
In the name of God

Espilat Mountaineering Club

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- **MEDICAL PROBLEMS IN HIGH MOUNTAIN ENVIRONMENTS**

Arya Hamedanchi MD, MPH
Level one International Anthropometrist
International Certificate of Ski Medicine

Medical Problems Related to Sustained Hypoxia

- Acute Mountain Sickness
- High Altitude Pulmonary Edema
- High Altitude Cerebral Edema
- High Altitude Peripheral Edema
- High Altitude Retinal Hemorrhage
- Thromboembolic Events
- Subacute Mountain Sickness
- Immune Suppression and Poor Wound Healing

Medical Problems Unrelated to Hypoxia

- Cold Injuries
- Solar Radiation Injuries
- High Altitude Pharyngitis and Bronchitis
- Lightning Injuries
- Carbon Monoxide Poisoning
- Terrain-Related Trauma and Orthopedic Problems
- Constipation and Hemorrhoids
- Infectious Diseases

Exacerbation of pre-existing medical conditions

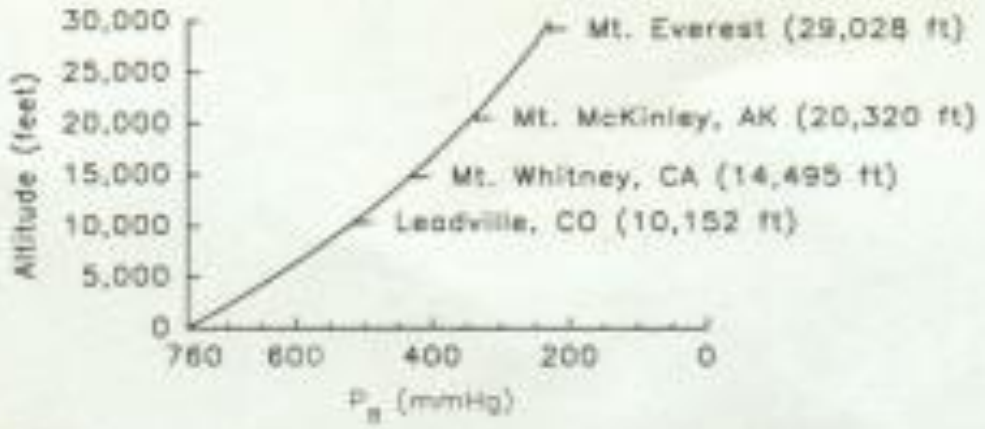

Figure 2. Relationship of barometric pressure and elevation.

At sea level the barometric pressure (PB) is approximately 760 mmHg, and the partial pressure of oxygen (P02) in dry air is about 160 mmHg (760 mmHg x 0.21). At 18,000 ft *(5,500 m)*, P9 is approximately 380 mmHg and the P02 is only 80 mmHg (380 x 0.21).

- Arterial hemoglobin saturation
- Sustained hypobaric hypoxia at elevations over 5,000 ft (1,524 m) triggers a series of integrated physiologic changes in soldiers who ascend from lower altitudes.These changes function to increase oxygen supply to body tissues and are most noticeable in those body systems that are directly related to oxygen delivery (i.e.,cardiovascular and respiratory)

- way to identify these individuals
- How acclimatization is probably lost

High altitude syndromes:

- Although this can be accomplished using supplemental oxygen, the most efficient means to decrease hypobaric hypoxia is to descend to lower altitude. **The preferred step in treating any high altitude syndrome is to evacuate the patient to a lower altitude whenever possible!**

- **Acute Mountain Sickness (AMS)**
- Acute mountain sickness is a self-limited symptom complex which occurs inunacclimatized individuals who ascend rapidly to altitudes 6,000 ft (1,829 m)(?)

- Why important?

- Rapid ascent to 17,500 ft (5,333 m) causes severe, incapacitating symptoms in almost all individuals.(?)

- The onset of AMS symptoms
- Symptoms and Diagnosis:
- Headache is the most common AMS symptom
- Anorexia, nausea and vomiting are the next most common symptoms of AMS
- Other symptoms and signs include weakness, lassitude, general malaise,decreased coordination, dizziness or lightheadedness and oliguria. Sleep disturbances.

