

Physiology and Pathology at High Altitude

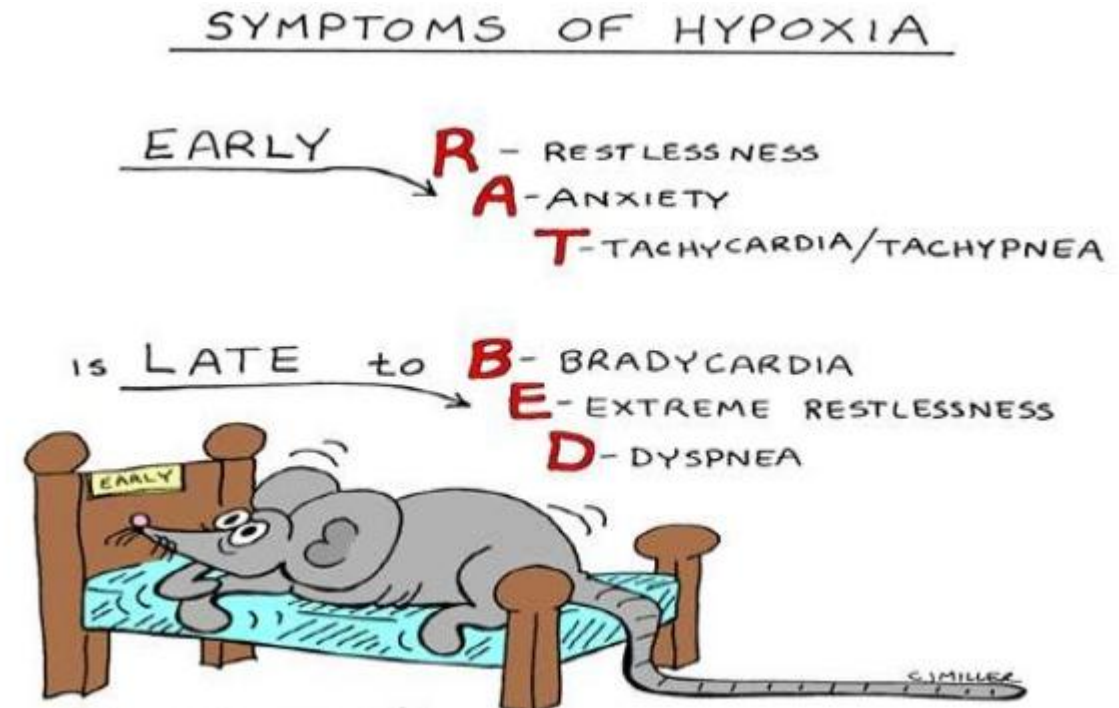
Dr. Sumit Mandale

Altitude above 8000 feet is called as High altitude



One get sick at altitude because of hypoxia

- Hypoxia means inadequate oxygen supply to body tissue
- As one one get higher and higher air becomes thin .
- Partial pressure of oxygen is decreased
- One get hypoxic.



How do we get oxygen

- **Acquisition-** Done by Lungs
- **Transportation-** Done by Heart and oxyhaemoglobin
- **Delivery** – Done by Peripheral arteries and capillaries
- **Utilization-** Done in cells
- **To deal with less oxygen pressure at high altitude body needs to do some changes at above mentioned level.**
- **We call it as “ Acclimatization”**

