High Altitude Pulmonary Edema: First description

Pietro Ramella

" Pietro Ramella è giunto alle ore 9,12, si sente bene, non ha male di capo, ma è molto stanco. La faccia alquanto cianotica, le mani assai fredde. Tolte le scarpe e le calze, trovati i piedi in stato normale, si avviluppano in una coperta di lana: e subito Ramella si corica su di un materasso.

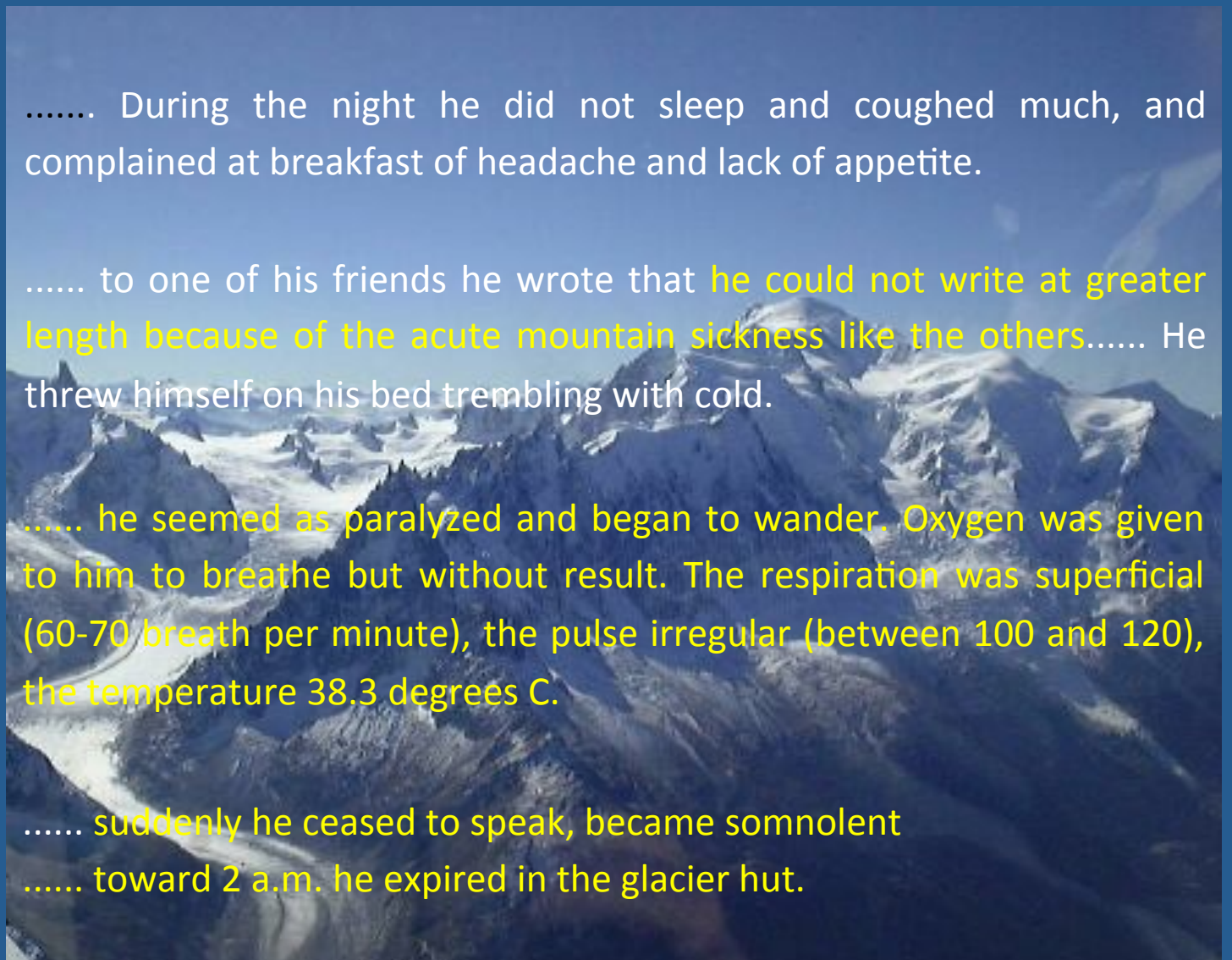
Ore	9,18	Polso	110		Respiro	25	Temperatura rettale	37°,6
„	9,27	„	102		„	20	„ „	37°,05
„	9,45	„	110		„	20	„ „	37°
„	17,50	„	120 a 124		„	26	„ „	39°

" Accusa male di capo e tendenza al vomito; essendo molto depresso gli amministriamo 10 centigrammi di cloridrato di cocaina in mezzo bicchiere di vino di Marsala. La cianosi è cresciuta, compaiono i brividi.