- Prevention:
- - If possible, you should spend at least one night at an intermediate elevation below 3000 meters.
  - At altitudes above 3000 meters (10,000 feet), your sleeping elevation should not increase more than 300-500 meters (1000-1500 feet) per night.
  - Every 1000 meters (3000 feet) you should spend a second night at the same elevation. (?)
- ***Drugs:*** Acetazolamide 125 to 250 mg po q 12 h reduces the incidence of AMS

Prevention &Treatment

- Descent –How to descend?
- Oxygen rarely available.
- Remaining at their current altitude ?
- Acetazolamide, prophylaxis or treatment?
- IS Dexamethasone is more effective than acetazolamide?
- . **If symptoms are getting worse while the traveler is resting at the same altitude, he or she must descend.**

- **High Altitude Pulmonary Edema (HAPE)**
- High altitude pulmonary edema is a non-cardiogenic pulmonary edema occurring in unacclimatized individuals following a rapid ascent to high altitude. It also occurs in long-term high-altitude residents who reascend rapidly following a several week stay at a low altitude.
- Untreated, HAPE can be rapidly fatal and is the most common cause of death among the altitude illness syndromes. It is often preceded by AMS and is frequently seen in individuals with HACE, but most cases of HAPE occur without concomitant HACE.

- Widely accepted risk factors

- The incidence of HAPE varies widely with geography, population at risk and the specific circumstances of exposure. In Colorado, for example, with skiing elevations of 6-10,000 ft (1,828 to 3,047 m**), the incidence is -1/10,000. On Mt. McKinley (20,320 ft or** 6,192 m**), the rate in climbers is -1/50.**

- High altitude pulmonary edema in unacclimatized people usually begins within the first two to four days after rapid ascent to altitudes greater than 8,000 ft (2,438 m)**,(?)**

- **Signs**

- **Syptoms**

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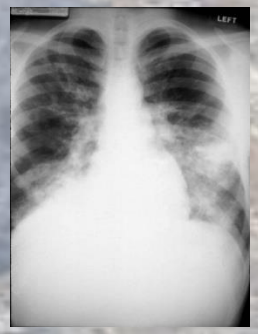
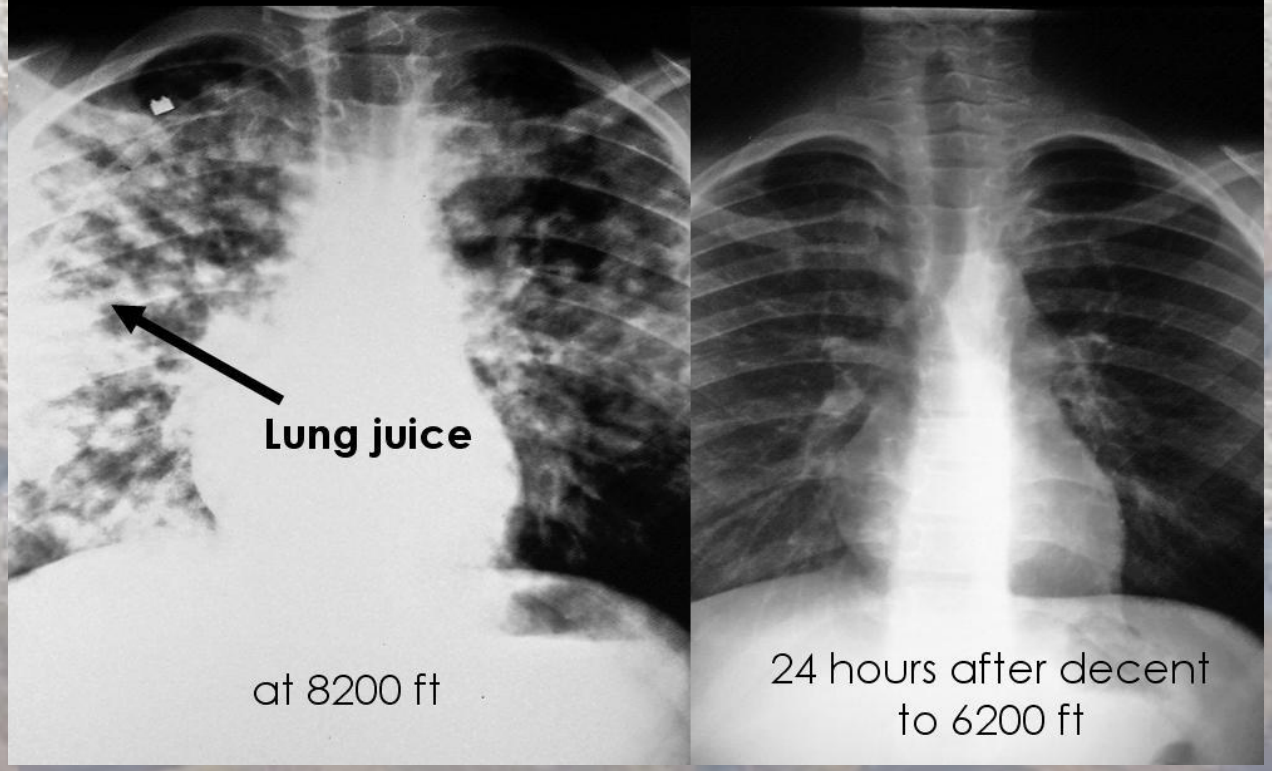
- Furthetmore mental status deteriorates with progressive confusion and sometimes vivid hallucinations. Ultimately, coma and death will occur without treatment.
- Arterial blood gas measurements
- chest x-ray
- The differential diagnosis of HAPE includes pneumonia