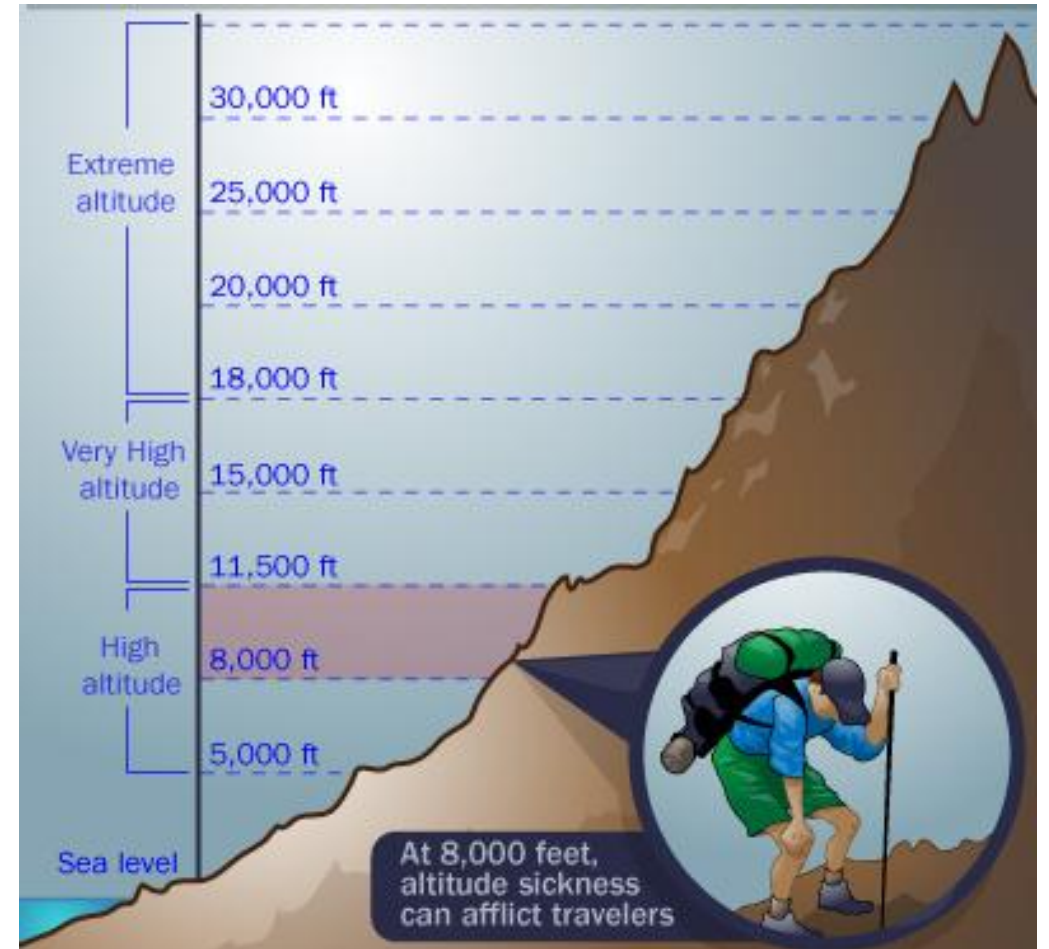
What does happen during Acclimatization

- To full fill the demand of oxygen body breaths faster and faster
- As a result of this body gets more O₂ & also exhale more CO₂ .
- But loosing CO₂ from body comes with cost.
- Because of more loss of CO₂ blood becomes more alkaline
- To reduce blood alkanity one should breath slowly so that less CO₂ can be exhaled
- **But breathing slowly at altitude is not possible.**
- Hence Body excret bicarbonate in urine and alkinity of blood is reduced.

Other Changes that occur in body during Acclimatization

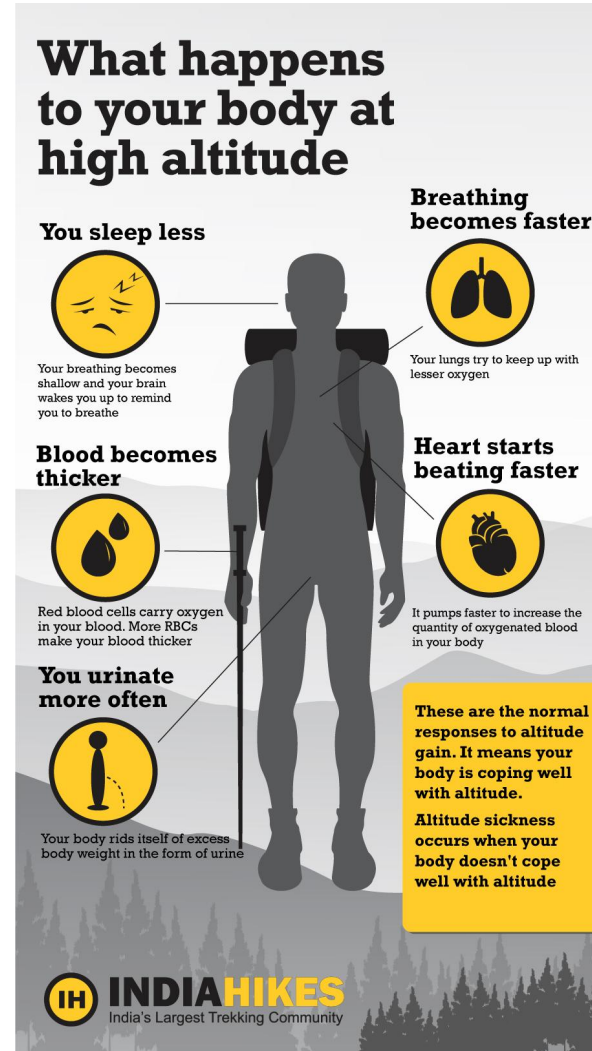
- **RBC production increased**- red blood cells production is increased so that haemoglobin can be increased which helps to carry more oxygen to cells
- **No.of mitochondrias are increased** - so that available oxygen can be used efficiently and body fatigue can be prolonged .
- **Neovascularisation**- New blood vessels are formed around the tissue so that More blood can be delivered

