Acute high-altitude illnesses

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CLINICAL PRACTICE

Acute High-Altitude Illnesses

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A 45-year-old healthy man wishes to climb Mount Kilimanjaro (5895 m) in a 5-day period, starting at 1800 m. The results of a recent exercise stress test were normal; he runs 10 km 4 or 5 times per week and finished a marathon in less than 4 hours last year. He wants to know how he can prevent becoming ill at high altitude and whether training or sleeping under normobaric hypoxic conditions in the weeks before the ascent would be helpful. What would you advise?

N Engl J Med 2013;368:2294-302.

Outline

1. **Physiology at altitude**

2. **High-altitude diseases**
   - **Acute Mountain Sickness (AMS)**
   - **High-Altitude Cerebral Edema (HACE)**
   - **High-Altitude Pulmonary Edema (HAPE)**

3. **Risk factors**

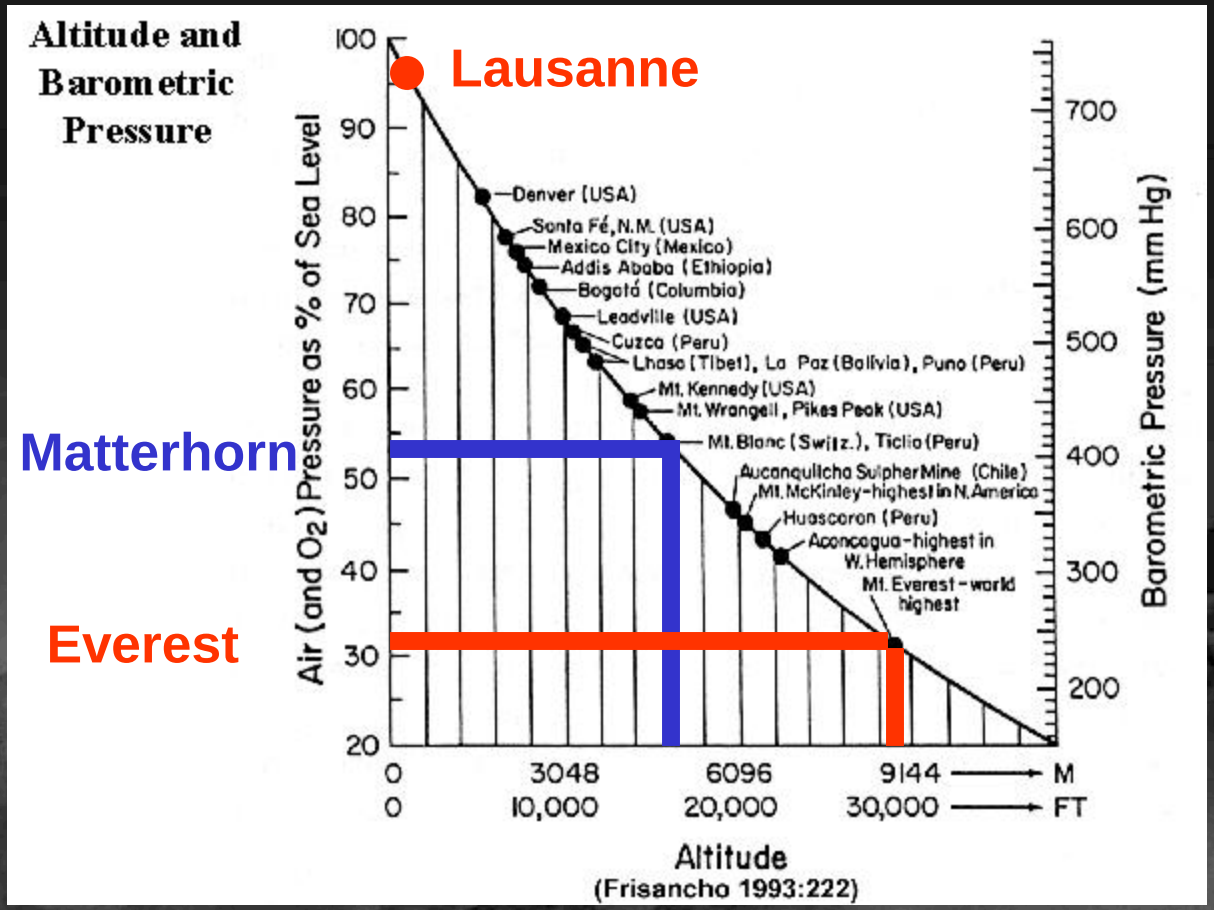
4. **Prevention**

5. **Treatment**

6. **Prediction**

7. **High-altitude consultation**

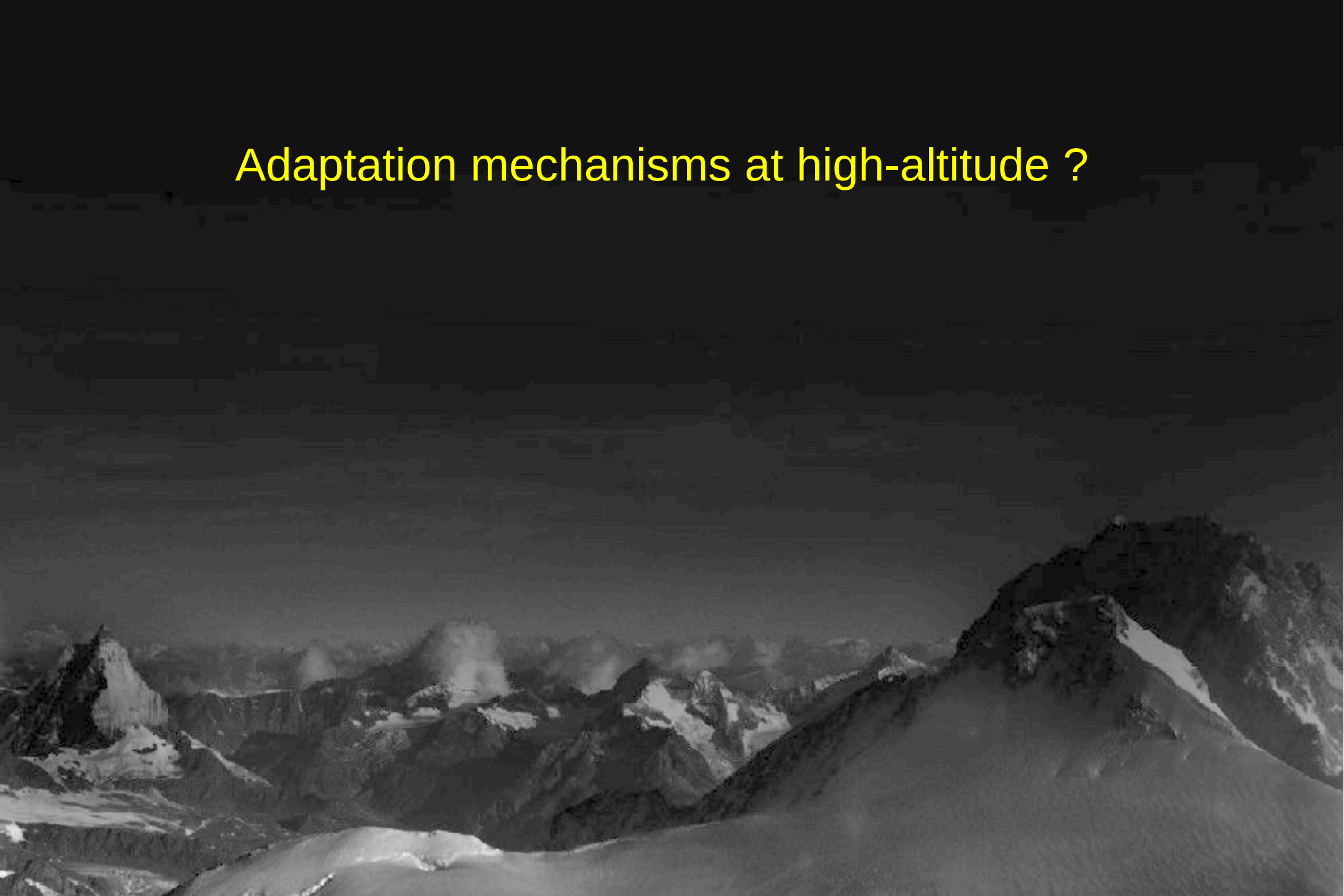
Barometric pressure and partial pressure of oxygen decrease with altitude



High altitude (>2500m)

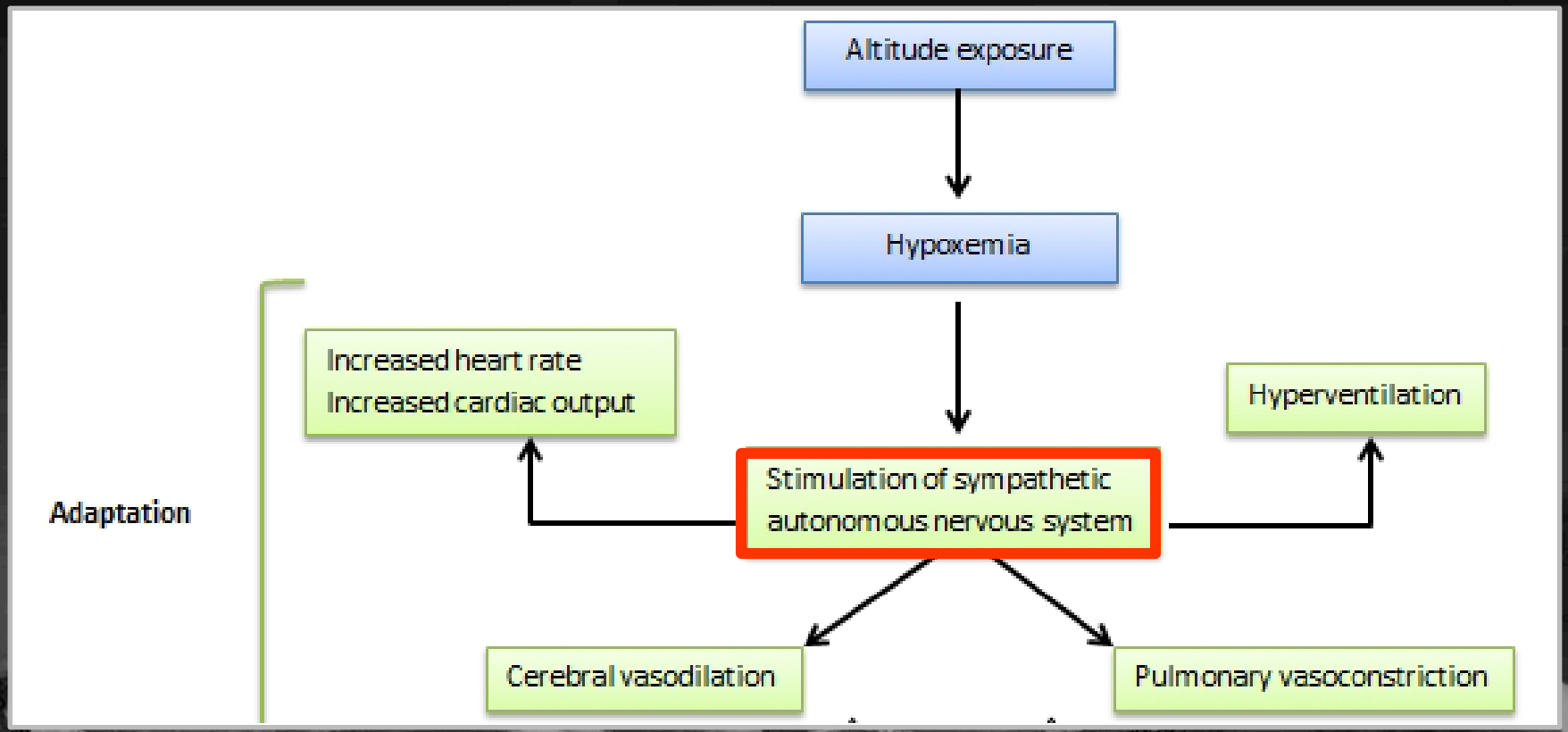
Altitude at which the oxygen saturation of hemoglobin is < 90%.

Adaptation mechanisms at high-altitude ?



Adaptation to altitude

- **Erythrocytosis**
- **Increased affinity oxygen-hemoglobin**
- **Pulmonary vasoconstriction, cerebral/muscular vasodilation**
- **Increased ventilation and cardiac output**


Altitude exposure
Hypoxemia
Increased heart rate
Increased cardiac output
Hyperventilation
Adaptation
Stimulation of sympathetic autonomous nervous system
Cerebral vasodilation
Pulmonary vasoconstriction

Oxygen content is preserved at altitude <7000m

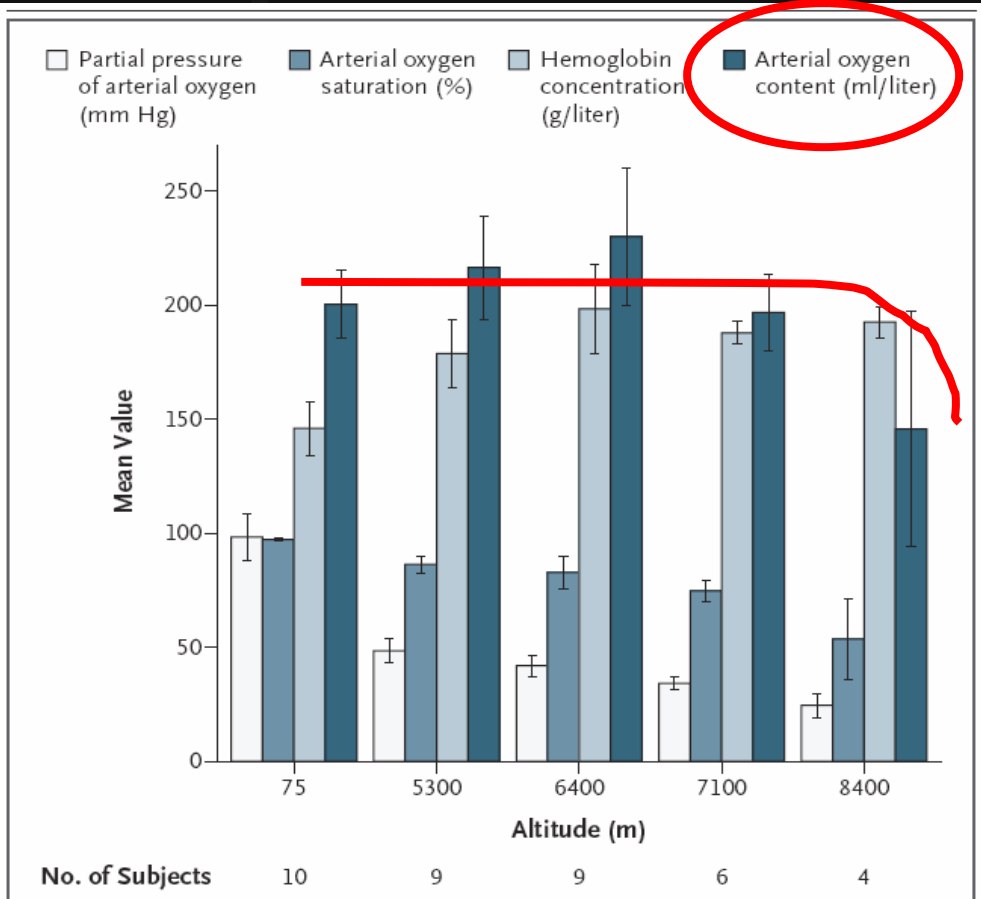


Figure 2. Changes in the Arterial Mean Partial Pressure of Oxygen, Oxygen Saturation, Hemoglobin Concentration, and Oxygen Content in Climbers on Mount Everest.

I bars denote standard deviations.