High altitude pulmonary edema (HAPE)

Fluid buildup in the lungs



Chest X-ray of HAPE

Prevention:

- Nifedipine may prevent HAPE from developing in those who have a history of prior episodes. It is administered in a 20 mg dose by mouth every eight hours beginning on the day of ascent and continuing for three days after reaching the final destination altitude.
- Nifedipine is not indicated for those without a history of HAPE, or for those with no prior altitude experience. For such individuals, acetazolamide may help prevent HAPE, although this suggestion is based upon anecdotal reports. Those people could appropriately take acetazolamide to prevent AMS and thereby gain possible prophylaxis for HAPE.

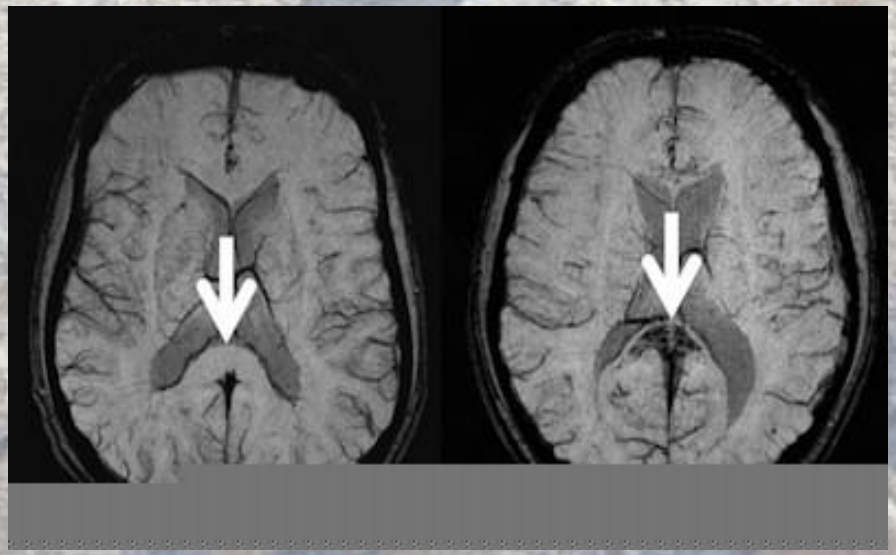
Treatment:

- immediate descent
- descent should be by passive means
- When available, supplemental oxygen should be administered during descent(2 to 4 L per min) by mask or nasal cannula in mild cases.
- hyperbaric chamber may be lifesaving
- (10 days to 2 weeks) limiting strenuous physical activity may be helpful to these individuals.

