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High Altitude Medicine Synopsis

Medical Importance

Over 30 million people live at altitude above 9000 feet and many more travel to these altitudes. Altitude illness is common and can range from being a nuisance to a fatal illness. We will talk today about how human adapt to altitude and what can go wrong.

Objectives:

1. Be able to name the changes in the O2 disassociation curve with ascent to mode set, increased, and extreme altitude.
2. Be able to describe the biphasic mechanism of increased hematocrit to altitude
3. Be able to list the "Big Three" high altitude illnesses
4. Be able to name the cardinal symptom of AMS
5. If given a list of medicine be able to state if they are useful in treating or preventing AMS, HACE, and HAPE
6. Be able to name two effective and one ineffective methods for preventing traveler's DVT

Adjustment to Altitude

- Major problem is low oxygen!
- Major goal of altitude adaptation is to improve "chain of oxygen"
    - Ventilation: increase respiratory rate, increase CO2 sensitivity
    - Pulmonary artery pressure: increases
    - Cardiac: HR increases, CO decreases due to lowered stroke volume
    - Hematologic: Initial increase hematocrit due to hemoconcentration then increase in EPO secretion
    - Changes in oxygen disassociation curve
        - Modest elevation (0-10,000 ft): lowered O2 affinity to increase tissue delivery
        - Increased elevation (10-20,000 ft): shift back to normal O2 affinity
        - Extreme elevation (>20,000 ft) increased O2 affinity to increase O2 uptake from air
    - Fluid balance: Early diuresis upon arriving at altitude

Nutrition: increase metabolism, anorexia and possible fat malabsorption

High Altitude Training

- Considerable controversy on role of hypoxia and altitude for improving performance
- Most data for "Train-low Sleep-High" programs with best results for athletes spending over 18 hours at altitude
- Response correlated with increase in hematocrit and EPO
- Only 60% of athletes respond - unknown genetic factors

DISEASES OF HIGH ALTITUDE

ACUTE MOUNTAIN SICKNESS

Incidence varies - rate increases with altitude and rate of ascent with less than 5% with rapid travel to 5,000 ft, 40-60% at 10,000ft, and almost 100% at 15,000ft.

- Little AMS seen with rate of ascent less than 1000ft/day
- AMS occurs 6- 24 hour at altitude

- Cardinal symptom is headache - victims may also c/o of fatigue, nausea and decreased urine output
- Score by Lake Louise Score (see table) AMS if self-reported >4 or total score greater than 5.

THERAPY:
1) No further ascent!
2) Acetazolamide 250 mg BID- increases oxygenation and aids diuresis
3) Descending by 150-3000 ft, especially is symptoms are moderate or severe.
4) Dexamethasone 4 mg q 6hr - improves symptoms but does not aid acclimatization. Used with acetazolamide for severe cases

Options for Prevention of AMS
1) Slow ascents: Classic recommendation not to ascend more than 1000ft/day above 10,000ft with a rest day (2 nights at the same altitude) every 2-3 days.
2) Acetazolamide 125 mg BID to start 1 day before and continue for 2-3 days at altitude.
3) Ginkgo Biloba 60-120 mg BID to start 5 day before and continued at altitude. Most useful for modest altitude – variation with type of preparation.

HIGH ALTITUDE CEREBRAL EDEMA
Severe AMS with altered mental status, ataxia, and other neurological manifestations such as seizures.
Rare: 1-3%
Can be fatal - fatality rate 60% once patient is comatose

THERAPY:
1) Descent as soon as possible
2) Dexamethasone 8 mg load then 4 mg q6 hours
3) O2 at 2-4 l/hour
4) If descent not possible consider oxygen and portable hyperbaric chamber.

Etiology of AMS/HACE
- Predisposing factors: hypoxia, lowered hypoxic ventilatory response, fluid retention
- Past occurrence of AMS/HACE strongest risk factor for recurrence
- Current theories center on role of brain swelling at altitude and raised ICP

HIGH ALTITUDE PULMONARY EDEMA
- High altitude disease that kill most people
- Incidence: severe cases 1-5% but increase lung water seen in 75% of climbers
- Early signs are weakness and shortness of breath that evolves in tachypnea, tachycardia, and severe hypoxia

THERAPY
1) Rapid Descent
2) Oxygen 4-6/l
3) Nifedepine 10 mg po then 30mgSR q12-24 hours
4) Portable hyperbaric chamber if descent not possible
5) Sildenafil (Viagra) 50 TID: Lowers pulmonary artery pressures and improves oxygenation without systemic hypotension
6) Increasing data that acetazolimide may also help HAPE

Prevention:
Patients who have suffered from HAPE are prone to recurrence
1) Slower ascent
2) Nifedipine 20-30 mg q12 hours
3) Increasing evidence that steroids may prevent HAPE

Etiology
- Patients prone to HAPE have exaggerated pulmonary artery pressure to hypoxia
- Uneven blood flow to parts of the lung may lead to stress breakdown of endothelium and fluid leak

Sleep Problems at Altitude
- Poor sleep common at altitude - increase incidence of Cheyne-stokes breathing
- Therapy: acetazolamide 125 mg or zolpidem 10 mg qHS

High Altitude Retinopathy and Refractive Surgery
- Incidence of hemorrhage 36-56% at altitudes 15,000ft
- Rarely causes permanent damage
- Patients with both RF can have dramatic vision changes with ascending to over 12,000ft. Vision returns to normal when descending to sea level. Increasing data to suggest LASIK does not cause significant vision changes at altitude.

High Altitude and Travel's Thrombosis
- Multiple case reports of DVT, PE, and stroke at altitude
- Hypoxia not associated with increase in coagulation
- Most cases due to classic risk factors such as dehydration, immobilization, and genetic factors
- Risk of thrombosis with air-travel increase 3-4 fold
- Most patients with DVT have other risk factors

Prevention:
1) Aspirin ineffective
2) Elastic Stockings
3) Prophylactic LMWH for high risk patients

Lake Louis Score
Self Reported

Parameter	Finding	Points
Headache	none at all	0
	a mild headache	1
	moderate headache	2
	severe headache incapacitating	3
Gastrointestinal Symptoms	good appetite	0
	poor appetite or nausea	1
	moderate nausea or vomiting	2
	severe incapacitating nausea and vomiting	3
Fatigue And/or Weakness	not tired or weak	0
	mild fatigue/weakness	1
	moderate fatigue/weakness	2
	severe incapacitating nausea and vomiting	3
Dizziness/lightheadedness	none	0

	mild	1
	moderate	2
	severe incapacitating	3
Difficulty Sleeping	slept as well as usual	0
	did not sleep as well as usual	1
	woke many times poor night's sleep	2
	could not sleep at all	3

Physical Examination

Parameter	**Finding**	**Points**
Change in Mental Status	none	0
	lethargy lassitude	1
	disoriented confused	2
	stupor semiconscious	3
	coma	4
Ataxia in Heel to Toe Walking	none	0
	balancing maneuvers	1
	steps off line	2
	falls down	3
	can't stand	4
Peripheral Edema	none	0
	1 location	1
	2 or more locations	2

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