" Nella notte cresce ancora la febbre, e solo nel giorno successivo, in seguito all'esame dei polmoni, esprimo il dubbio che si tratti di una polmonite.

Mosso A. Fisiologia dell'uomo sulle alpi. Vol. 1889. Milano: Fratelli Treves, Editori, 1889.

Dr Jacottet's tragedy at the Vallot hut on Mont-Blanc (1891), written by Dr. Guglielmetti



..... During the night he did not sleep and coughed much, and complained at breakfast of headache and lack of appetite.

..... to one of his friends he wrote that he could not write at greater length because of the acute mountain sickness like the others..... He threw himself on his bed trembling with cold.

..... he seemed as paralyzed and began to wander. Oxygen was given to him to breathe but without result. The respiration was superficial (60-70 breath per minute), the pulse irregular (between 100 and 120), the temperature 38.3 degrees C.

..... suddenly he ceased to speak, became somnolent

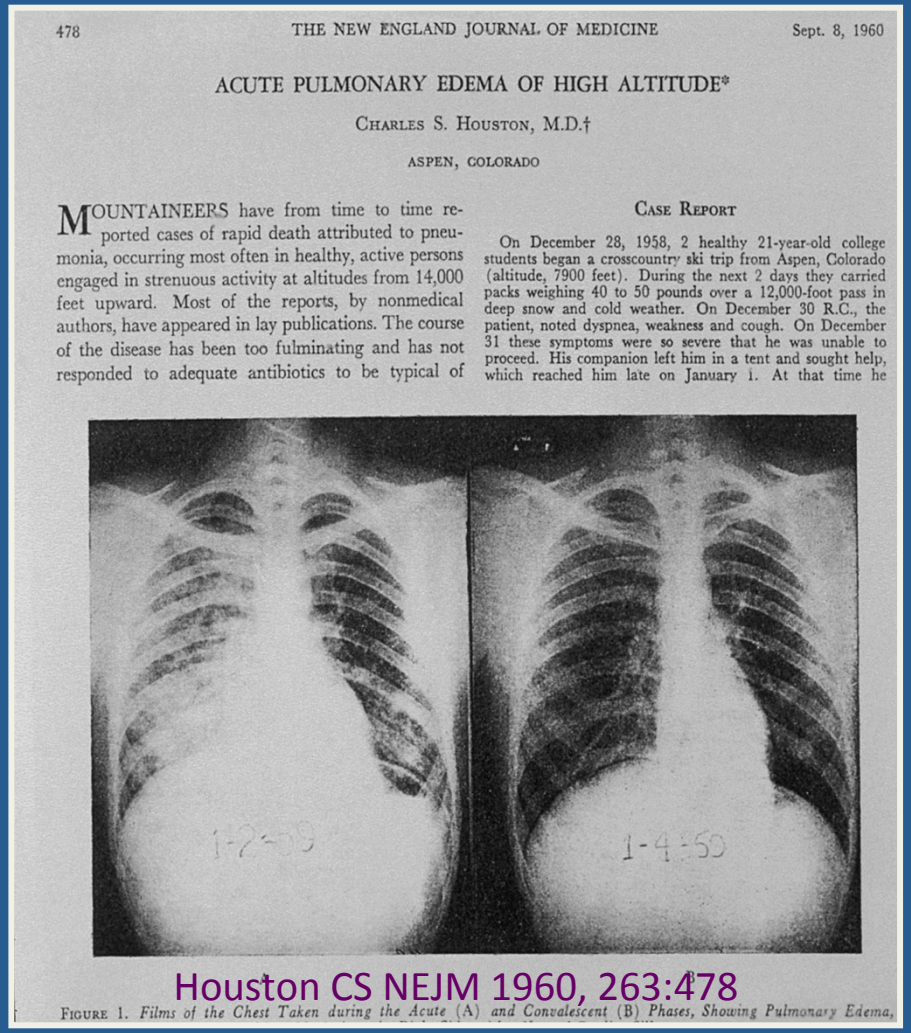
..... toward 2 a.m. he expired in the glacier hut.

Acute Pulmonary edema of high altitude

- *Dr Wizard's post-mortem examination of Dr. Jacottet*

  ... Dr Jacottet had died of capillary bronchitis and lobular pneumonitis.

  ... The immediate cause of death was therefore probably a suffocative catarrh, accompanied by acute edema of the lung.