- **High Altitude Cerebral Edema (HACE)**
- High altitude cerebral edema is clinically apparent edema in the brain associated with a rapid ascent to high altitude
- While HACE can occur as low as 8,000 ft (2,430 m). the vast majority of cases occur above 12,000 ft (3,600 m)**. Other risk factors include** the same risk factors as for AMS.

- Untreated, HACE can progress to death over one to three days, but the course also can be more fulminant with death occurring in less than 12 hours.
- Early signs and symptoms often resemble AMS and include severe headache, nausea, vomiting and extreme lassitude. These symptoms are not invariably present,however. Truncal ataxia and change in mental status help differentiate early HACE from AMS. Truncal ataxia (i.e., swaying of the upper body, especially when walking) is a fairly sensitive sign of developing HACE

- visual changes, anesthesias, paresthesias, rigidity, hemiparesis, clonus, pathological reflexes, hyperreflexia, bladder and bowel dysfunction, hallucinations, seizures and coma. Papilledema may be present in up to half of patients with HACE, but is *not universal. If a lumbar puncture is performed, the cerebral spinal* fluid pressure is usually elevated. Cerebral edema may be apparent on computed tomography (CT) and magnetic resonance images (MR) if these procedures are obtained.



HACE on MRI

- A presumptive diagnosis of HACE can be made in patients with AMS symptoms who additionally have either ataxia, mental status changes or both.

- Prevention and Treatment
- High carbohydrate diet and use of acetazolamide
- **Definitive treatment of HACE is immediate descent. In general, the greater the** descent, the better the outcome. Descent of more than 1000 ft (300 m) may be required for clinical improvement,
- Supplemental oxygen
- Dexamethasone is the most widely accepted adjunctive therapy for HACE

Review

- Prevention:
- - If possible, you should spend at least one night at an intermediate elevation below 3000 meters.
  - At altitudes above 3000 meters (10,000 feet), your sleeping elevation should not increase more than 300-500 meters (1000-1500 feet) per night.
  - Every 1000 meters (3000 feet) you should spend a second night at the same elevation. (?)

Review 2:

- HAPE responds best to descent.
- Oxygen, if available, should be provided.
- Nifedipine (Procardia), a medication for high blood pressure, has been shown to be beneficial for HAPE.
- Antibiotics may be given if a fever is present and pneumonia is possible.
- For more severe cases of HAPE, continuous positive airway pressure (CPAP) mask ventilation can be used. Although uncomfortable to wear, the CPAP mask helps by increasing the pressure of the inhaled air.
- If this intervention fails, a tube may be placed through the mouth and into the airway. This, along with assisted ventilation, is required to treat respiratory failure.

Review3:

- The only definitive treatment for HACE is descent.
- Dexamethasone (Decadron, a steroid) may be beneficial.
  - Generally, if dexamethasone is considered, then a plan for descent should be in place unless descent is impossible.
  - Some people, after receiving dexamethasone, may feel so much better that they want to continue ascending. Under no circumstance should this be allowed.
- Oxygen may be helpful.
- A Gamow bag may buy time until descent is possible.

Centers for Disease Control and Prevention

CDC 24/7: Saving Lives. Protecting People.™

Table 2-07. Recommended medication doses to prevent and treat altitude illness

MEDICATION	INDICATION	ROUTE	DOSE
Acetazolamide	AMS, HACE prevention	Oral	125 mg twice a day Pediatrics: 2.5 mg/kg every 12 h
	AMS treatment[1]	Oral	250 mg twice a day Pediatrics: 2.5 mg/kg every 12 h
Dexamethasone	AMS, HACE prevention	Oral	2 mg every 6 h or 4 mg every 12 h Pediatrics: should not be used for prophylaxis
	AMS, HACE treatment	Oral, IV, IM	AMS: 4 mg every 6 h HACE: 8 mg once, then 4 mg every 6 h Pediatrics: 0.15 mg/kg/dose every 6 h

Nifedipine	HAPE prevention	Oral	30 mg SR version every 12 h, or 20 mg SR version every 8 h
	HAPE treatment	Oral	30 mg SR version every 12 h, or 20 mg SR version every 8 h
Tadalafil	HAPE prevention	Oral	10 mg twice a day
Sildenafil	HAPE prevention	Oral	50 mg every 8 h
Salmeterol	HAPE prevention	Inhaled	125 µg twice a day[2]

Abbreviations: AMS, acute mountain sickness; HACE, high-altitude cerebral edema; HAPE, high-altitude pulmonary edema; IM, intramuscular; IV, intravenous; SR, sustained release.