- Acute Mountain Sickness
- High Altitude Pulmonary Edema
- High Altitude Cerebral Edema



Symptoms

- Headache
- Nausea
- Loss of appetitiet
- Disturb sleep pattern
- Tierdness



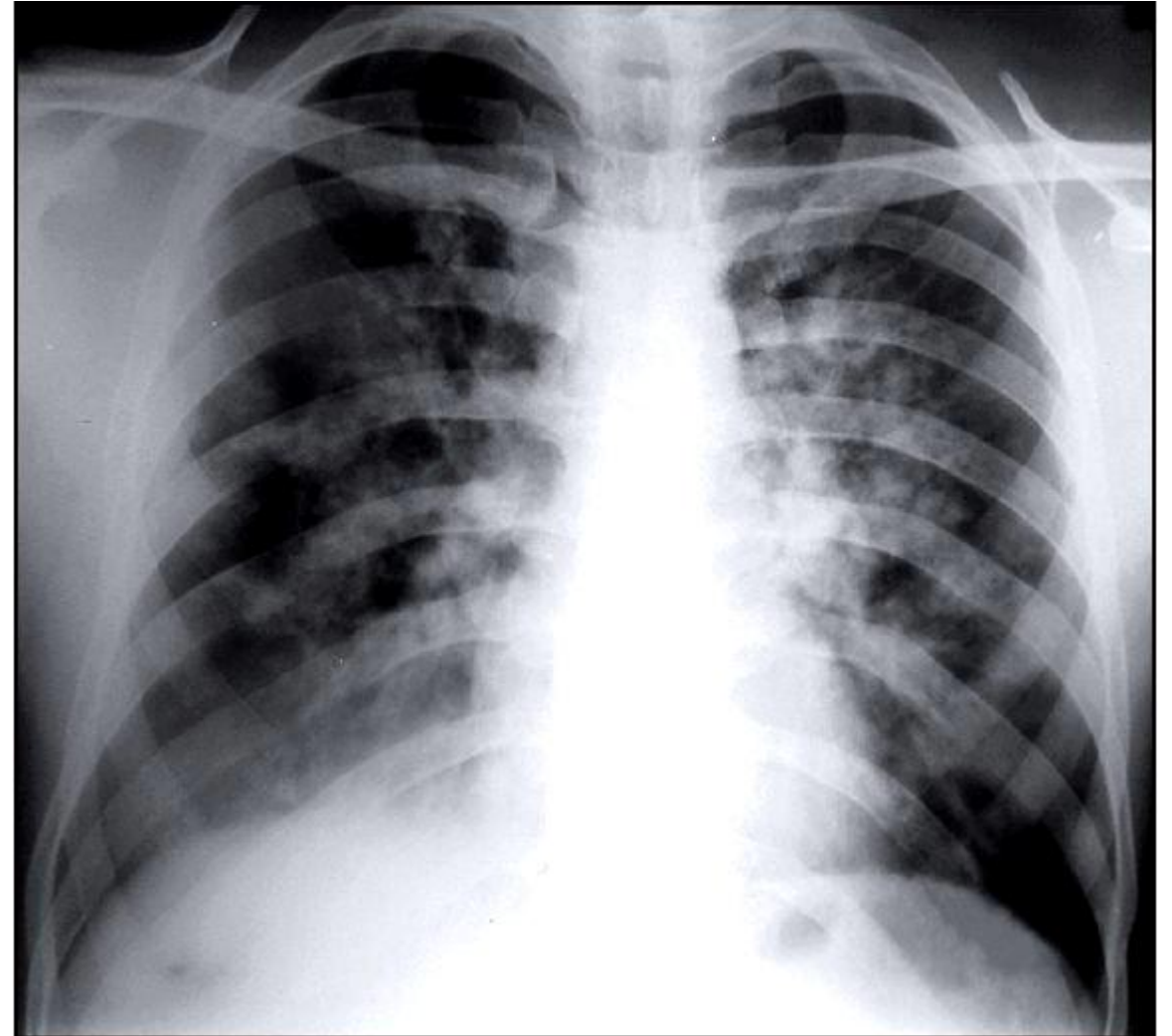
AMS treatment

- Symptomatic treatment
- Stop climbing to further altitude
- Drink plenty water
- Avoid suffocated place
- Protect casualty from cold with adequate layers of warm clothes
- If there is no improvement in health then descent to lower altitude

