)</td>
<td>Ataxia and apathy develop</td>
</tr>
</tbody>
</table>

The “umbles”

https://www.clinicalkey.com#!/content/book/3-s2.0-B978145570651001408
### Characteristics of Hypothermia

<table>
<thead>
<tr>
<th>Moderate</th>
<th>Stupor; 25% decrease in oxygen consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 (89.6)</td>
<td>Decreased shivering thermogenesis</td>
</tr>
<tr>
<td>31 (87.8)</td>
<td>Atrial fibrillation and other dysrhythmias; poikilothermia; pulse</td>
</tr>
<tr>
<td>30 (86)</td>
<td>and cardiac output two-thirds normal; insulin ineffective</td>
</tr>
<tr>
<td>29 (85.2)</td>
<td>Progressive decrease in level of consciousness, pulse, and respiration; pupils dilated</td>
</tr>
</tbody>
</table>
## Characteristics of Hypothermia

<table>
<thead>
<tr>
<th>Severe</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>28 (82.4)</td>
<td></td>
<td>Ventricular fibrillation susceptibility; 50% decrease in oxygen consumption and pulse</td>
</tr>
<tr>
<td>27 (80.6)</td>
<td></td>
<td>Losing reflexes and voluntary motion</td>
</tr>
<tr>
<td>26 (78.8)</td>
<td></td>
<td>Major acid-base disturbances; no reflexes or response to pain</td>
</tr>
<tr>
<td>25 (77)</td>
<td></td>
<td>Cerebral blood flow one-third normal; cardiac output 45% normal; pulmonary edema may develop</td>
</tr>
<tr>
<td>24 (75.2)</td>
<td></td>
<td>Significant hypotension</td>
</tr>
<tr>
<td>23 (73.4)</td>
<td></td>
<td>No corneal or oculocephalic reflexes</td>
</tr>
<tr>
<td>22 (71.6)</td>
<td></td>
<td>Maximum risk of ventricular fibrillation; 75% decrease in oxygen consumption</td>
</tr>
</tbody>
</table>

https://www.clinicalkey.com/#!content/book/3-s2.0-B9781455706051001408
Characteristics of Hypothermia

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profound</td>
<td>20 (68) Lowest resumption of cardiac electromechanical activity; pulse 20% of normal</td>
</tr>
<tr>
<td>19 (66.2)</td>
<td>Flat electroencephalogram</td>
</tr>
<tr>
<td>18 (64.4)</td>
<td>Asystole develops</td>
</tr>
<tr>
<td>14.2 (57.6)</td>
<td>Lowest accidental hypothermia survival in an infant</td>
</tr>
<tr>
<td>13.7 (56.7)</td>
<td>Lowest accidental hypothermia survival in an adult</td>
</tr>
<tr>
<td>9 (48.2)</td>
<td>Lowest therapeutic hypothermia survival</td>
</tr>
</tbody>
</table>

https://www.clinicalkey.com/#!/content/book/3-s2.0-B9781455706051001408
ECG Changes in Hypothermia

Hypothermia may produce the following ECG abnormalities:
• Bradyarrhythmias Sinus bradycardia (may be marked)
• Atrial fibrillation with slow ventricular response
• Slow junctional rhythms
• Varying degrees of AV block (1st-3rd)
• Osborne Waves (= J waves)
• Prolonged PR, QRS and QT intervals
• Shivering artefact
• Ventricular ectopics
• Cardiac arrest due to VT, VF or asystole

http://lifeinthefastlane.com/ecg-library/basics/hypothermia/
CLEAR!
J Wave
Who is at risk?
Who is at risk?