Grocott *et al.* N Engl J Med 2009

Alterations (transient ?) observed at 2500 m

affect

character

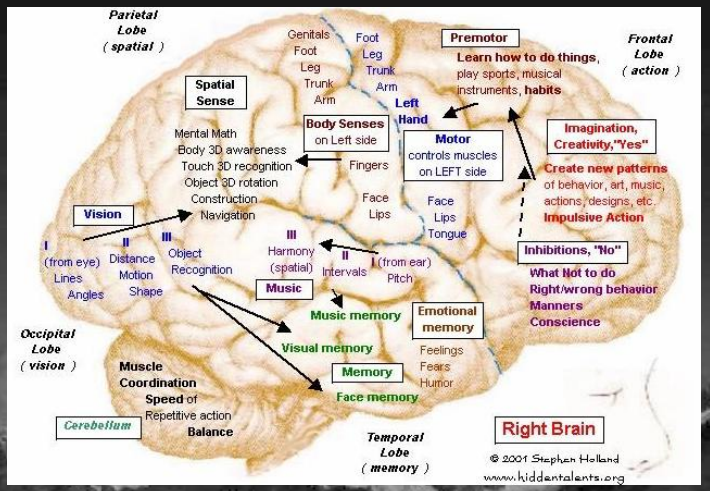
manual ability

mood, impulse control

orientation

personnality trait

decision making



personnality trait

sense of reality

reaction time

visual sensitivity

hearing sensitivity

balance

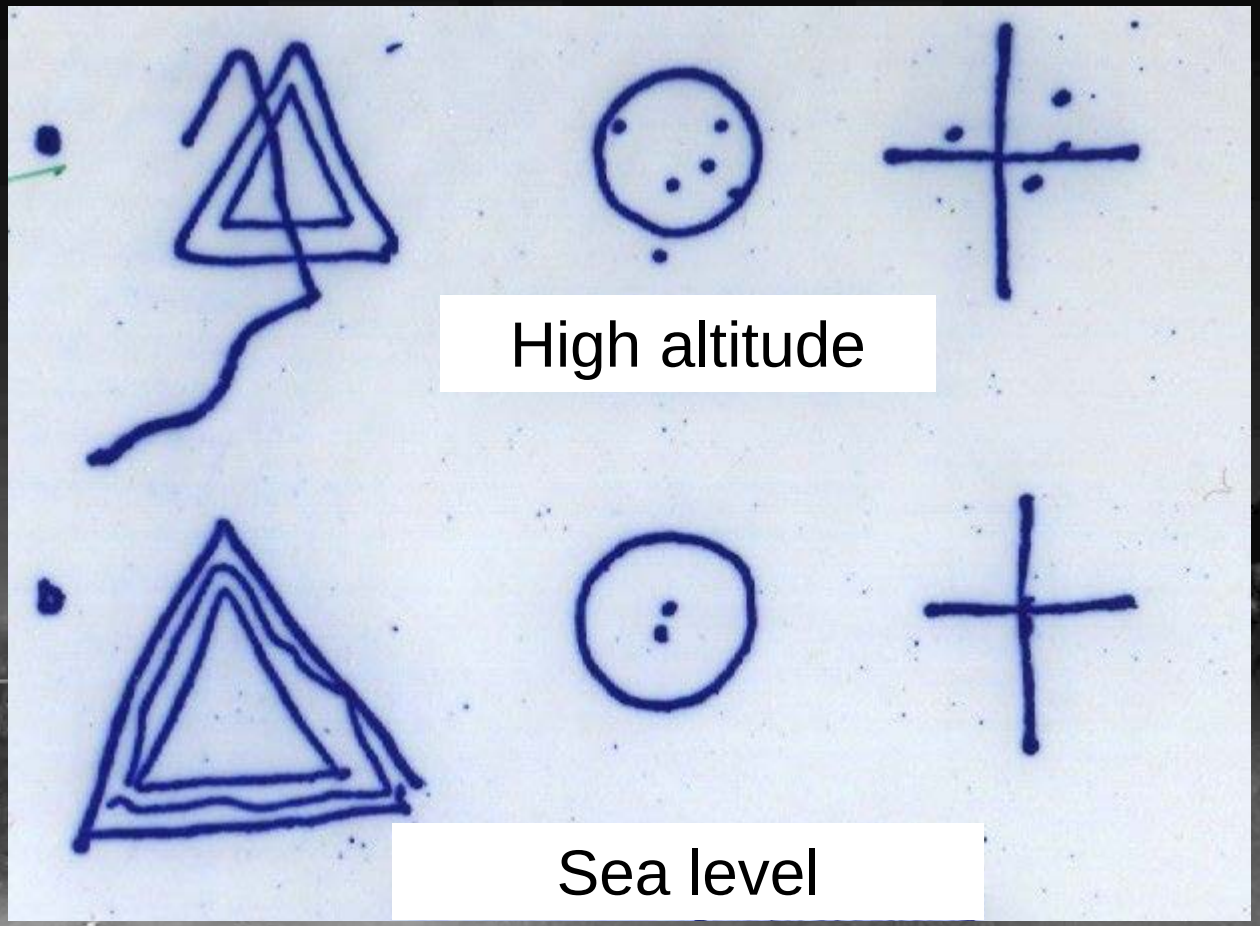
judgment

concentration

behavior

memory

Coordination



Summary

Table 1 *Cognitive capabilities as a fraction of sea-level performance for unacclimatized subjects according to McFarland (1972)*

Altitude (m)	Visual sensitivity	Attention span	Short-term memory	Arithmetic ability	Decision making
2500	83%	100%	97%	100%	100%
3500	67%	83%	91%	95%	98%
4200	56%	70%	83%	92%	95%
5000	48%	57%	76%	86%	90%

Note: Adapted from McFarland, 1972.

Diagnosis and pathophysiology of high-altitude illnesses?

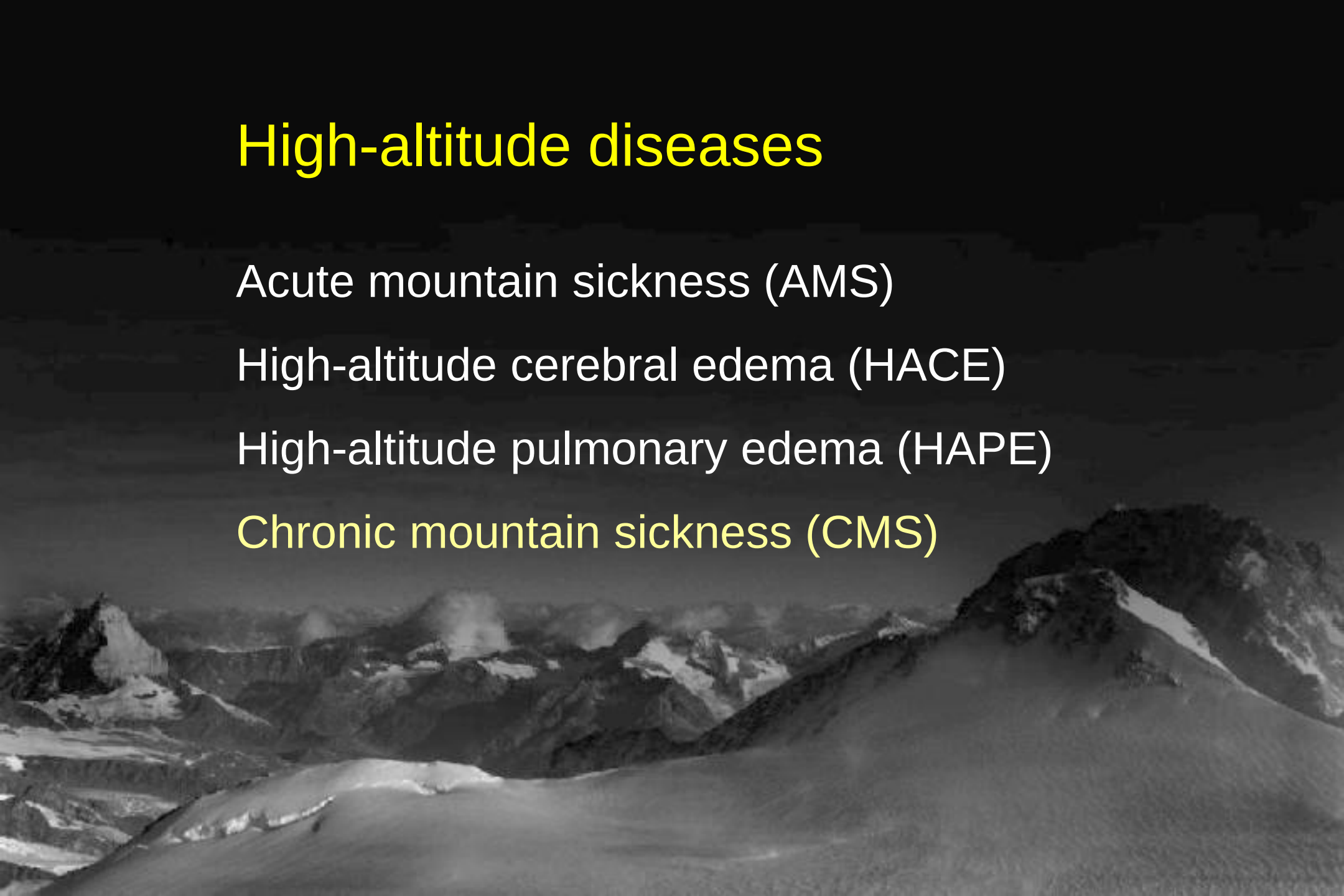
High-altitude diseases

Acute mountain sickness (AMS)

High-altitude cerebral edema (HACE)

High-altitude pulmonary edema (HAPE)

Chronic mountain sickness (CMS)



Which are the most characteristic symptoms of acute mountain sickness (AMS)

a) insomnia
b) dizziness
c) fatigue
d) abdominal pain
e) confusion
f) headache
g) diarrhea
h) ataxia
i) nausea or vomiting

Existing AMS diagnostic scores

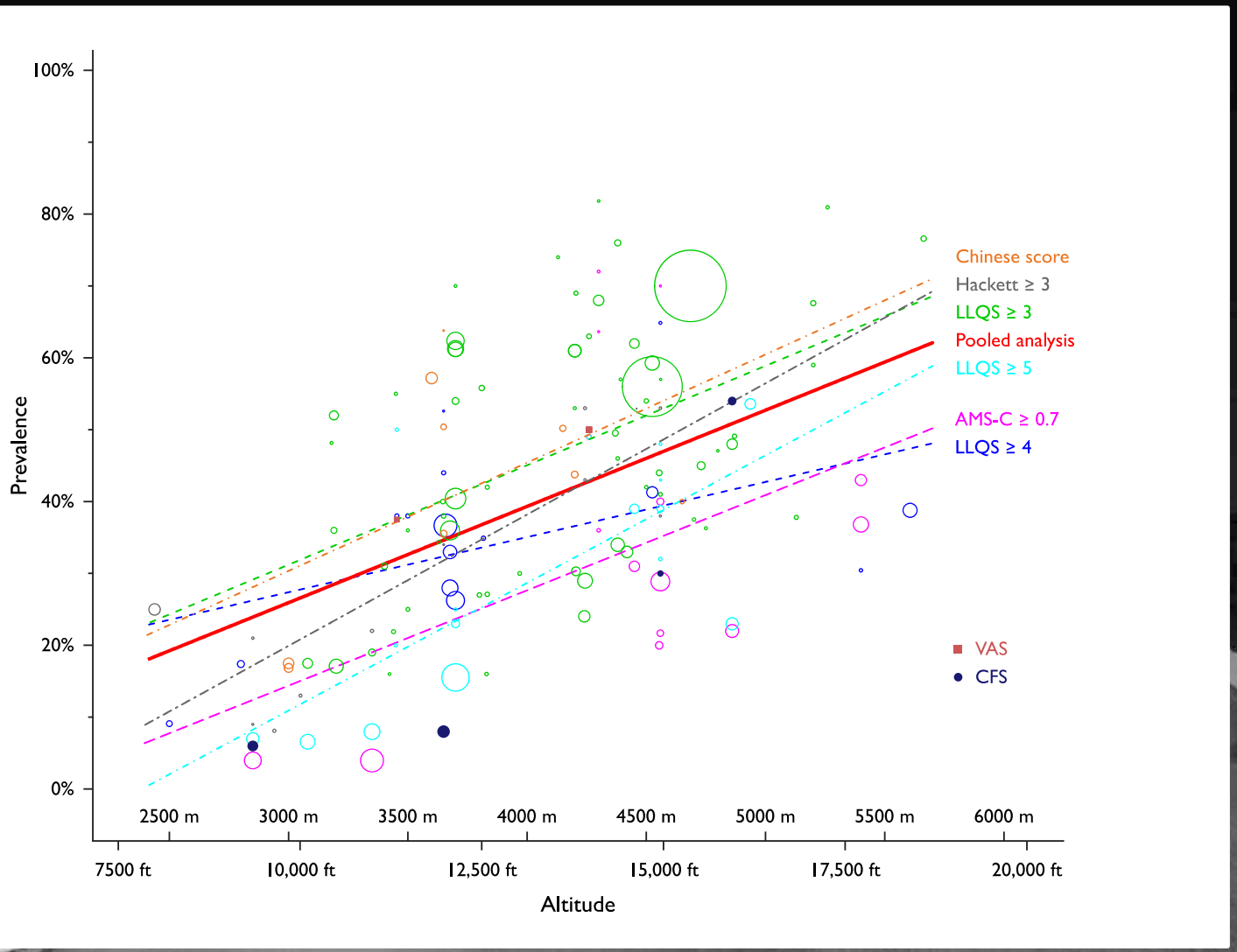
1. AMS-C score (derived from ESQ-III)		2. Hackett's clinical score		3. Lake Louise Questionnaire Score (LLQS)		4. Visual Analog Scales: VAS(C) and VAS(O)	5. The Chinese score for AMS		6. Clinical functional score (CFS)	
Symptom (rated 0 to 5)	*Weight*	*Symptom*	*Value*	*Symptom*	*Value*	*Symptom*	*Symptom*	*Degree*	*Symptom*	*Value*
Headache	0.465	Headache	1 point	Headache	0-3	None — Severe Headache	Headache	0-7		
		Headache not relieved by painkillers	2 points							
Loss of appetite	0.413	Nausea/Anorexia	1 point	GI symptoms	0-3	None — Severe GI symptoms	Vomiting	0-7		
Sick to stomach	0.347	Vomiting	2 points				Nausea, Anorexia, Abdominal distension, Diarrhea, Constipation	1 point each		
Coordination off	0.519	Dizziness	1 point	Dizziness/lightheadedness	0-3	None — Severe Dizzy/lightheadness	Dizziness/lightheadedness, Dazzling/blurred vision, Numbness of the extremities	1 point each		
Dim vision	0.501									
Lightheaded	0.489	Ataxia	2 points							
Dizzy	0.446									
Faint	0.346					None — Severe				
Feeling weak	0.387			Fatigue and/or weakness	0-3	Fatigue/Weakness	Lethargy	1 point		
		Difficulty sleeping	1 point	Difficulty sleeping	0-3	Trouble sleeping None — Severe	Insomnia	1 point		
		Shortness of breath at rest, Pulmonary rales 1 location, Peripheral edema	1 point each				Palpitation, Shortness of breath, Chest distress, Cyanosis of the lips	1 point each		
		Tachypnea > 25/min, Pulmonary rales > 1 location	2 points each							
Feeling sick	0.692					None — Severe Overall severity of AMS symptoms			Symptoms causing reduction of daily activity?	0 No reduction 1 Mild reduction 2 Moderate reduction 3 Severe reduction (bed rest)
Feeling hungover	0.584									
Final score = sum of (item score * weight) / 25.95 * 5		Final score = sum of all individual symptoms		Final score = sum of all individual symptoms		Mark indicating the severity of each symptom with subesquent calculation of a composite score (various cut-off used)	Headache+, or vomiting+; or total score of 5 points considered as AMS		AMS if CFS ≥ 2	
AMS if AMS-C ≥ 0.7		AMS if Hackett's clinical score ≥ 3		AMS if LLQS ≥ 3, 4, or 5						

Lake Louise Score of AMS

Headache	(0 - 3)	(absent, mild, moderate, severe)
Nausea, vomiting	(0 - 3)	(absent, mild, moderate, severe)
Fatigue	(0 - 3)	(absent, mild, moderate, severe)
Dizziness	(0 - 3)	(absent, mild, moderate, severe)
Difficulty sleeping	(0 - 3)	(normal - no sleep at all)