Fluid accumulation in lung

Symptoms & Signs

- Cough
- Shortness of breath
- Decreased exercise performance
- Chest tightness
- Tachycardia
- Tachypnea



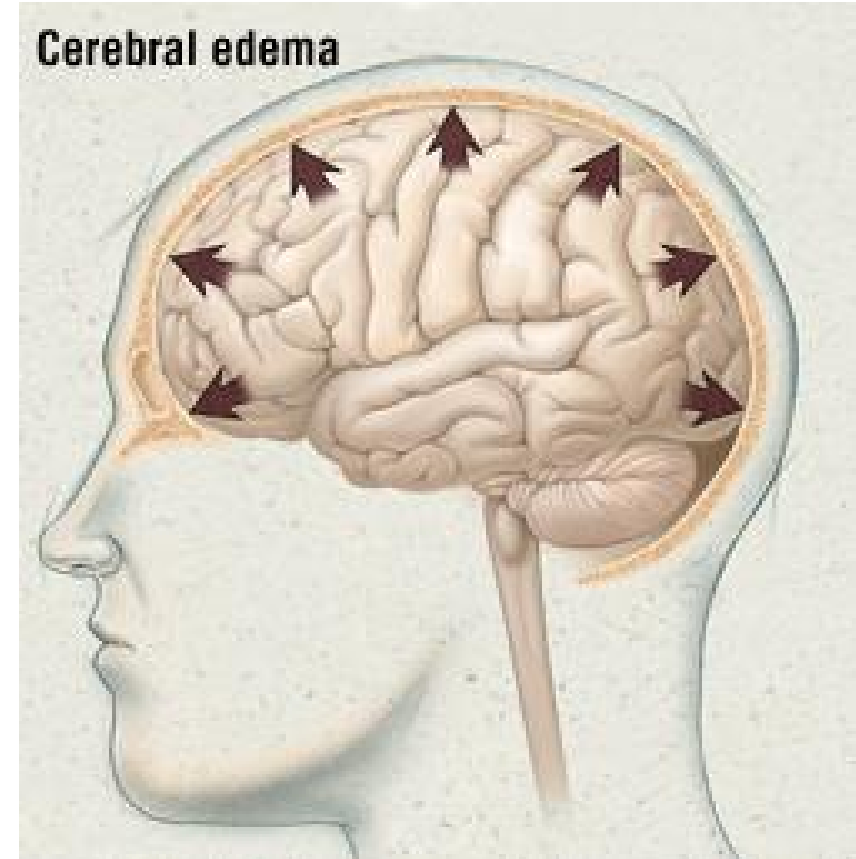
HAPE treatment

- Descent to low altitude as early as possible
- Oxygen
- Inj Dexamethasone
- Tab Depin 5mg

Fluid accumulation in brain

Symptoms and signs

- Ataxia
- Fatigue
- Altered mental state
- loss of consciousness
- Tachycardia
- Tachypnea



HACE treatment

- Descent to low altitude as early as possible
- Oxygen
- Inj Dexamethasone
- Inj Mannitol

How one can avoid mountain sickness

- Drink lot of hot water
- Keep yourself warm
- Eat healthy food avoid spicy food
- Slow height gain
- Don't exert yourself
- Walk slow and steady
- Start early finish early
- Keep yourself active during rest





Other medical conditions that occur at high altitude



Cold injuries

1. Hypothermia-
2. Chilblains
3. Frost bite

Hypothermia- when body temperature drops to below 34°C
caused by exposures to very cold temperature

Causes

- Exposures to very cold temperature
- If a person becomes chilled from rain, sweat, or submersion in cold water, and get exposed to wind with cold temperature

Symptoms

- Shivering
- Exhaustion or feeling very tired
- Confusion
- Fumbling hands
- Memory loss
- Slurred speech
- Drowsiness

Treatment

- Get the person into a warm room or shelter.
Remove any wet clothing the person is wearing.
- Warm drinks can help increase body temperature, but do not give alcoholic drinks.
- Warm the center of the person's body—chest, neck, head, and groin
- use dry layers of blankets, clothing, towels, sleeping bags to cover victim body

Chilblains

Chilblains (CHILL-blains) is a condition that causes inflamed swollen patches and blistering on the hands and feet.