- age (elderly and infants at risk)
- environmental – exposure, drowning, alpine environment, poverty (lack of heating or shelter)
- drugs/tox – alcohol, sedatives, vasodilators
- Sepsis
- CNS disorders e.g. hypothalamic lesions, hypopituitarism
- Endocrine/metabolic – hypothyroidism, adrenal insufficiency, hypothermia, hypoglycaemia, malnutrition
- Trauma — burns, spinal cord injury
- Shock
- Skin disorders — psoriasis, exfoliating conditions
- Iatrogenic — cold fluid administration, intra-operative, therapeutic hypothermia
- Psychiatric (may lead to exposure)
Factors Predisposing to Hypothermia

- increased heat loss
- decreased heat production
- impaired thermoregulation
- Miscellaneous associated clinical states
Decreased Heat Production

- Endocrinologic failure
- Hypopituitarism
- Hypothyroidism
- Diabetes
- Insufficient fuel
- Hypoglycemia
- Malnutrition
- Marasmus
- Kwashiorkor
- Extreme exertion
- Neuromuscular inefficiency
- Age extremes
- Impaired shivering
- Inactivity
- Lack of adaptation
Increased Heat Loss

Environmental
Immersion
Nonimmersion
Induced vasodilation
Pharmacologic
Toxicologic
Erythrodermas
Burns
Psoriasis

Ichthyosis
Exfoliative dermatitis
Iatrogenic
Emergency deliveries
Cold infusions
Heatstroke treatment

https://www.clinicalkey.com/#!/content/book/3-s2.0-B9781455706051001408
Impaired Thermoregulation

Peripheral failure
Neuropathies
Acute spinal cord transection
Diabetes
Central failure, neurologic
Central nervous system trauma
Cerebrovascular accident
Toxicologic
Metabolic
Subarachnoid hemorrhage
Pharmacologic
Hypothalamic dysfunction
Parkinson's disease
Anorexia nervosa
Cerebellar lesion
Neoplasm
Congenital intracranial anomalies
Multiple sclerosis

https://www.clinicalkey.com/#!/content/book/3-s2.0-B9781455706051001408
Miscellaneous Associated Clinical States

- Recurrent hypothermia
- Episodic hypothermia
- Sepsis
- Pancreatitis
- Carcinomatosis
- Cardiopulmonary disease
- Vascular insufficiency
- Uremia
- Paget's disease
- Giant cell arteritis
- Sarcoidosis
- Shaken baby syndrome
- Multisystem trauma
- Shapiro's syndrome
- Wernicke-Korsakoff syndrome
- Hodgkin's disease
What Can You Do?

- Identify
- Initiate appropriate care
- Transport
you're not feline well?

do you need a purramedic?
Pre-hospital management

- Extract individual from hypothermic environment in horizontal position
- Evaluation and support of airway, breathing and circulation
- Remove wet clothing
- Prevention of further heat loss
- Initiate rewarming appropriate to the degree of hypothermia
- Treatment of complications
Clinical Practice Guidelines
ADVANCED PARAMEDIC

SECTION 4
MEDICAL EMERGENCIES

Hypothermia

- Immersion: Yes
  - Remove patient horizontally from liquid (Provided it is safe to do so)
- Immersion: No
  - Protect patient from wind chill
  - Complete primary survey (Commence CPR if appropriate)
  - Remove wet clothing by cutting
  - Place patient in dry blankets/showering bag with outer layer of insulation
  - ECG & SpO2 monitoring
  - Check and record core temperature

Members of rescue teams should have a clinical leader of at least EFR level.

Hypothermic patients should be handled gently & not permitted to walk.

Pulse check for 30 to 45 seconds.

Equipment list:
- Low reading thermometer
- Survival bag
- Space blanket
- Hot pack

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Check and record core temperature

Mild 34 – 35.5°C
Give hot sweet drinks

Moderate 30 – 33.9°C

Severe < 30°C

If Cardiac Arrest
- Follow CPGs but: - no active re-warming.
  - double medication interval until temperature > 34°C
  - no active re-warming beyond 32°C

If BradyCardiac
- Follow CPGs but:
  - do not use Atropine until temperature > 34°C

If Unresponsive
- Yes
  - Consider advanced airway
- No

NACI warmed to 40°C approx
Adult: 250 mL IV, Repeat prn to max 1 L
Paediatric: 10 mL/kg IV, Repeat prn x 1