AMS = (Headache +) Symptoms Score ≥ 3

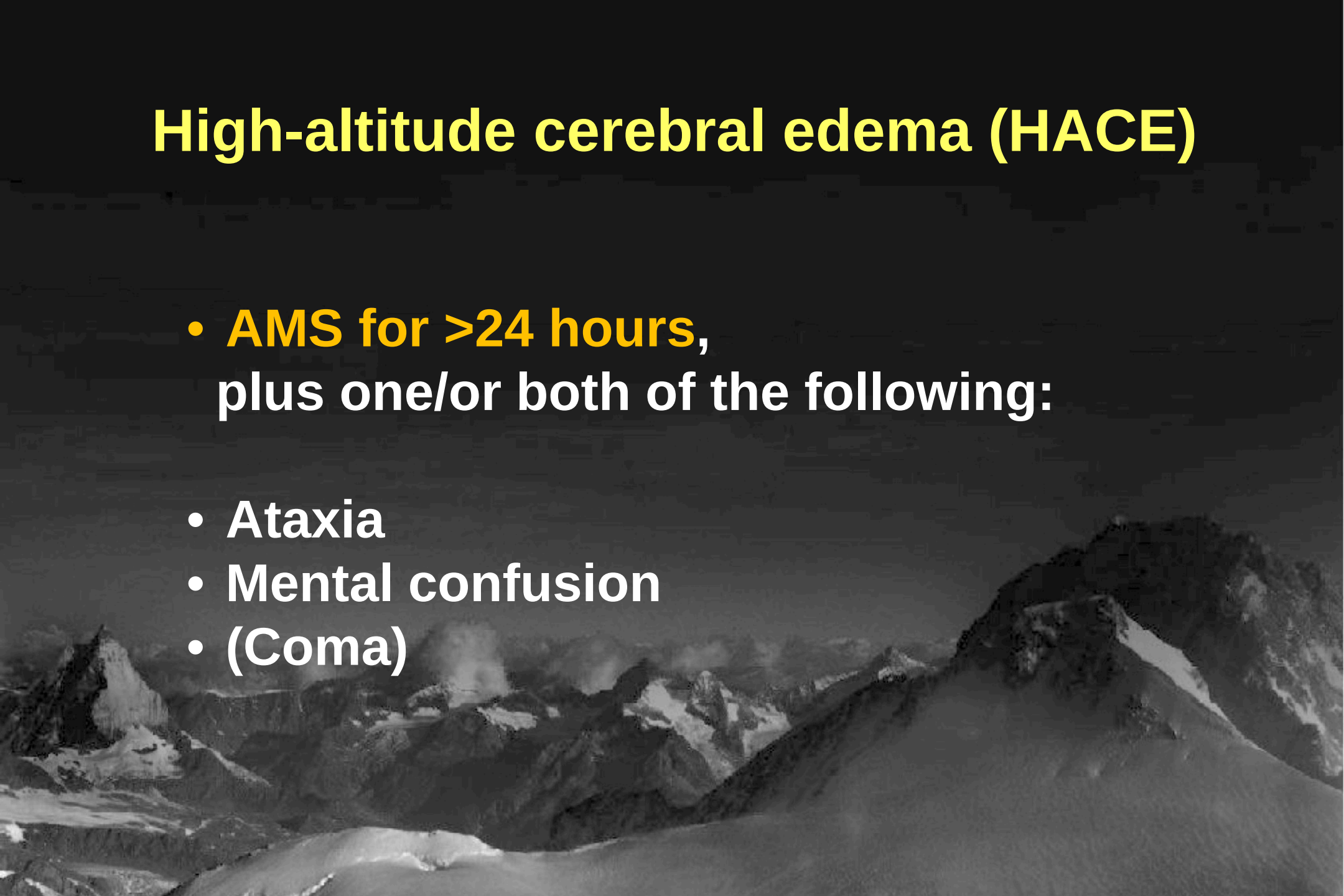
AMS prevalence



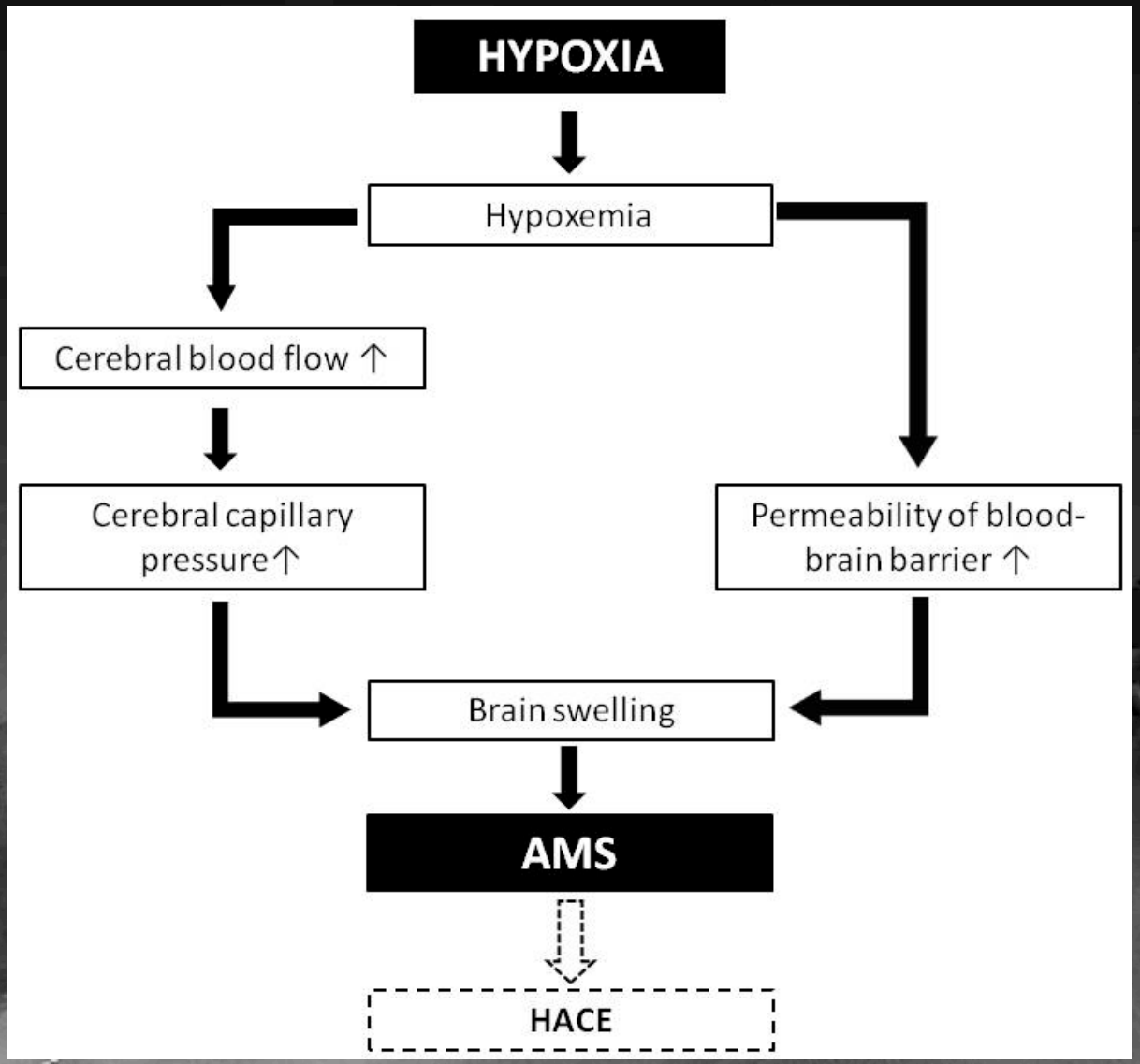
High-altitude cerebral edema (HACE)

- **AMS for >24 hours,**
  plus one/or both of the following:

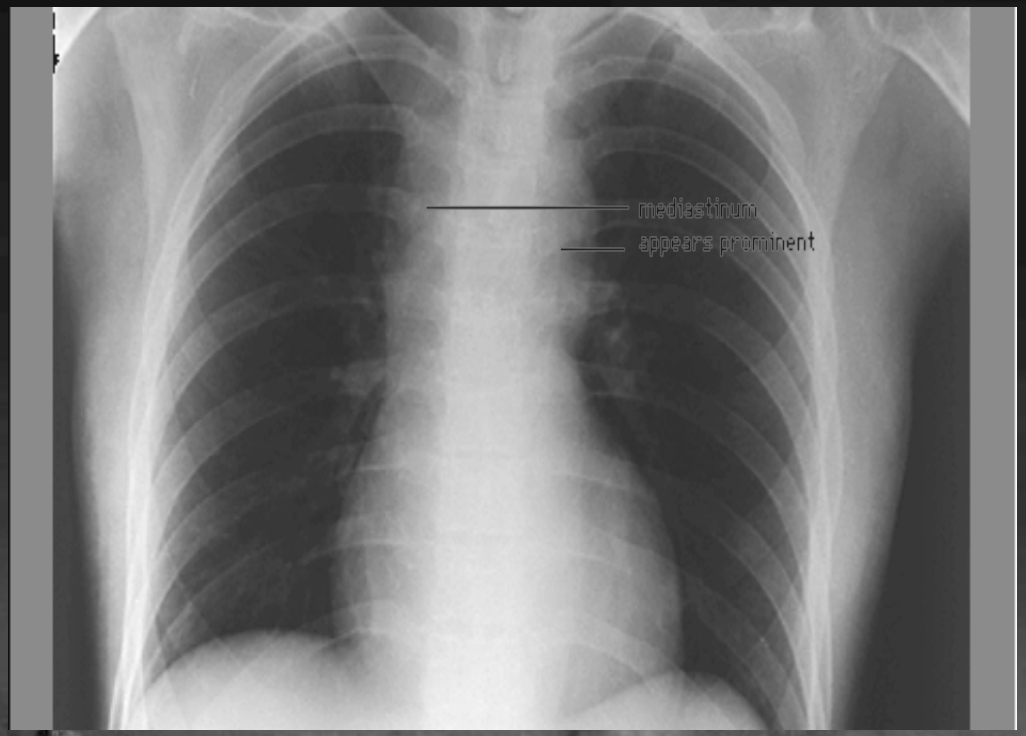
- **Ataxia**
- **Mental confusion**
- **(Coma)**



Pathophysiology of AMS-HACE



High-altitude pulmonary edema (HAPE)



Normal

HAPE

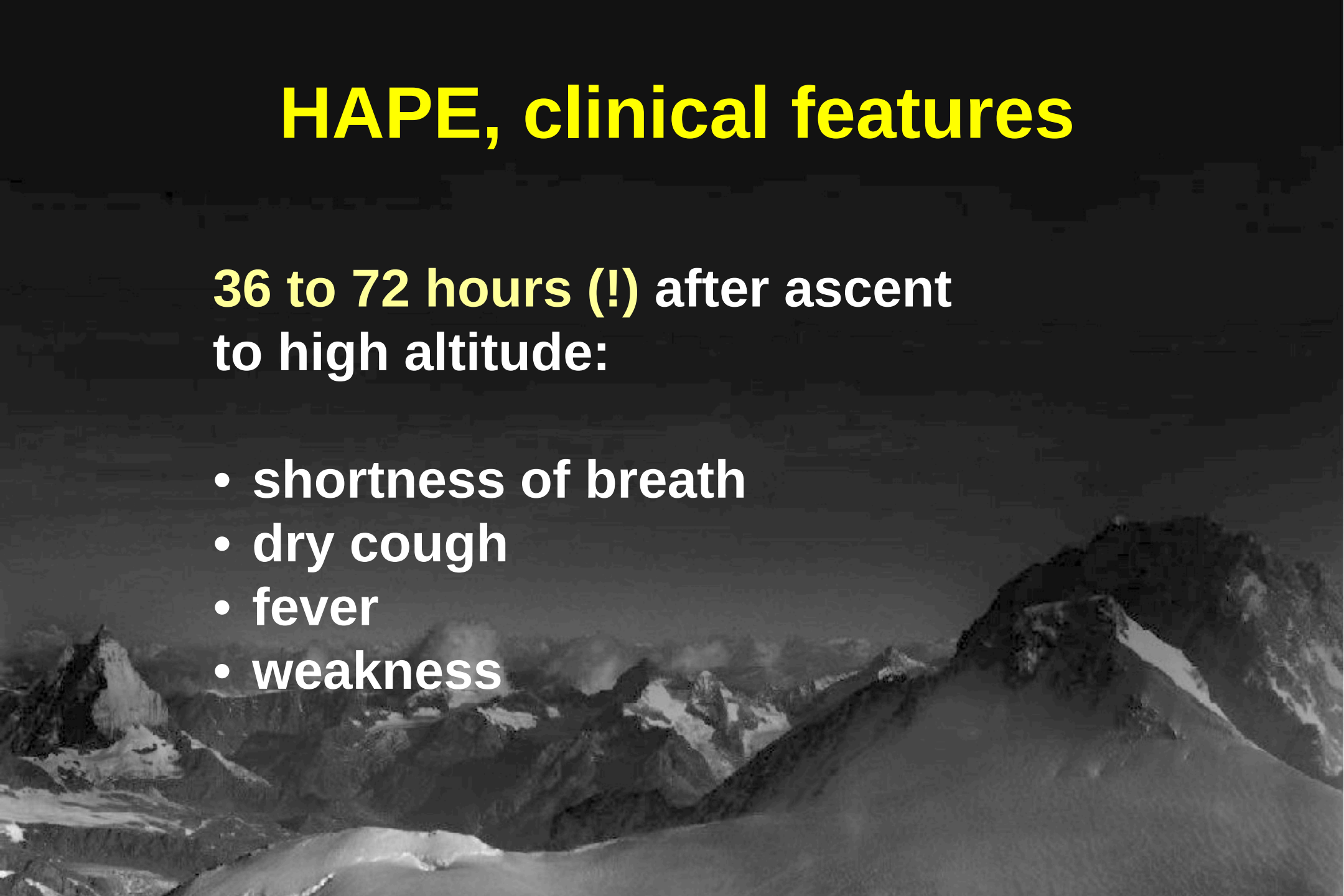
2) Which are the most characteristic symptoms of altitude pulmonary edema (HAPE) ?

a) fatigue
b) dizziness
c) headaches
d) dyspnea
e) diarrhea
f) cough
g) ataxia
h) nausea or vomiting
i) drowsiness, coma
l) fever

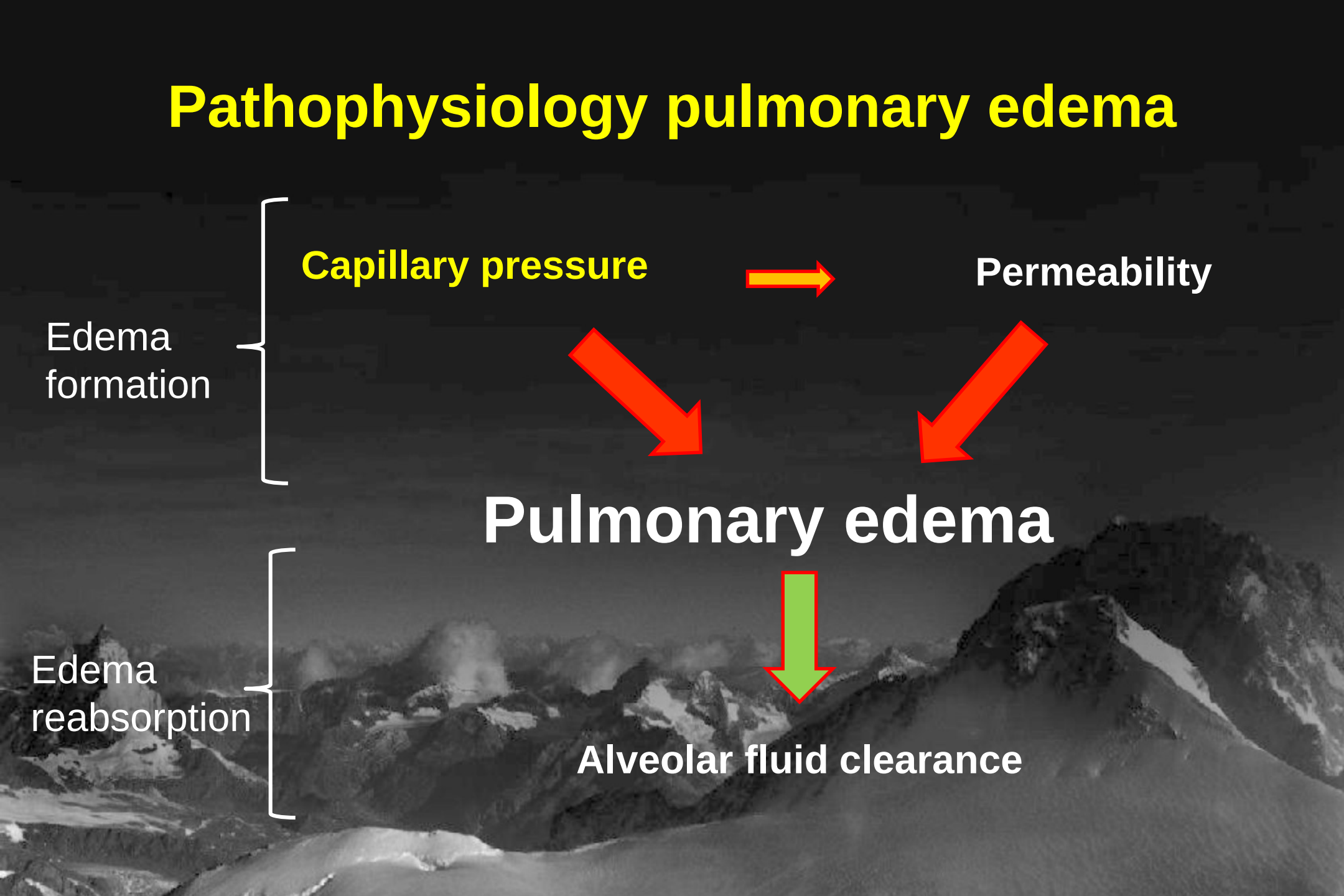
HAPE, clinical features

36 to 72 hours (!) after ascent to high altitude:

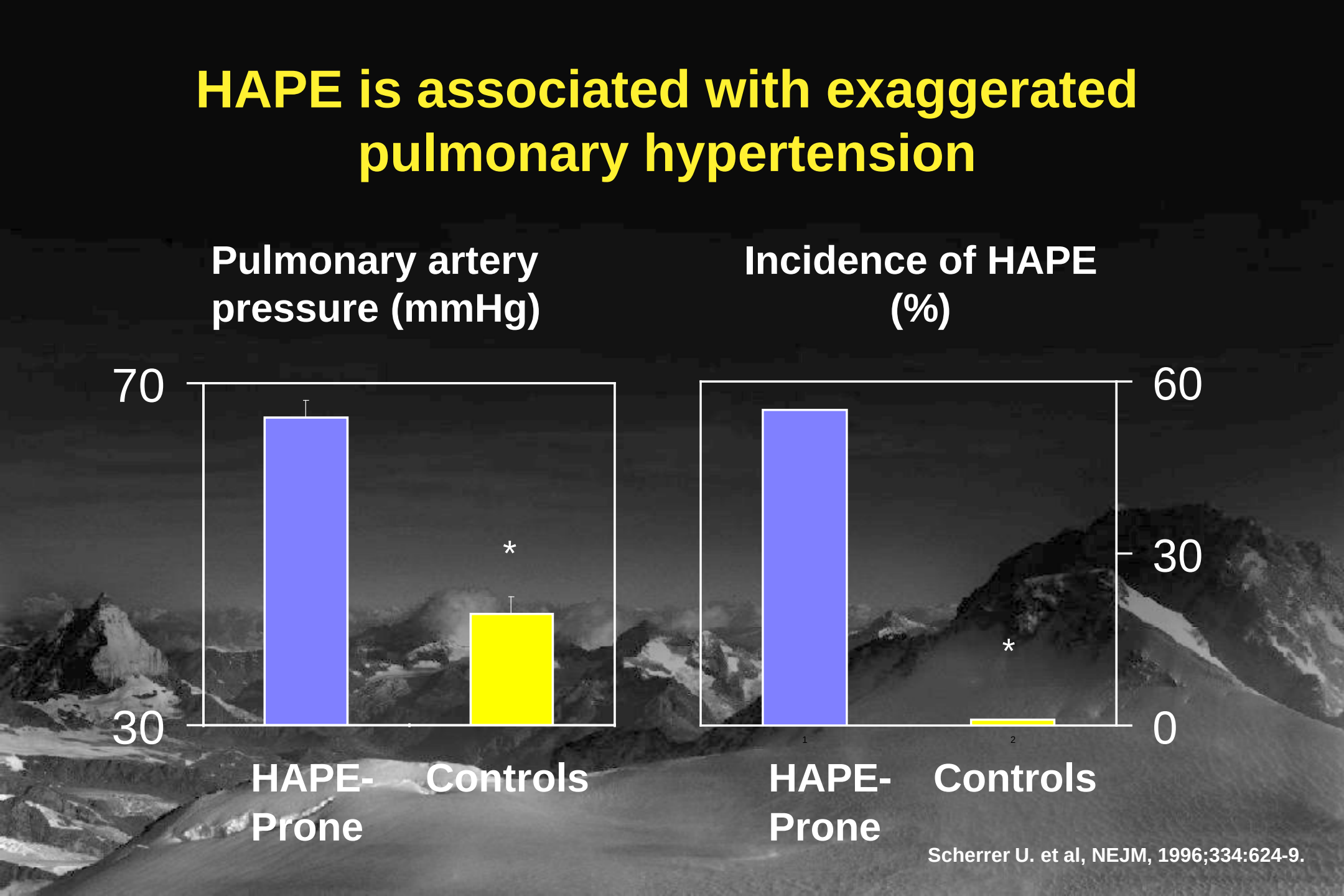
- **shortness of breath**
- **dry cough**
- **fever**
- **weakness**