Causes

It's caused by exposure to damp air that's cold but not freezing

Symptoms

- Small, itchy areas on your skin, often on your feet or hands.
- Sores or blistering.
- Swelling.
- Pain or stinging.
- Changes in skin colour

Chilblains

- Rewarming of the skin
- Remove wet clothing
- Avoid exposure to the cold.
- Hydrate casualty
- Dress in layers of loose clothing and wear mittens, a scarf and a hat, and warm, water-resistant footwear.
- Keep hands, feet and dry and warm.

Frost bite

Frostbite is a type of injury caused by freezing. It leads to a loss of feeling and color in the areas it affects, usually extremities such as the nose, ears, cheeks, chin, fingers, and toes.

Causes

- Extreme cold temperature along with wind
- Inadequate layers of clothing
- Dehydration & Hypoxia

Frost bite

Types

- First Degree
- Second Degree
- Third Degree
- Fourth Degree

Frost bite

Degree	First (frostnip)	Second	Third	Fourth
Pathophys	Partial-skin freezing	Full-thickness skin freezing	Tissue loss involving entire thickness of skin	Extension into subcutaneous tissues, muscle, bone, and tendon; little edema
Symptoms	Stinging and burning, followed by throbbing	Numbness followed by aching and throbbing	Extremity feels like a "block of wood" followed by burning, throbbing, shooting pains	Deep, aching joint pain
Course	Numbness, erythema, swelling, dysesthesia, desquamation (days later)	Substantial edema over 4-6 hours; skin blisters form within 6-24 hours; Desquamate and form hard black eschars over several days	Hemorrhagic blisters form and are associated with skin necrosis and blue-gray discoloration	Skin is mottled with nonblanching cyanosis and formation of deep, dry, black eschar
Pain with rewarming	Minimal	Mild to moderate	Severe	None
Prognosis	Excellent	Good	Often poor	Extremely poor
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Frost bite treatment

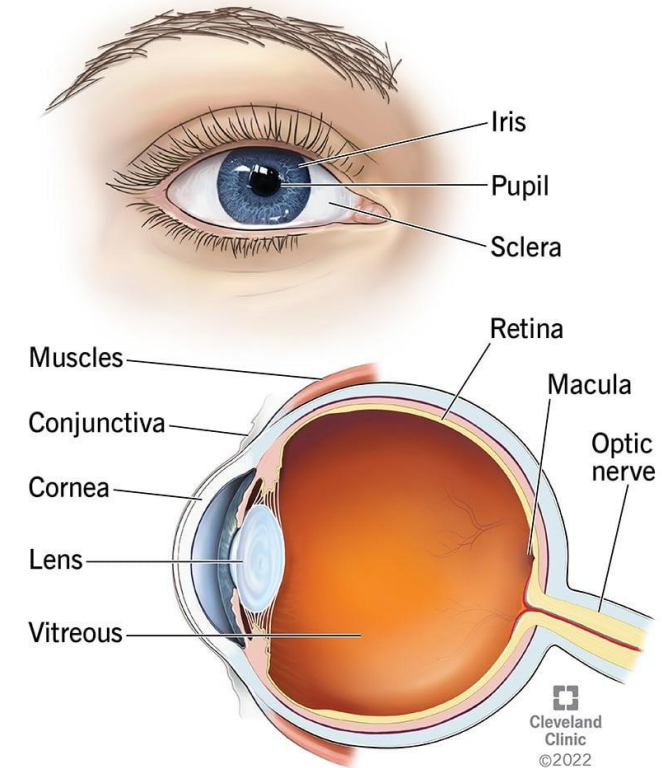
- **Remove wet clothing**
- **Rewarming of the skin.** rewarm the area using a warm-water bath for 15 to 30 minutes. The skin may turn soft. Casualty may be encouraged to gently move the affected area as it rewarms.
- Oral pain medicine.
- Dressing with sterile bandages
- Hydrate casualty with warm water, tea, coffee
- Apply artificial Oxygen
- Descent to lower altitude

Other medical conditions that occur at high altitude

Ophthalmic Injuries

- Dry eye syndrome
- Keratitis
- Retinal Haemorrhage

Eye anatomy



Ophthalmic Injuries

Symptoms

- Irritation
- Burning of eye
- Foreign body sensation
- Blurred vision

Treatment

- Topical tear substitute eye drop and lubricating eye drop

Precaution

- **Wear goggles**
- **Avoid contact lenses at altitude**

The mountain way!!!!

Climbing or trekking at high altitude is mostly about suffering. This is the essence of high altitude. Every step is overcoming your weakness. It simply about overcoming your pain and overcoming your pain results in an exhilarating sense of liberation.

- VOYTEK KURTYKA

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One should climb mountains gradually