Warm fluids to be administered over 30 minutes

Transport in head down position
Helicopter: head forward
Boat: head aft

AHA, 2005, Part 10.4; Hypothermia, Circulation 2005;112;136-138
Resuscitation (2005) 6751, S135-S170
# Hypothermia

<table>
<thead>
<tr>
<th>Temp</th>
<th>Direction for cardiac arrest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild</strong></td>
<td>Follow CPGs but no active re-warming</td>
</tr>
<tr>
<td>34 - 35.9°C</td>
<td></td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>Follow CPGs but double medication interval until temperature &gt; 34°C and no active re-warming beyond 32°C</td>
</tr>
<tr>
<td>30 - 33.9°C</td>
<td></td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>Follow CPGs but limit defibrillation to 3 shocks, withhold medications until temperature &gt; 30°C and no active re-warming beyond 32°C</td>
</tr>
<tr>
<td>&lt; 30°C</td>
<td></td>
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</tbody>
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**Re-warming:** **NaCl at 40°C**
Resuscitation Next
Resuscitation

- pulse check – palpate for up to 1 minute (consider Echo / Doppler as hard to find – do not delay CPR)
- move patient gently if <32 degrees due to risk of triggering VF (risk is overstated)
- no adrenaline or other drugs until >30C
- between 30-35C double the dose intervals of ACLS drugs
- shock VF up to 3 times if necessary, then no further shocks until T>30C
- ‘not dead until warm and dead’ (30-32C)

http://lifeinthefastlane.com/ccc/hypothermia/
Rewarming
Rewarming techniques

• Passive external rewarming
• Active external rewarming
• Active internal rewarming

The degree of hypothermia determines rewarming technique
Rewarming Options for Accidental Hypothermia

<table>
<thead>
<tr>
<th>Passive External</th>
<th>Active External</th>
<th>Active Internal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove wet clothing</td>
<td>Warm blankets</td>
<td>Warmed iv saline</td>
</tr>
<tr>
<td>Blankets</td>
<td>Increased room temperature</td>
<td>Gastric lavage</td>
</tr>
<tr>
<td>Sleeping bag</td>
<td>Forced-air blanket</td>
<td>Colonic lavage</td>
</tr>
<tr>
<td>Tent</td>
<td>Heated water-circulating blanket or suit</td>
<td>Bladder lavage</td>
</tr>
<tr>
<td>Dry clothing</td>
<td>Fire</td>
<td>Peritoneal lavage</td>
</tr>
<tr>
<td>Insulation</td>
<td>Warm-water immersion</td>
<td>Thoracic lavage</td>
</tr>
<tr>
<td></td>
<td>Heated fluidized-bead beds</td>
<td>Cardiopulmonary bypass</td>
</tr>
</tbody>
</table>

AJN ▼ January 2012 ▼ Vol. 112, No. 1

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Passive External Rewarming

Rx for mild hypothermia
Useful in conscious patients who are able to shiver (1.5°C per hour)

• Remove wet clothing
• keep dry
• warm environment
• insulation with blankets (e.g. aluminium foil) and hat
• allow to mobilise if conscious (beware of hypotension on cessation of exercise)

http://lifeinthefastlane.com/ccc/hypothermia/
Active External Rewarming

- chemical heat pads
- radiant methods
- forced air warming blankets (1-2C/h)
- NB. Afterdrop, a drop in core body temperature during rewarming may occur as a consequence of peripheral vasodilation and release of cold peripheral blood to the body core. It is not usually significant.
REWARMING RATES FOR DIFFERENT METHODS

• Shivering 1.5° C/hr
• Warming Blanket 2° C/hr
• Warm O2 1 °C/hr with mask; 1.5° C/hr ET tube
• IV Fluids do not add, but do not take away either
• Peritoneal Lavage 3° C/hr
• Thoracic Lavage with Chest Tubes 3-6° C/hr
• Cardiac Bypass 9-18° C/hr
Scenario
Thank You
Any Questions
References


Pre-Hospital Emergency Care Council (PHECC) (2014) PHECC Clinical Practice Guidelines. 3rd edn. Naas: PHECC.
Web Sites