Pathophysiology pulmonary edema

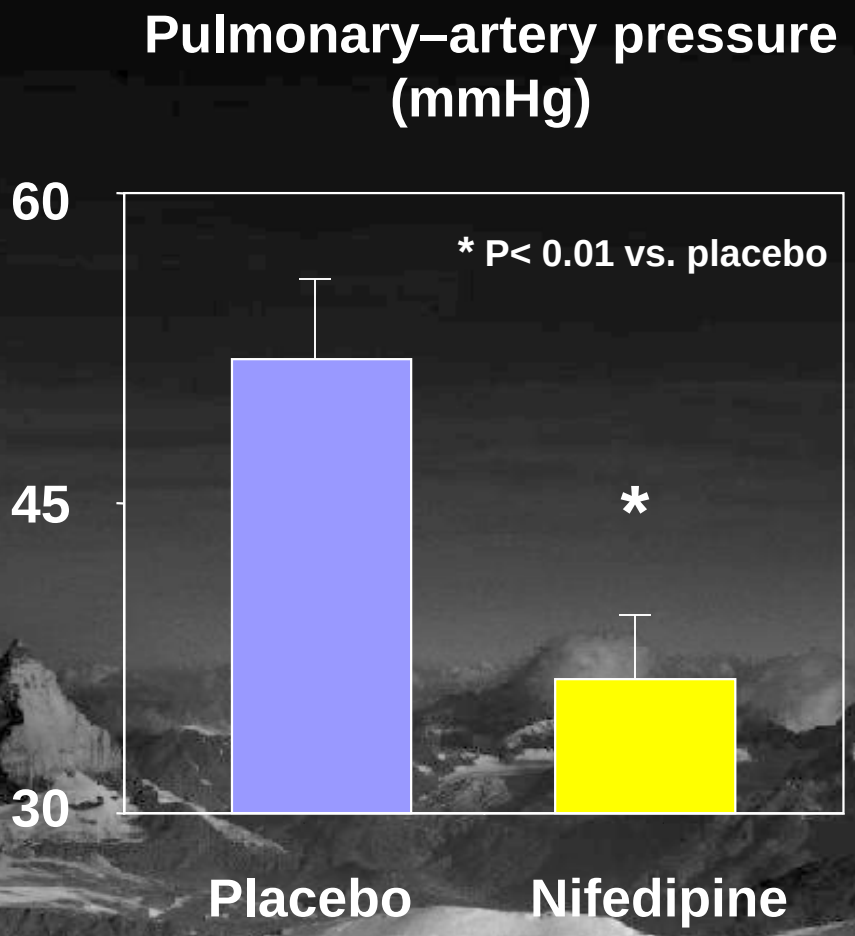


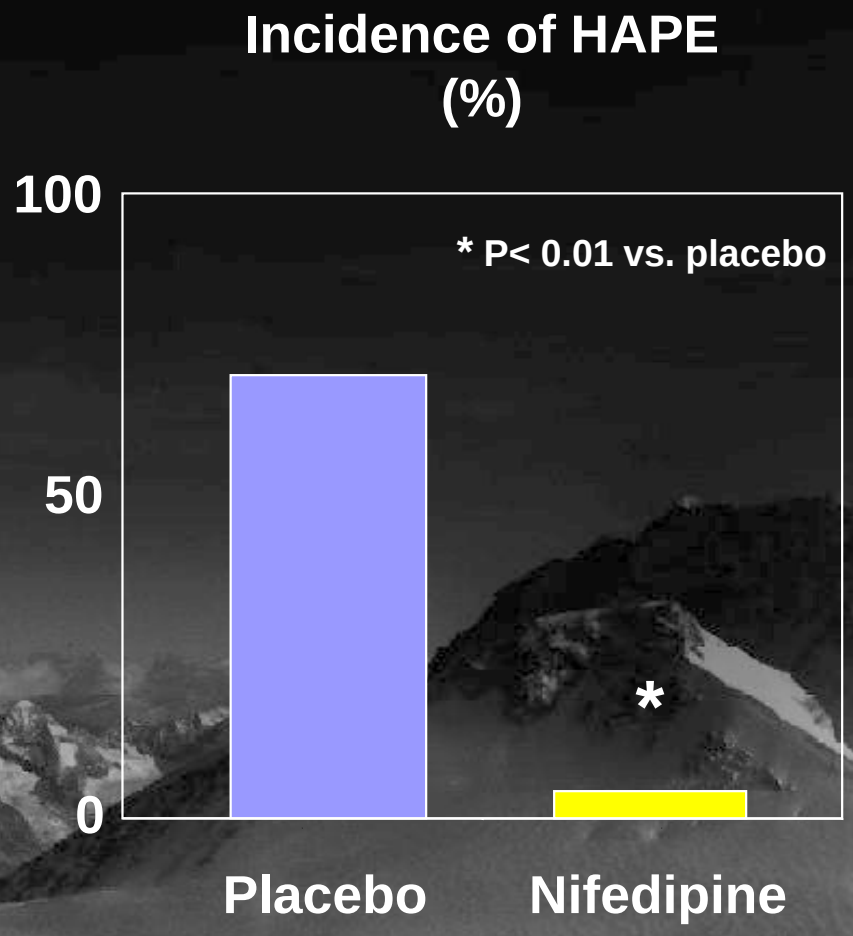
HAPE is associated with exaggerated pulmonary hypertension



Scherrer U. et al, NEJM, 1996;334:624-9.

Prevention of exaggerated pulmonary hypertension decreases the incidence of HAPE





Bärtsch et al. NEJM, 1991; 325:1284- 9.

However, pulmonary artery hypertension is unfrequently associated with pulmonary edema.

Hypothesis

In order to cause lung edema, hypoxic pulmonary vasoconstriction needs to be inhomogenous :

Zones **with vasoconstriction**:	**protected** from edema
Zones **without vasoconstriction**:	**prone** to edema

High-altitude pulmonary edema

36 – 72 hours

Hypoxia

↓

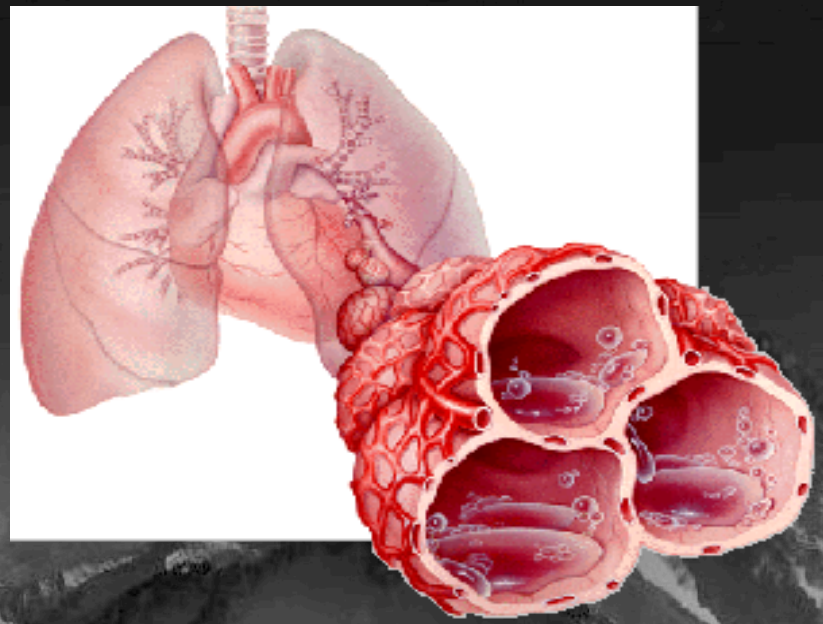
Exaggerated pulmonary vasoconstriction (non uniform)