[1] Acetazolamide can also be used at this dose as an *adjunct* to dexamethasone in HACE treatment, but dexamethasone remains the primary treatment for that disorder.

[2] Should not be used as monotherapy and should only be used in conjunction with oral medications.

acetaminophen	AMS headache	325 mg q. 4 h to 1000 mg q.i.d., p.o., or t.i.d. p.o.	
ibuprofen	AMS headache	200-800 mg t.i.d. or q.i.d. p.o.	Other non-steroidal anti-inflammatories stomach irritation
aspirin	AMS headache superficial thrombophlebitis	325-1000 mg 4-6h, p.o 325-1000 mg q. 4-6 h, p.o.	Stomach irritation

- **Altitude-induced peripheral edema** is most evident in the hands and peripheral areas of the face. It is usually associated with decreased urine output and a weight gain of approximately 6 to 12 pounds (2.7 to 5.4 kg) over several days and is most evident upon awakening. Diagnosis is based upon the association of the characteristic peripheral edema with ascent to high altitude. The diagnosis can often be made by history alone because it tends to recur consistently with repeat ascents. Peripheral edema is more common in females. The differential diagnosis includes cardiogenic edema, allergic reactions and edema of the upper extremities caused by packstraps or binding by tight clothing

- Treatment:250 mg of acetazolamide every eight hours for three doses) and salt restriction. As with most altitude illness syndromes, the definitive treatment is descent to a lower elevation.
- Prophylaxis with salt restriction and the acetazolamide regimen used to prevent AMS is often successful in preventing altitude inducedperipheral edema

Local Evidences

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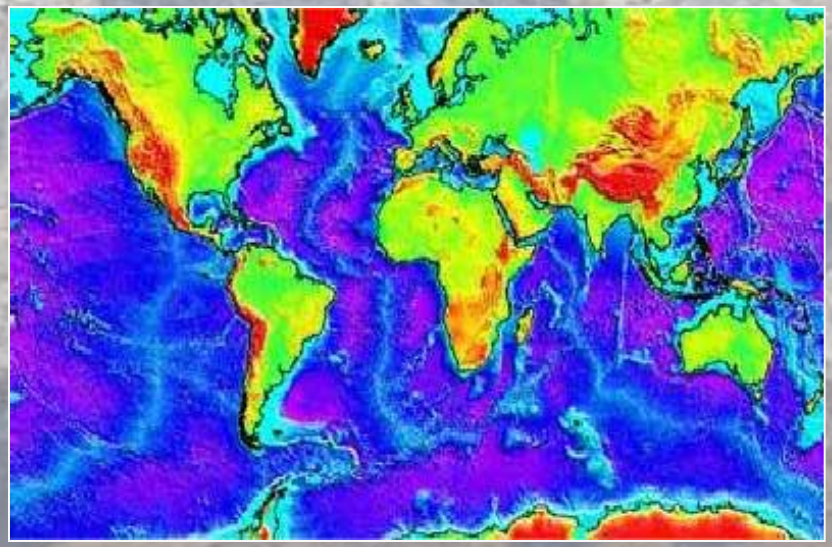

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Brief Report

Skiing Injuries at the Dizin Ski Resort

Amir Hossein Khalilifar, [1, *] **Mohammad Hassan Kazemi**, [2] **Arya Hamedanchi**, [3] and **Mohammad Javad Hosseini** [4]

[1] Iran Triathlon Federation, Tehran, IR Iran
[2] NEZAJA Preventive Medicine Department, Tehran, IR Iran
[3] University of Social Welfare and Rehabilitation Sciences, Tehran, IR Iran
[4] Molecular Biology Research Center, Baqiyatallah University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Amir Hossein Khalilifar, Iran Triathlon Federation, Tehran, IR Iran. Tel.: +98-2188452819, Fax: +98-2177116451, E-mail: **drkhalilifar@gmail.com**.

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Thank you for your attention

doctorarya@yahoo.comm