↓

Exaggerated intracapillary pressure

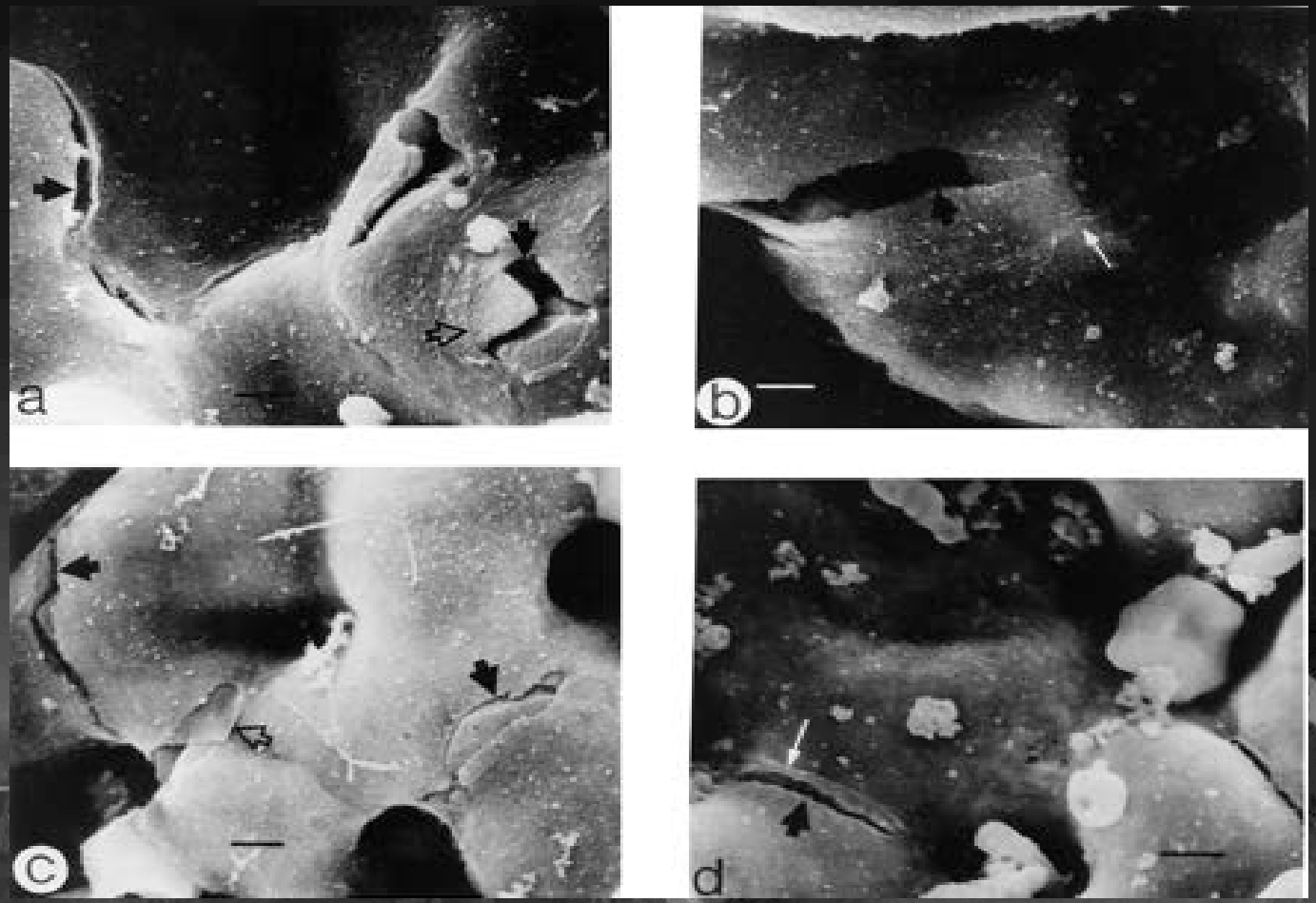
↓

Capillary leak



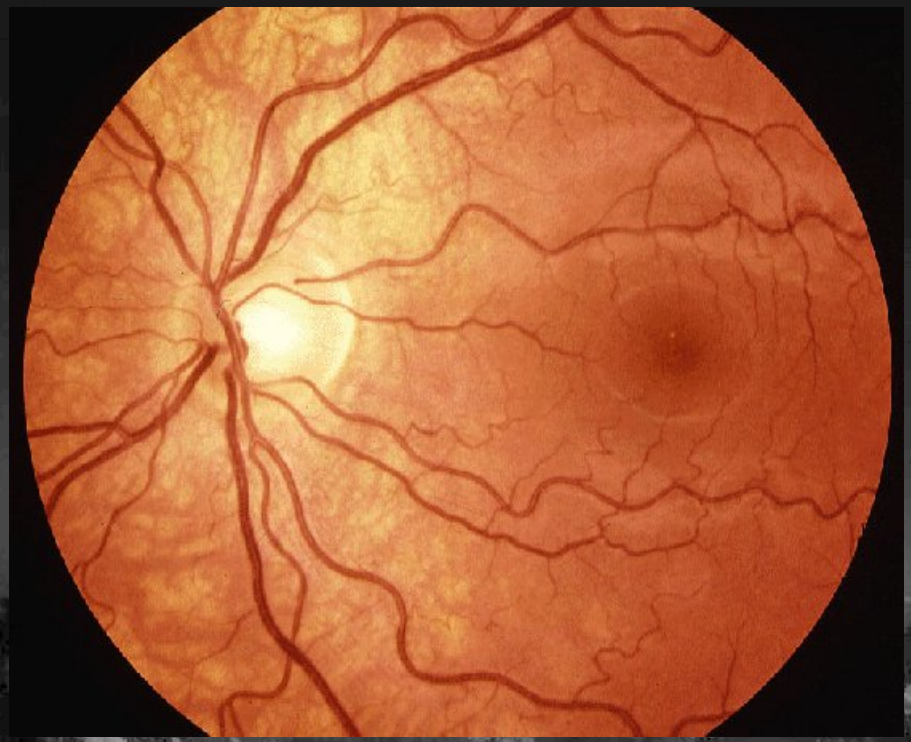
Fluid accumulation in the lung

Capillary stress failure



West JB, J Appl Physiol. 2000;89:2483-9

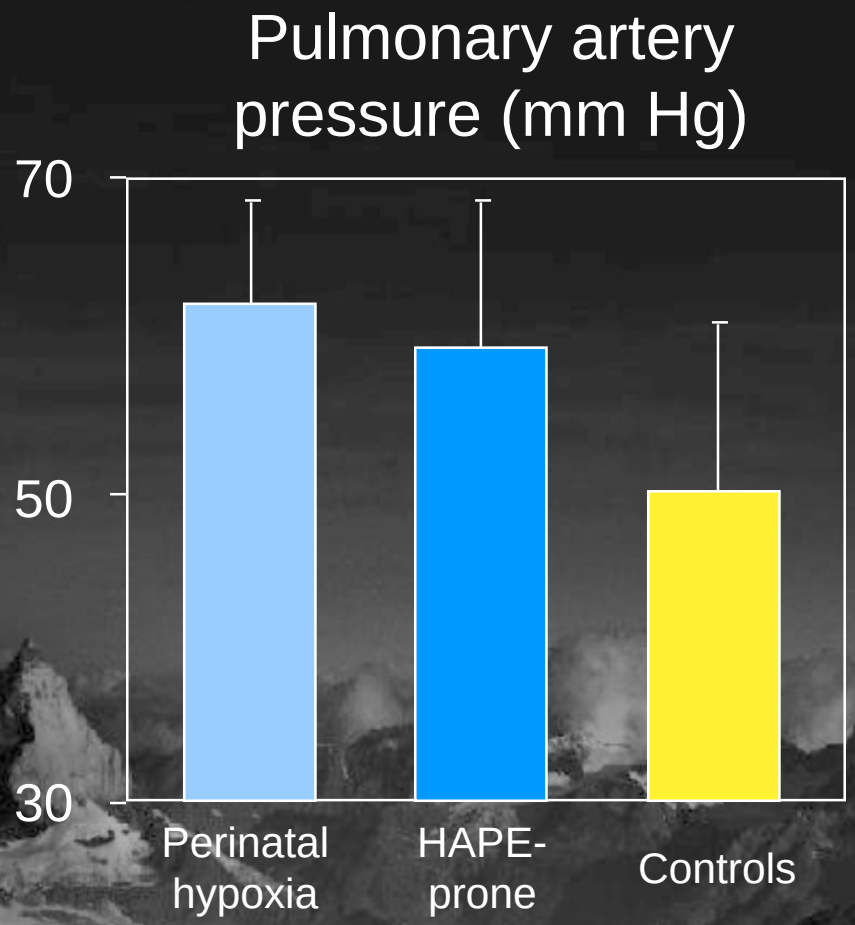
High-altitude retinopathy

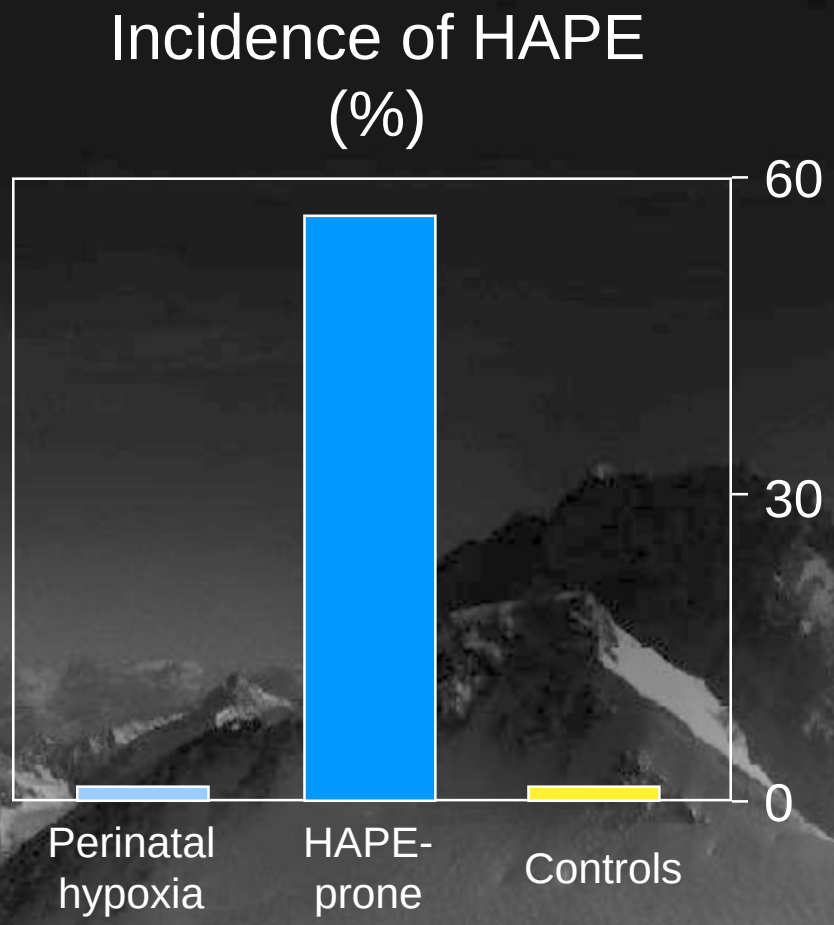


Sea level

High altitude

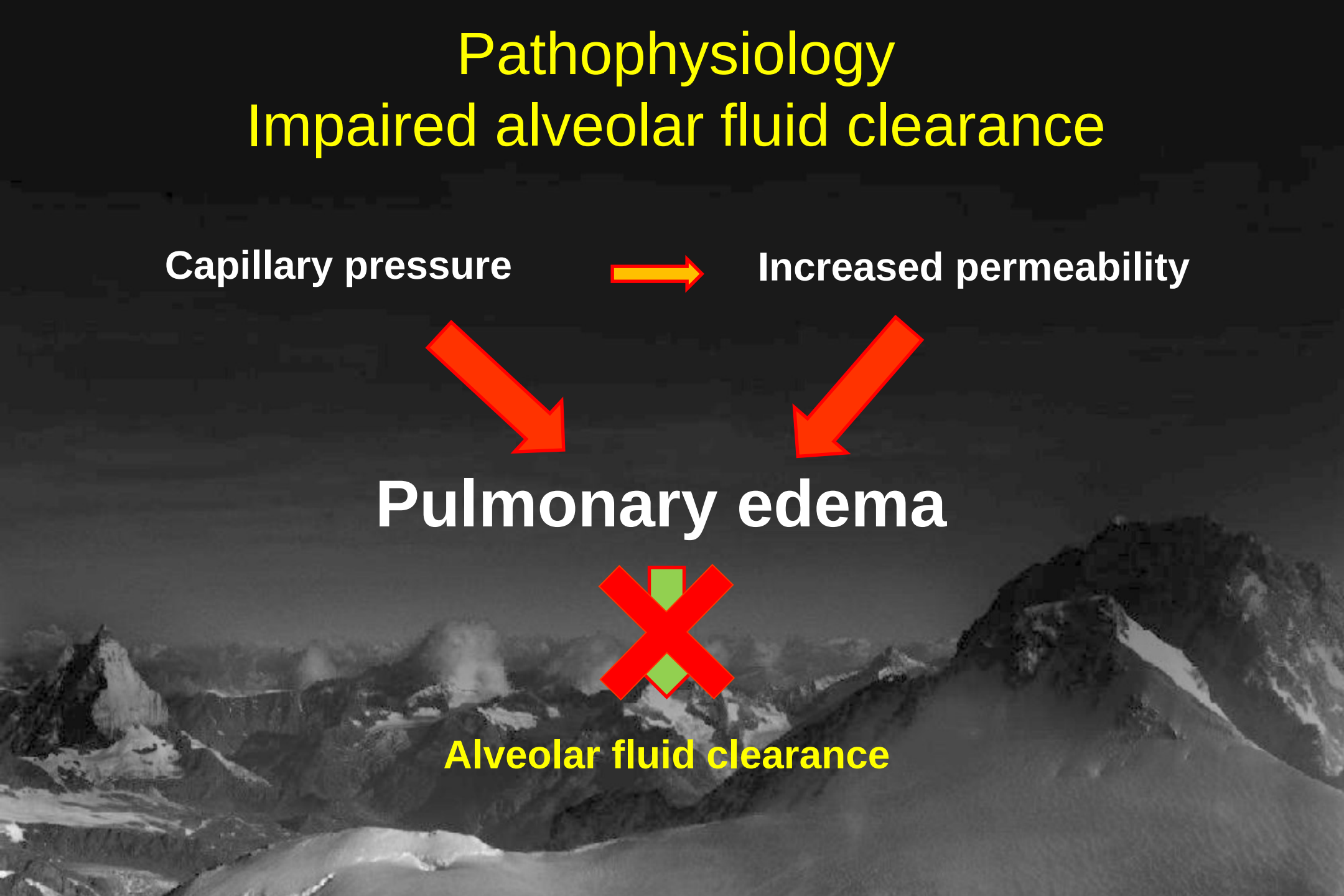
Transient perinatal hypoxia predisposes to exaggerated hypoxic pulmonary hypertension, but not to HAPE



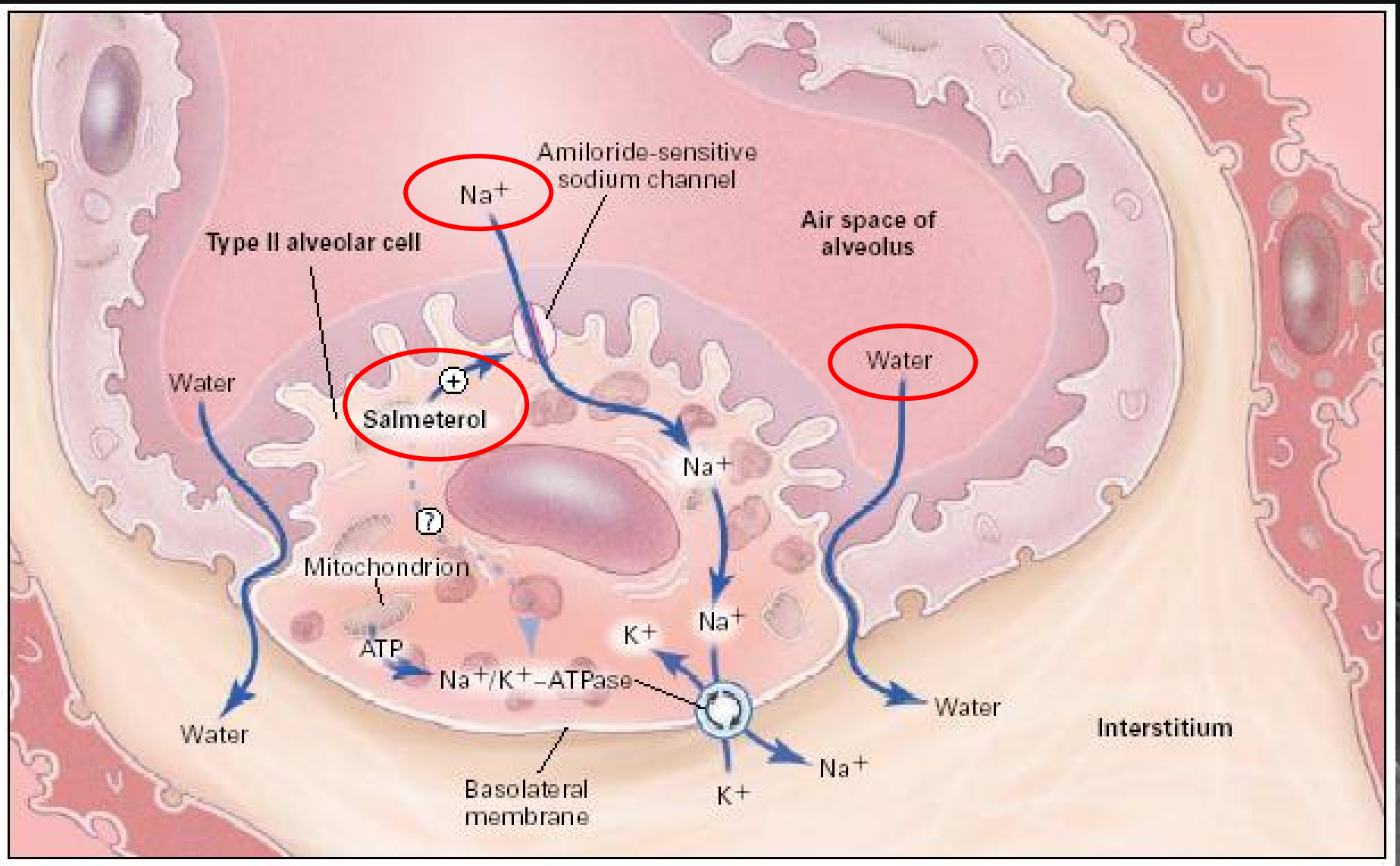


Sartori et al, Schweiz Med Wschr, 2000;130:385-9.

Pathophysiology
Impaired alveolar fluid clearance

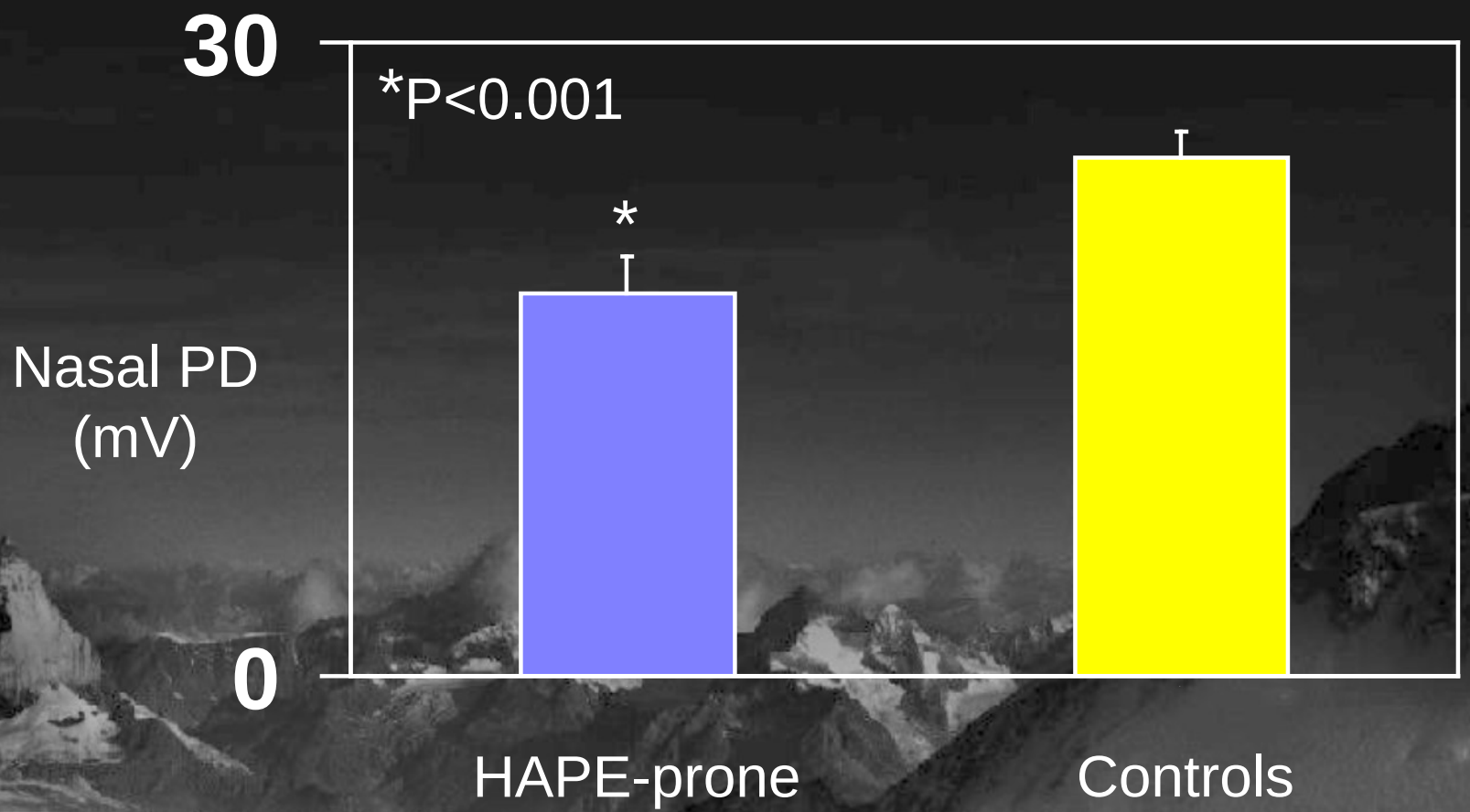


Alveolar fluid clearance



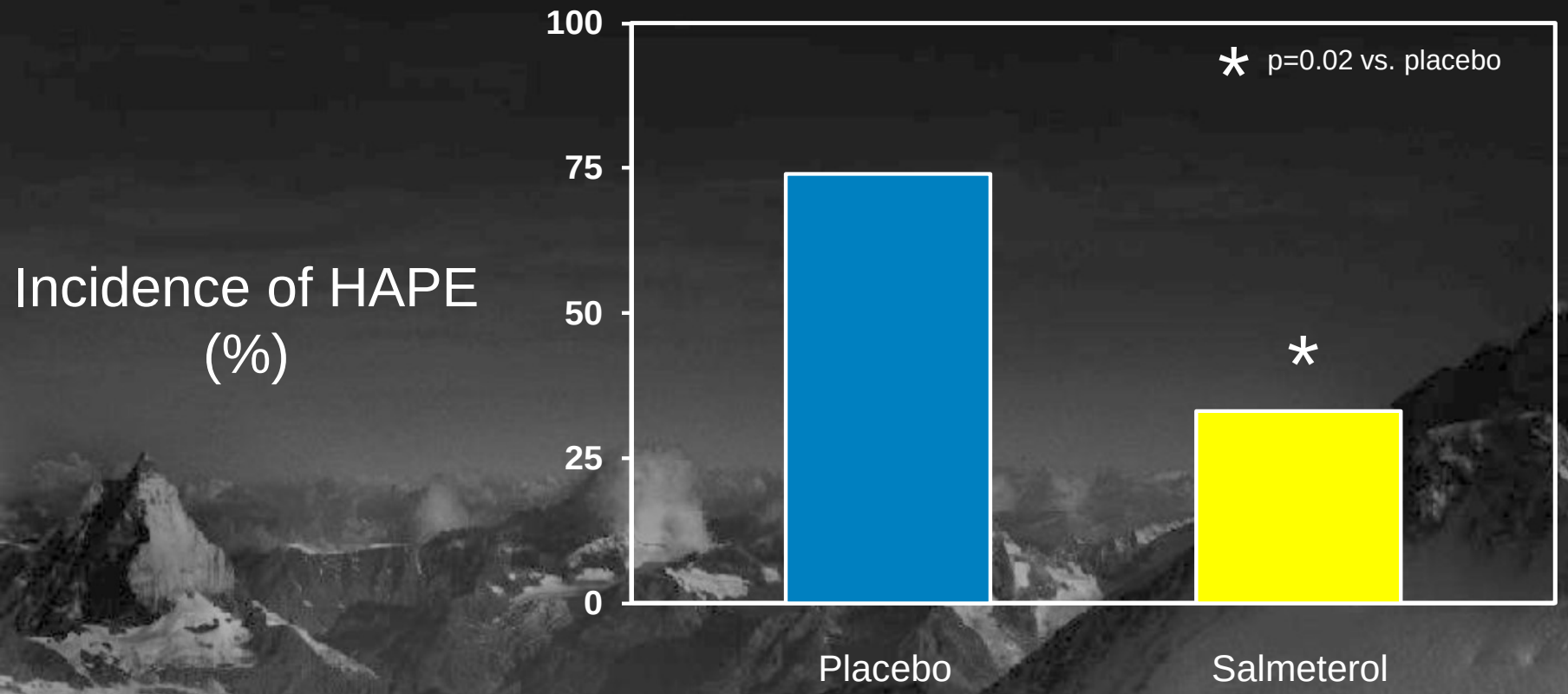
Sartori et al., N Engl J Med, 2002;346:1631-6

Defective transepithelial sodium transport, and in turn, alveolar fluid clearance in HAPE-prone subjects

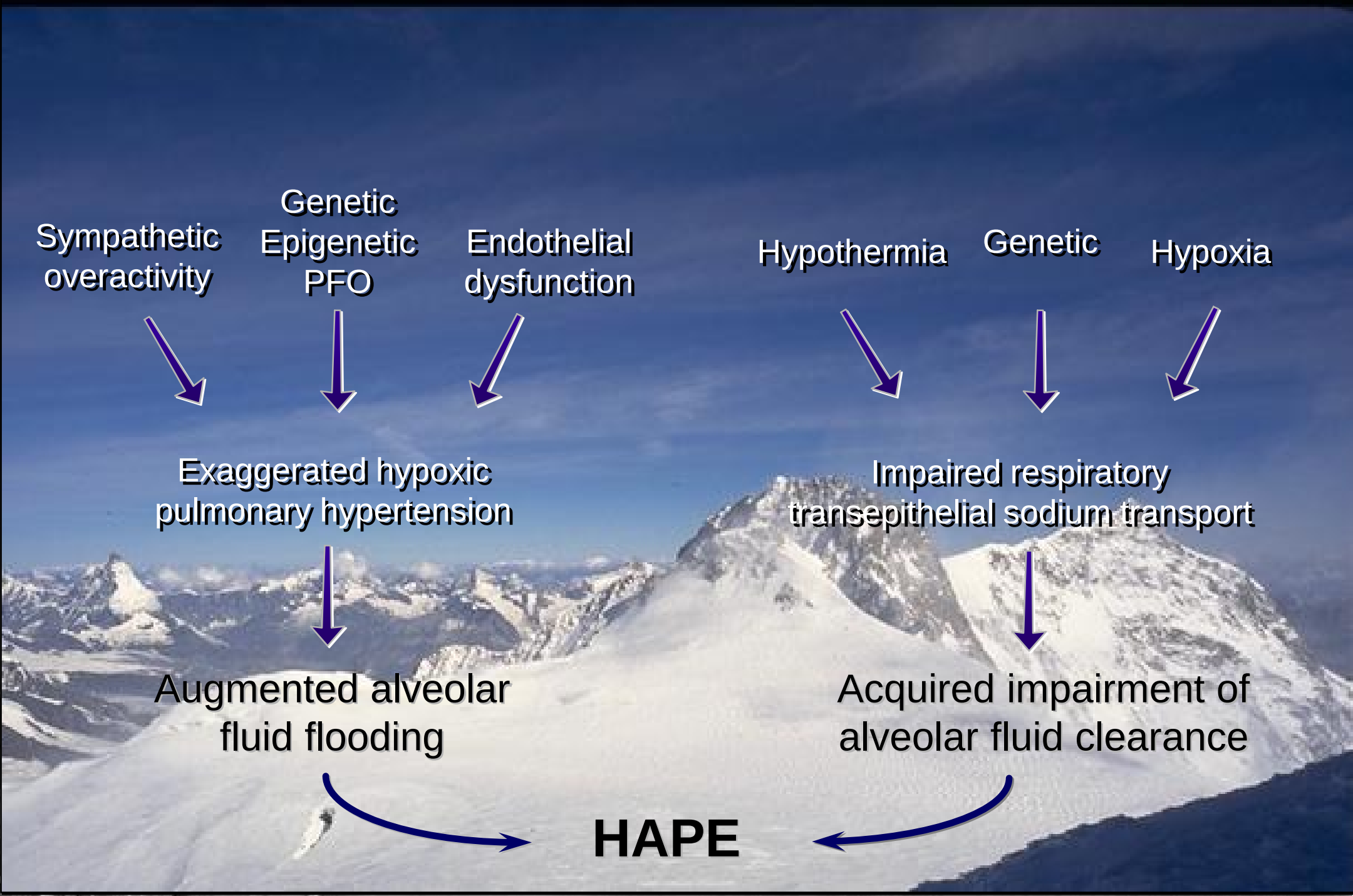


Sartori C. et al., N Engl J Med, 2002;346:1631-6.

Salmeterol inhalation stimulates alveolar fluid clearance and prevents pulmonary edema in HAPE-prone subjects



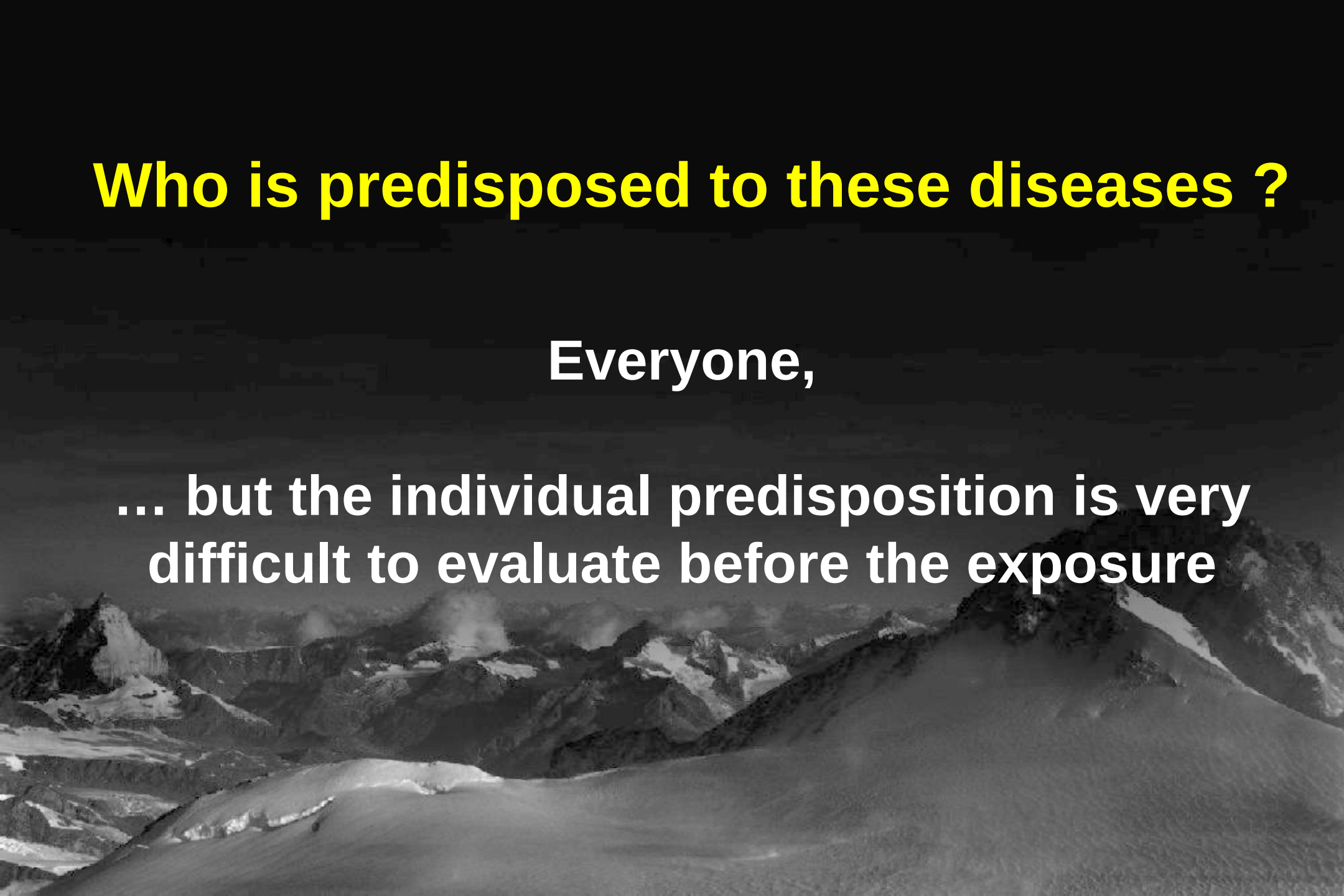
Sartori C. et al., N Engl J Med, 2002;346:1631-6.

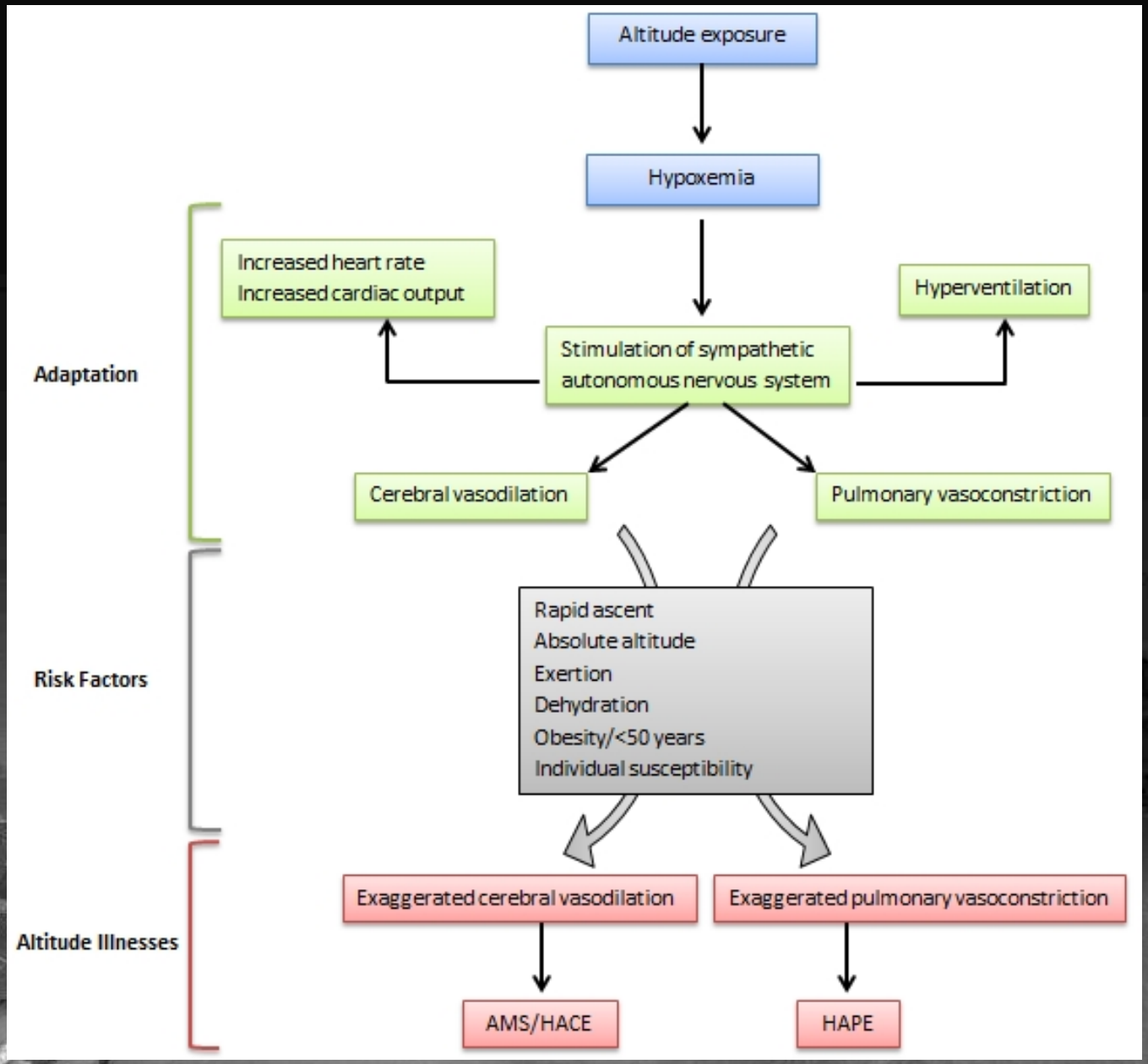

Sympathetic overactivity
Genetic Epigenetic PFO
Endothelial dysfunction
Hypothermia
Genetic
Hypoxia
Exaggerated hypoxic pulmonary hypertension
Impaired respiratory transepithelial sodium transport
Augmented alveolar fluid flooding
Acquired impairment of alveolar fluid clearance
HAPE

Who is predisposed to these diseases ?

Everyone,

… but the individual predisposition is very difficult to evaluate before the exposure




Altitude exposure
Hypoxemia
Increased heart rate
Increased cardiac output
Hyperventilation
Adaptation
Stimulation of sympathetic autonomous nervous system
Cerebral vasodilation
Pulmonary vasoconstriction
Rapid ascent
Absolute altitude
Exertion
Dehydration
Obesity/<50 years
Individual susceptibility
Risk Factors
Exaggerated cerebral vasodilation
Exaggerated pulmonary vasoconstriction
Altitude Illnesses
AMS/HACE
HAPE

Risk factors

Risk factors: comorbidities

Metabolic

Cardiac

Vascular

Pulmonary

Hypertension

Obesity

Age

Hematological

Absolute contre-indications to high-altitude exposure ?

Contre-indications à l’altitude

Relatives

- Insuffisance cardiaque compensée
- Cardiopathie ischémique avec test d’effort négatif
- BPCO de degré léger à modéré
- Insuffisance rénale
- Grossesse
- Antécédent de HACE ou HAPE

Absolues

- Insuffisance cardiaque avec FEVG < 30%
- Angor instable, infarctus du myocarde < 3 à 6 mois
- AVC < 3 mois
- HTAP symptomatique
- Hypertension artérielle non contrôlée
- Maladie thromboembolique (?)
- BPCO modéré à sévère
- Insuffisance respiratoire

COPD and cystic fibrosis at altitude

Increased mortality and incidence of cor pulmonale

More severe hypoxemia at rest and during exercise

Threshold fixed by ATS: $PaO_2 > 73$ mmHg (sea level)

$PaO_2 > 50$ mmHg (altitude)

Lack of symptoms of severe hypoxemia in many patients

Disease-induced acclimatization ?

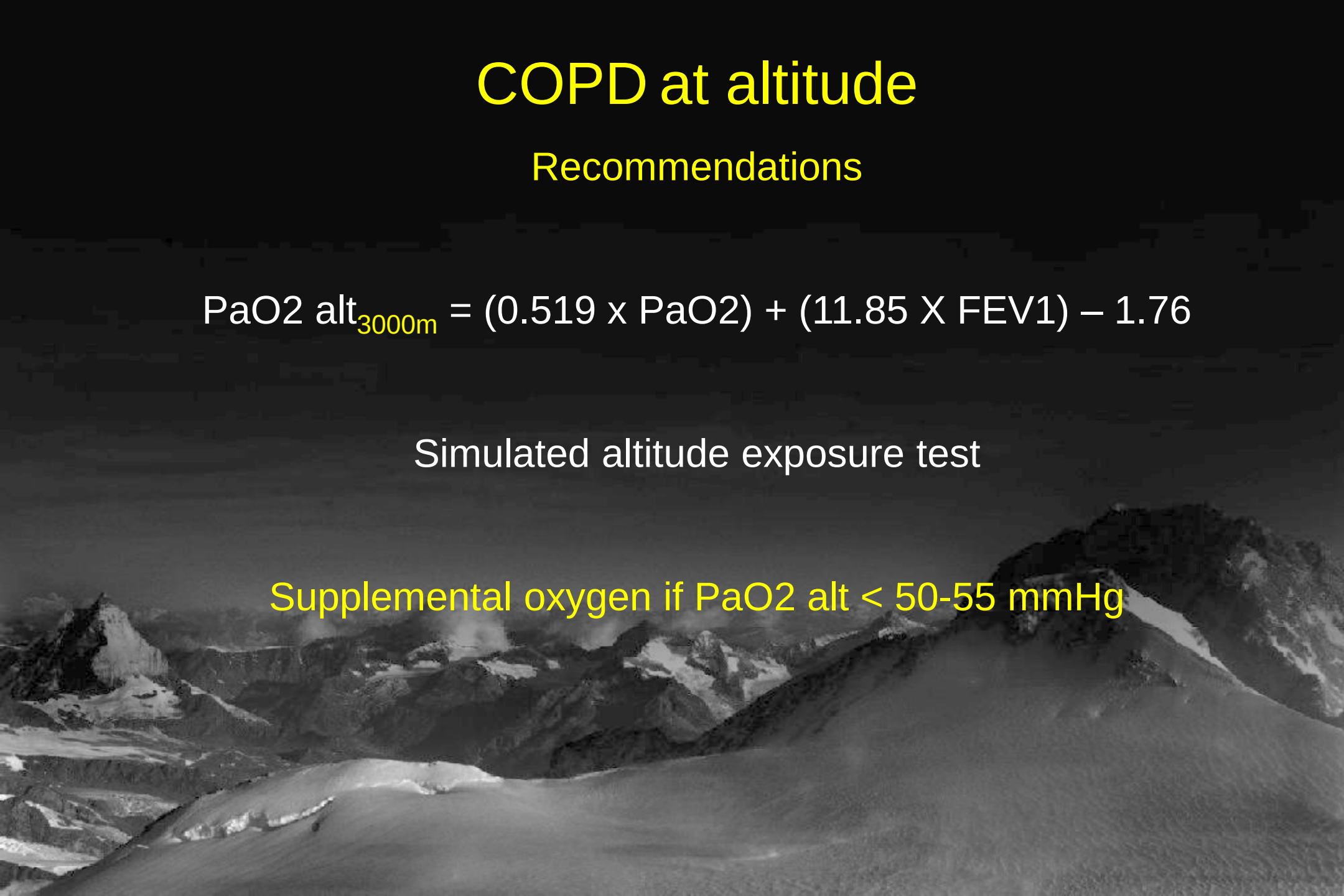
COPD at altitude

Recommendations

$PaO_2\ alt_{3000m} = (0.519 \times PaO_2) + (11.85 \times FEV_1) - 1.76$

Simulated altitude exposure test

Supplemental oxygen if PaO_2 alt < 50-55 mmHg



Pulmonary hypertension

Increased risk for HAPE and acute right heart failure

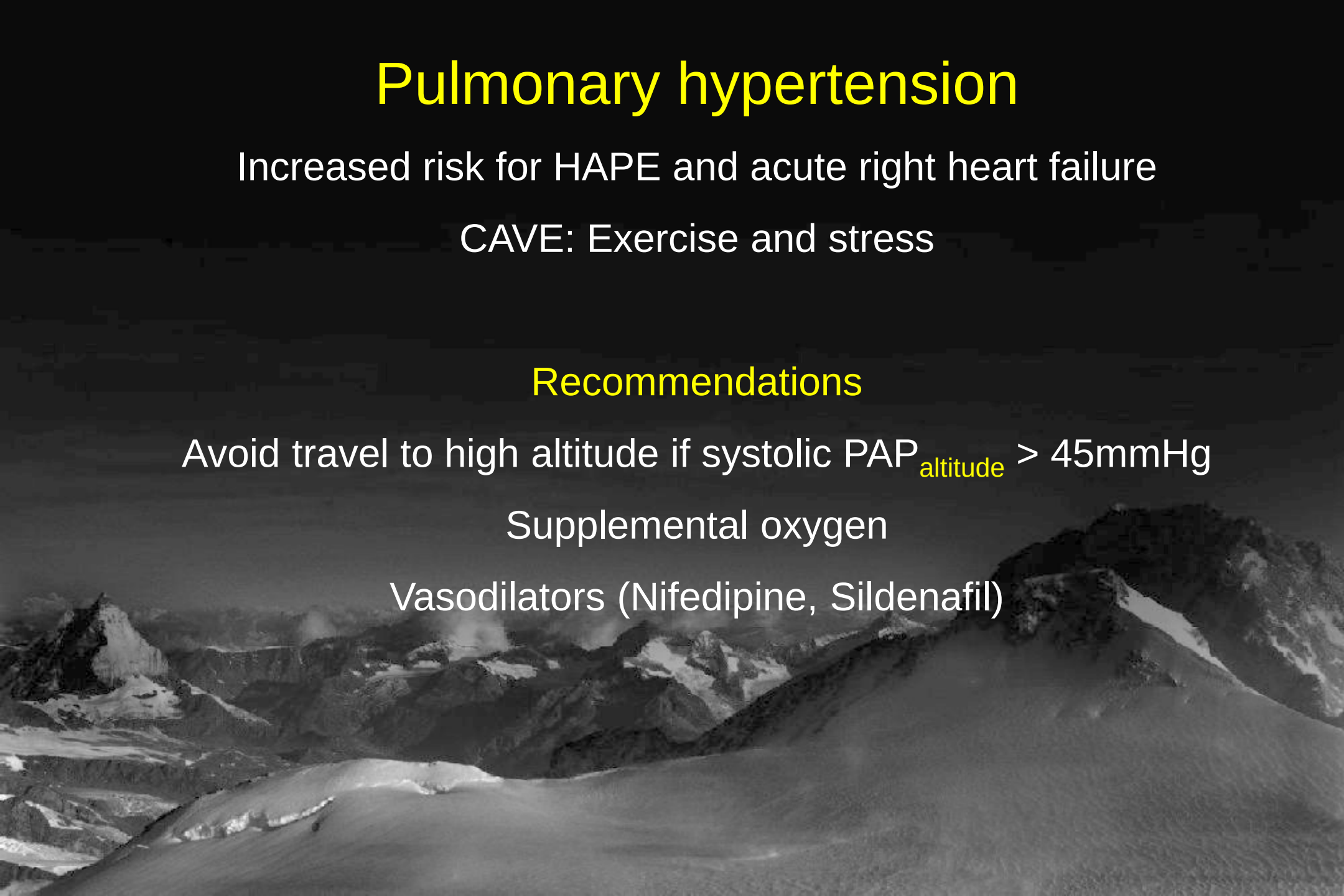
CAVE: Exercise and stress

Recommendations

Avoid travel to high altitude if systolic $PAP_{altitude}$ > 45mmHg

Supplemental oxygen

Vasodilators (Nifedipine, Sildenafil)



Non-pharmacological and pharmacological prevention ?

3) Increased hydration is recommended to prevent acute mountain sickness.

a) True

b) False

c) I don't know

4) Good physical condition prevents altitude-related illnesses.

a) True

b) False

c) I don't know

5) Which is the ideal ascension rate (increase in altitude of sleep location between two nights) above 2500m ?

a) 200 to 300 m

b) 300 to 500 m

c) 500 to 700 m

d) 700 to 1000m

4. Prevention

Table 3. Prevention of High-Altitude Illnesses.

Method	Description
Acclimatization before exposure	Sojourning several days at intermediate altitudes at or above 2000 m (staging), hiking or climbing on day tours above 3000 m, or both
Slow ascent	Ascent rate of 300–500 m/day above 2500–3000 m, with a day of rest every 3–4 days; appropriate treatment of early symptoms of acute mountain sickness for prevention of severe high-altitude disease

Acclimatation

Vitesse maximale d'ascension : (300m/jour, 1B) et un jour de repos chaque 3 à 4 jours (1C).
Ascension à < 2800 m à J1.
Eviter les efforts intenses et prolongés.
Hydratation, éviter l'alcool.

6) Find the appropriate drugs for the prevention of acute mountain sickness (AMS) and rank them in order of preference.

a) NSAIDs (anti-inflammatory, aspirin, ibuprofen,...)
b) Zolpidem
c) Acetazolamide
d) Gimko Biloba
e) Nifedipine
f) Dexamethasone
g) Coramine
h) Paracetamol
i) Coca leafs

PREVENTION

AMS

Acetazolamide
(125-250 mg twice daily, day -1 to day 3)

Dexamethasone
(2-4 mg every 6 hrs, day 1 to 3, then tapered over 1 to 3 days)

HACE

Dexamethasone ?
(2-4 mg every 6 hrs, day 1 to 3, then tapered over 5 days)

HAPE

Nifedipine
(30 mg slow-release/day Day -3 to 0; then 30 mg every 12 hrs for 5 to 7 days)

Salmeterol
(2 x 4 puffs/day, starting at day -2)

Dexamethasone (2x4mg/day)
Tadalafil (2x10 mg/day)

Avoid direct transport to an altitude >2’750 m
Ascend at a slow rate (increase *sleeping* altitude by 300 m/day on average)
Avoid overexertion, alcohol, and hypnotics
High carbohydrate diet
Adequate fluid intake (Keep hydrated! Keep hydrated! Keep hydrated!)

Treatment ?

7) When climbing a 4000m, your patient complains of fatigue and headaches shortly after leaving the cabin. What do you suggest?

a) Hydration, acetazolamide, rest 15 minutes, then continue the ascent

b) Hydration, painkillers, rest 15 min, then continue the ascent

c) Hydration, rest 15 min, then continue the ascent

d) Hydration, pain relief and descent

e) Hydration, dexamethasone and descent

8) 30 minutes before reaching a summit at 4800m, your client has persistent headache, dizziness, and you notice that his gait is difficult. He loses balance several times and his talk is inconsistent. What do you suggest?

a) Painkillers, hydration, then continue the ascent

b) Painkillers, hydration, dexamethasone then continue the ascent

c) Painkillers, hydration, rest, descent if no improvement.

d) Painkillers, hydration, acetazolamide and immediate descent

e) Painkillers, hydration, dexamethasone, immediate descent

f) Painkillers, hydration, nifedipine, immediate descent.

9) Which of the following medications are indicated for the treatment of high altitude pulmonary edema (HAPE)?

a) NSAIDs (anti-inflammatory, aspirin, ibuprofen,...)
b) Acetazolamide
c) Gimko Biloba
d) Nifedipine
e) Paracetamol
f) Coramine
e) Dexamethasone
f) Salmeterol
g) Tadalafil
h) Zolpidem

TREATMENT: DESCENT

Oxygen

At altitude, the administation of 1-2 L/min of oxygen is equivalent to a descent of about 800-1000m

TREATMENT

AMS

Paracetamol/ Antiemetics

Dexamethasone (4-8 mg every 6 hours)

Acetazolamide (250-500 mg every 8 hours)

Oxygen/Hyperbaric chamber/Descent if severe

HACE

DESCENT

Oxygen/Hyperbaric chamber

Dexamethasone (4-8 mg every 6 hours)

HAPE

DESCENT

Oxygen/Hyperbaric chamber

Nifedipine (30 mg slow-release every 8 hours)

Medications

Analgetics (paracetamol, AINS)

Anti-hemetics (métoclopramide)

Acetazolamide

Dexamethasone / Prednisone

Nifedipine / Tadalafil / Salmeterol

Analgetics

Start rapidly

Altern paracetamol and NSAD

Ibuprofen > others NSAD (?)

Acetazolamide (Diamox)

Induces a metabolic acidosis
Increases ventilation
Decreases permeability (?)

Takes up to 3-12 hours to be effective
Better for prevention than treatment of AMS

Cave: side effects !!

Dexamethasone / Prednisone

Very efficient for prevention (AMS, HACE, HAPE) and treatment (AMS, HACE)

Decreases the sympathetic activation and reduces permeability

BUT…

Multiples et important side effects!!!!

Should not be used for repeated exposures !!!

Nifedipine / Tadalafil

Pulmonary vasodilator

For both prevention and treatment of HAPE

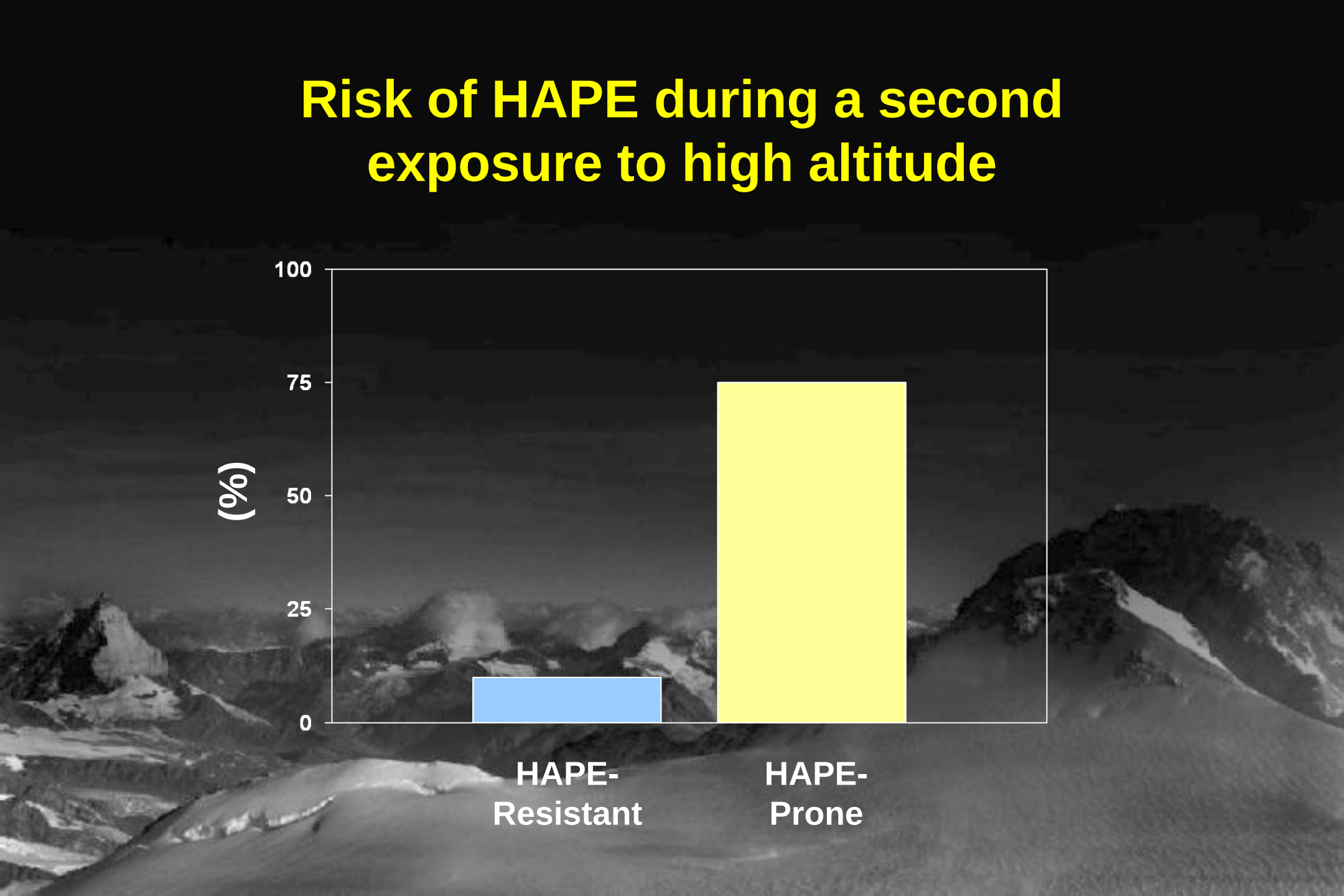
No effects on AMS et HACE !!!

May induce severe headache

CAVE: Hypotension !!!

How can we predict high-altitude illnesses ?

Risk of HAPE during a second exposure to high altitude



6. Prediction

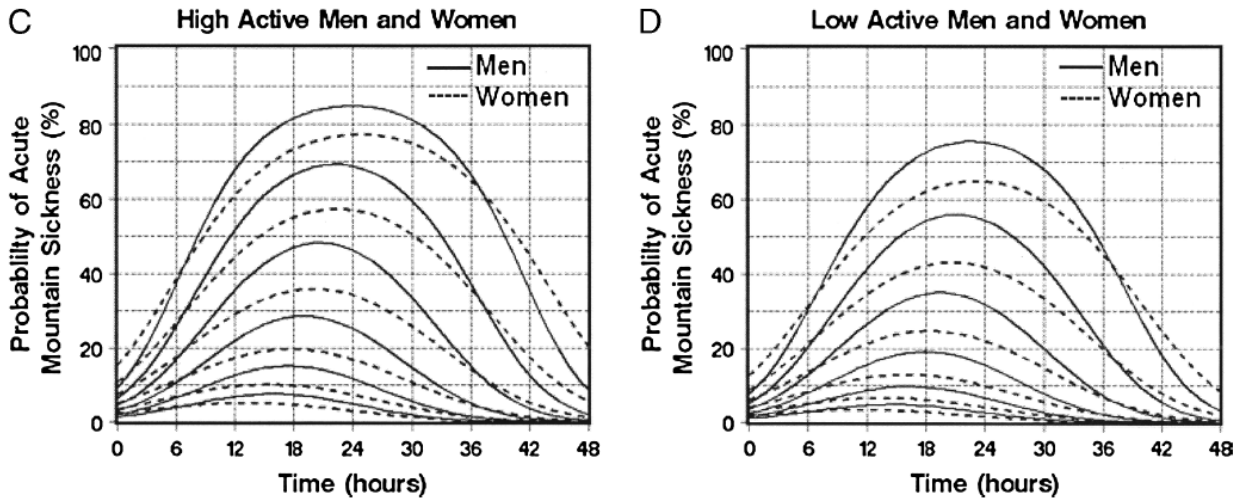


FIGURE 2—This figure demonstrates predictions for the probability of AMS over the first 48 h of altitude exposure after rapid ascent to altitudes ranging from 2000 to 4500 m. The lowest group of lines starts at 2000 m and increases by 500 m until reaching 4500 m for the top group of lines. Panels A and B demonstrate the effect of activity on probability of AMS in high active versus low active men and high active versus low active women. Panels C and D demonstrate the effect of sex on probability of AMS in high active men versus high active women and low active men versus low active women.

Med. Sci. Sports Exerc., Vol. 45, No. 4, pp. 792–800, 2013.

Evaluation du risque de développement d'un mal aigu de montagne (AMS), adapté de Luks, et al., Wilderness Environ Med, 2010. 21(2): p. 146–55.

Type de risque	Description	Prophylaxie
Faible	Pas d'antécédents de maladies liées à l'altitude et ascension jusqu'à 2800 m	Non indiquée
	Ascension en 2 j. jusqu'à 2500–3000 m puis dénivelé <500 m/j*	
Modéré	Antécédent d'AMS et ascension jusqu'à 2500–2800 m à J1	A conseiller
	Pas d'antécédent d'AMS mais ascension sup. à 2800 m à J1	
	Dénivelé >500 m/j en dessus de 3000 m*	
Elevé	Antécédent d'AMS et ascension >2800 m à J1	Nécessaire
	Antécédent d'HAPE ou HACE	
	Ascension >3500 m à J1	
	Dénivelé >500 m/j au-dessus de 3500 m*	
	Ascension très rapide (par ex. Mt Kilimanjaro)	

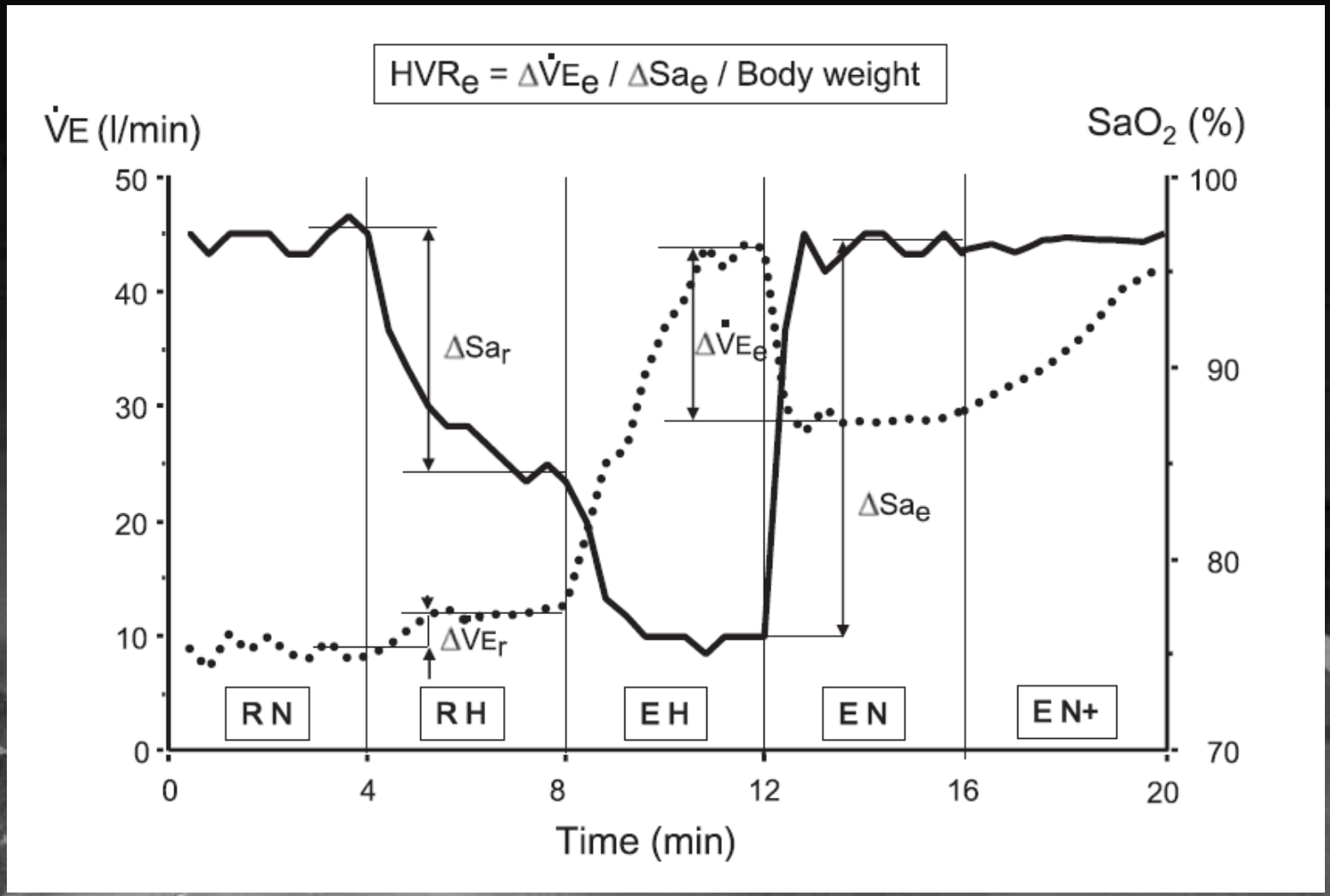
* Ce dénivelé correspond à la différence d'altitude entre les lieux où l'on dort.

For a single individual…

Risk Prediction Score for Severe High Altitude Illness: A Cohort Study

Florence Canouï-Poitrine[1,2*], Kalaivani Veerabudun[1,2], Philippe Larmignat[3], Murielle Letournel[5], Sylvie Bastuji-Garin[1,2☯], Jean-Paul Richalet[4,5☯]

Richalet, Larmignat, Poitrine, *et al.*: Physiological Risk Factors of Altitude Illness



Am J Respir Crit Care Med Vol 185, Iss. 2, pp 192–198, Jan 15, 2012

Table 2. Adjusted Odds Ratios (95% CI) for clinical and physio-clinical multivariate model and scoring system in subjects **with** previous high-altitude sojourn (n = 501, 36 missing).

	Clinical model		Physio-clinical model			
Variables	**Odds Ratio (95% CI) ***	**P Value†**	**Odds Ratio (95% CI) ***	**P value†**	**β′ regression coefficient‡**	**Points ¶**
History of Severe High Altitude Illness	12.35 (7.24–21.08)	<0.001	12.89 (6.78–24.49)	<0.001	2.58	2.5
Rapid ascent (> 400 m/night)	4.69 (2.79–7.90)	<0.001	5.89 (3.19–10.87)	<0.001	1.84	2
History of migraine	2.21 (1.15–4.24)	0.017	4.29 (1.93–9.54)	<0.001	1.27	1.5
Geographical location (Aconcagua, Mt Blanc, Ladakh)	2.7 (1.47–4.88)	0.001	2.43 (1.28–4.61)	0.006	0.79	1
Age < 46 years	1.62 (1.00–2.63	0.05	1.82 (1.00–3.29)	0.049	0.48	0.5
Female sex	1.60 (0.96–2.67)	0.073	1.38 (0.75–2.54)	0.30	0.29	0
Regular endurance physical activity	1.9 (1.09–3.19)	0.53	1.46 (0.80–2.65)	0.12	0.45	0.5
Hypoxic ventilatory response at exercise (l/min/kg)	-	-				
low < 0.68			20.59 (6.76–62.7)	<0.001	3.07	3
moderate (0.68–0.94)	-	-	3.41 (1.10–10.59)	0.034	1.18	1
high ≥0.94	-	-	ref	ref	ref	0
Hypoxic cardiac response at exercise (b/min/%)	-	-				
low <0.72			2.41 (1.16–5.03)	0.019	0.97	1
moderate (0.72–0.95)	-	-	0.94 (0.44–2.01)	0.89	0.07	0
high ≥0.95	-	-	ref	ref	ref	0
C-statistic (Area Under ROC Curve) (CI 95%)‡	0.84 (0.78–0.88)	-	0.91 (0.87–0.93)			
Calibration: Hosmer-Lemeshow chisquare	3.81 (p = 0.87)	-	4.52 (p = 0.81)			
Net Reclassification Index ¥	-	-	30% (p<0.001)			

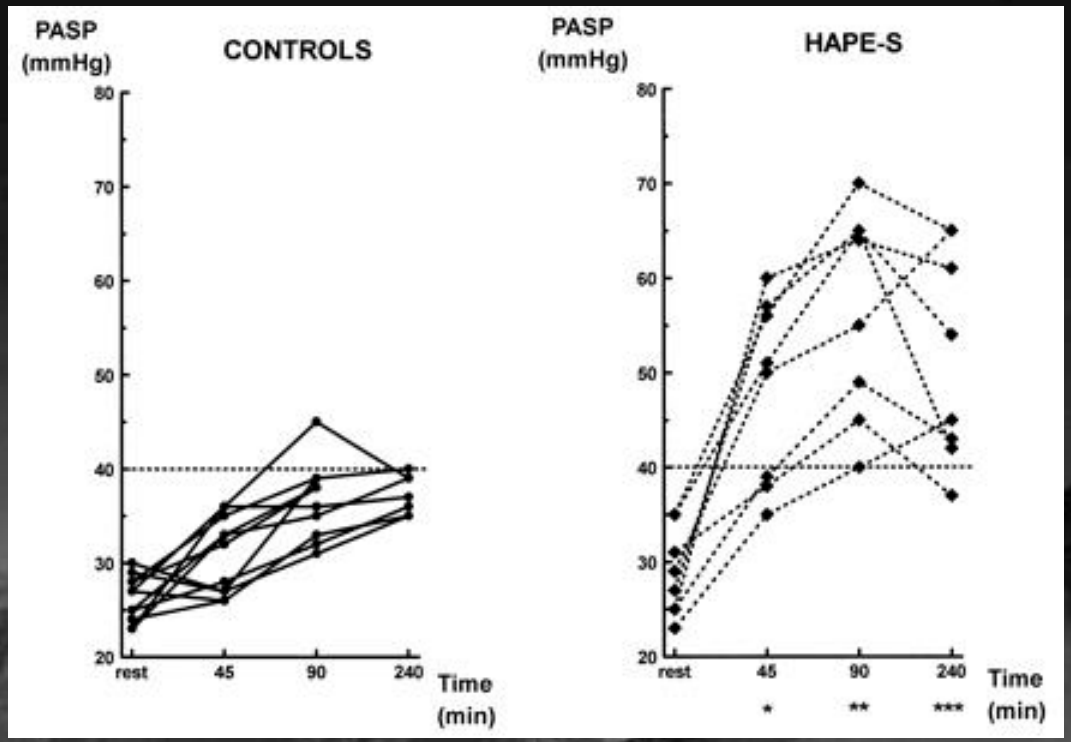
*Adjusted odds ratio from multivariate logistic regression adjusted for all variables listed in the column; † Wald test; ‡ Estimations obtained after 1000 resampling; ¶ β′ Coefficient rounded to the near half integer; ¥ Net Reclassification Index indicates the proportion of patients correctly classified (in the group who will and the group who will not develop SHAI when adding physiological variables to the clinical model.

doi:10.1371/journal.pone.0100642.t002

Predicting HAPE by a simulated altitude-exposure ?

Consultation
Le Dr Alban Lovis fait subir un test d'hypoxie à ses patients, une simulation des conditions d'altitude. ODILE MEYLAN

Pulmonary artery response to acute hypoxia (FiO2 12%): a simple test to detect HAPE-susceptibility?



Grunig et al., J Am Coll Cardiol 2000;35:980-7.

Predictive value of hypoxic pulmonary-artery vasoreactivity test

TABLE 3 Comparison of different conditions

	Rest hypoxia	Exercise normoxia	Exercise hypoxia
Cut-off value/range mmHg	41	39–43	52
Wrongly classified subjects	5	4	3
Correctly classified subjects	27	25	21
Sensitivity %	77	94	92
Specificity %	93	77	82
Positive predictive value %	56	30	35
Negative predictive value %	97	99	99
Missing values	5 (14)	8 (22)	13 (35)

Data are presented as n or n (%), unless otherwise stated.

Dehnert et al. Eur Respir J 2005; 25:545-551.

10) Une femme de 66 ans vous consulte en vue d'un trekking de 21 jours au Népal, à une altitude de 4500 m.

Elle est connue pour un tabagisme ancien à 20 UPA, une hypertension artérielle traitée, une fibrillation auriculaire paroxystique anticoagulée et un infarctus du myocarde il y a 5 ans.

Quel traitement redouter le plus?

a) Diurétique
b) Bétabloquant
c) Statine
d) Anticalcique
e) Anticoagulant oral

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7. Consultation de Médecine de Montagne
Pour qui?

1. First exposure to altitude
2. History of altitude-induced diseases
3. Comorbidities
4. Training for altitude-events

High-altitude consultation

History

- Lengh of stay, ascent profile et transport
- Antecedents (altitude max, sleep altitude max, symptoms)
- Comorbidities, contra-indications, medications
- Smoke, hormones
- Physical training
- Guides, groups
- Oxygen, hydratation, food

Information about altitude diseases

Information about acclimatation

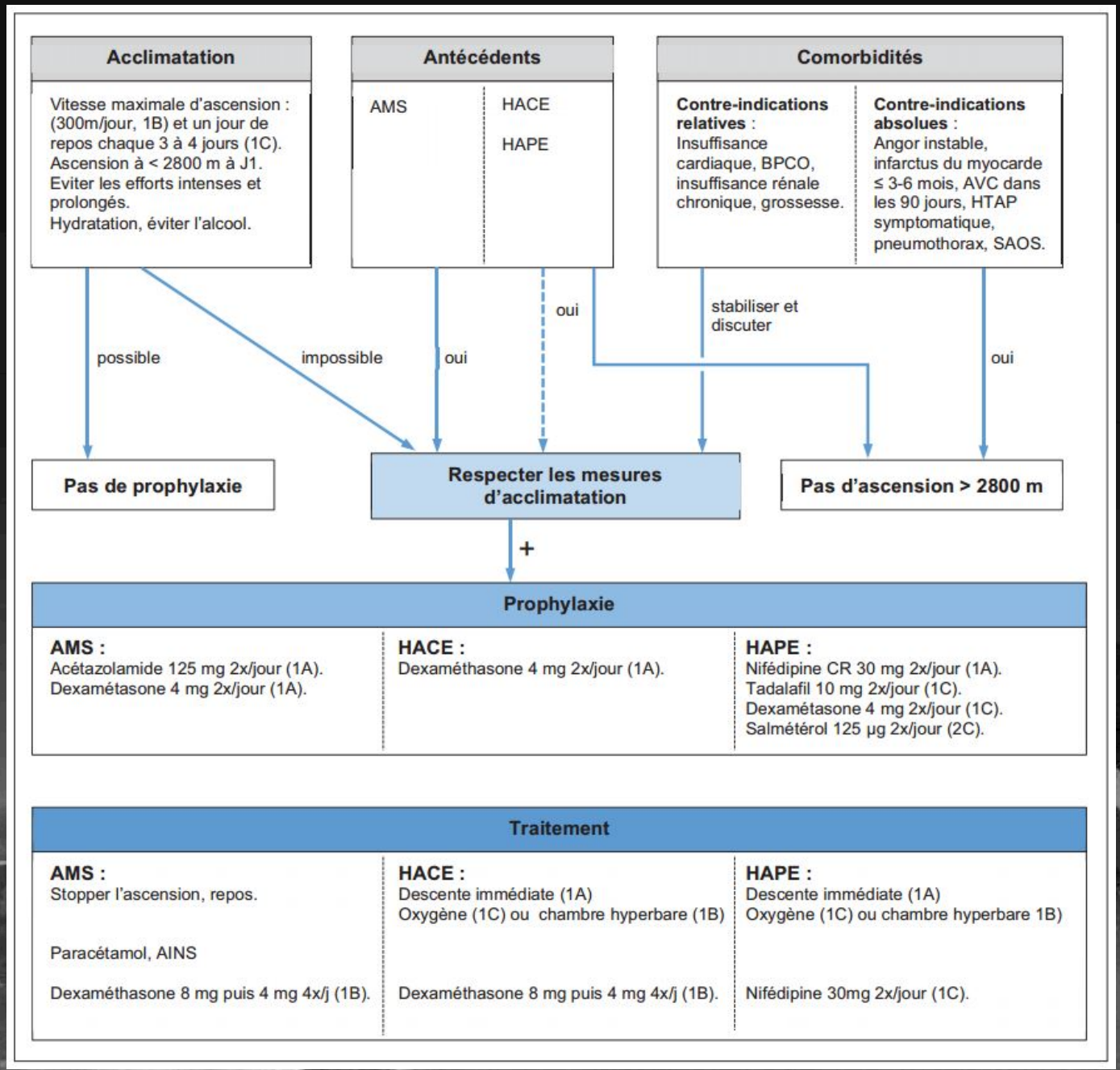
Indication to prophylaxis?

Indication to hypoxic tests?

Médications

Follow-up !

Summary


Acclimatation
Vitesse maximale d'ascension : (300m/jour, 1B) et un jour de repos chaque 3 à 4 jours (1C). Ascension à < 2800 m à J1. Eviter les efforts intenses et prolongés. Hydratation, éviter l'alcool.
Antécédents
AMS
HACE
HAPE
Comorbidités
Contre-indications relatives : Insuffisance cardiaque, BPCO, insuffisance rénale chronique, grossesse.
Contre-indications absolues : Angor instable, infarctus du myocarde ≤ 3-6 mois, AVC dans les 90 jours, HTAP symptomatique, pneumothorax, SAOS.
possible
impossible
oui
oui
stabiliser et discuter
oui
Pas de prophylaxie
Respecter les mesures d'acclimatation
Pas d'ascension > 2800 m
+
Prophylaxie
AMS :
Acétazolamide 125 mg 2x/jour (1A).
Dexamétasone 4 mg 2x/jour (1A).
HACE :
Dexaméthasone 4 mg 2x/jour (1A).
HAPE :
Nifédipine CR 30 mg 2x/jour (1A).
Tadalafil 10 mg 2x/jour (1C).
Dexamétasone 4 mg 2x/jour (1C).
Salmétérol 125 µg 2x/jour (2C).
Traitement
AMS :
Stopper l'ascension, repos.
Paracétamol, AINS
Dexaméthasone 8 mg puis 4 mg 4x/j (1B).
HACE :
Descente immédiate (1A)
Oxygène (1C) ou chambre hyperbare (1B)
Dexaméthasone 8 mg puis 4 mg 4x/j (1B).
HAPE :
Descente immédiate (1A)
Oxygène (1C) ou chambre hyperbare 1B)
Nifédipine 30mg 2x/jour (1C).

Maladies liées à l'altitude et consultation de médecine de montagne

Alban Lovis[a], Hervé Duplain[b], Laurent Nicod[a], Urs Scherrer[c], Claudio Sartori[d]

[a] Service de Pneumologie, CHUV, Lausanne
[b] Service de Médecine Interne Hôpital de Delémont
[c] Service de cardiologie, Hôpital de l'Ile, Berne
[d] Service de Médecine Interne, CHUV, Lausanne

Forum Med Suisse 2012;12(41):789–793

Au-dessus de 2500 m, une maladie liée à l'altitude est toujours le diagnostic le plus probable

Vertige sur la Haute Route

Pierre Métrailler, Claudio Sartori

Service de médecine interne, Centre Hospitalier Universitaire Vaudois CHUV, Lausanne

SWISS MEDICAL FORUM – FORUM MÉDICAL SUISSE 2015;15(39):872–875

Positive effects of altitude

Positive effects of altitude

- Cardiovascular and pulmonary readaptation

- Increased exercice performances

- Increased red blood cells

- Increased oxygen delivery to the muscles

Thank you for your attention

Consultation de médecine d'altitude

Dr Alban LOVIS

Dr Claudio SARTORI

Tél 021 314 09 30