478 THE NEW ENGLAND JOURNAL OF MEDICINE Sept. 8, 1960

ACUTE PULMONARY EDEMA OF HIGH ALTITUDE*

CHARLES S. HOUSTON, M.D.†

ASPEN, COLORADO

MOUNTAINEERS have from time to time reported cases of rapid death attributed to pneumonia, occurring most often in healthy, active persons engaged in strenuous activity at altitudes from 14,000 feet upward. Most of the reports, by nonmedical authors, have appeared in lay publications. The course of the disease has been too fulminating and has not responded to adequate antibiotics to be typical of

CASE REPORT

On December 28, 1958, 2 healthy 21-year-old college students began a crosscountry ski trip from Aspen, Colorado (altitude, 7900 feet). During the next 2 days they carried packs weighing 40 to 50 pounds over a 12,000-foot pass in deep snow and cold weather. On December 30 R.C., the patient, noted dyspnea, weakness and cough. On December 31 these symptoms were so severe that he was unable to proceed. His companion left him in a tent and sought help, which reached him late on January 1. At that time he

1-2-59 1-4-59

Houston CS NEJM 1960, 263:478

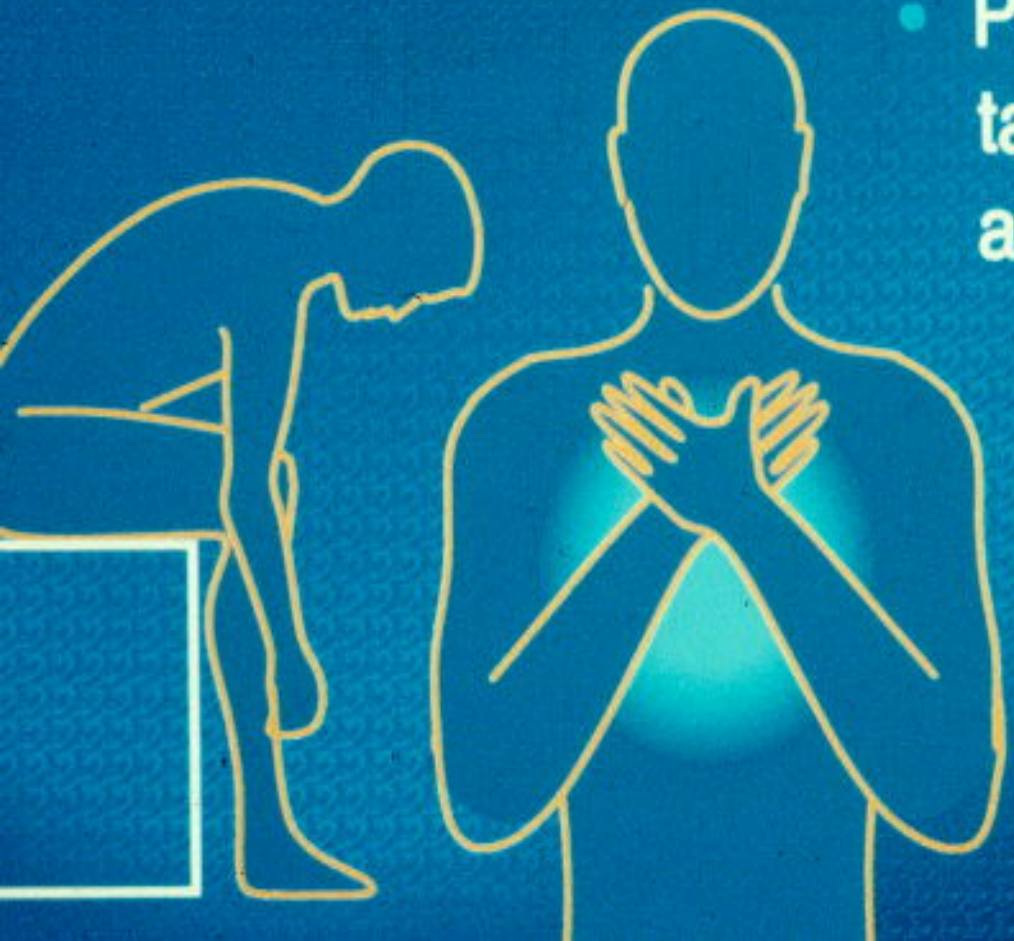
FIGURE 1. *Films of the Chest Taken during the Acute* (A) *and Convalescent* (B) *Phases, Showing Pulmonary Edema.*

Prevalence of HAPE in different settings

- General alpine mountaineering population
- (ascent ≥ 3 days) < 0.2%
- Skiers in Colorado 0.01-0.1%
- Denali 1%?
- Trekkers in Nepal at 4200 m 1%
- Indian soldiers: air lift to 5500 m 2-15%
- Climbers at the Margherita hut (4559 m)
  - Ascent within 2-4 days 4%
  - Ascent within 24h:
    - controls 6%
    - HAPE history 60-70%

Symptoms and signs

- Early symptoms: fatigue, weakness, dyspnea on exertion, dry cough



- Progress to: tachycardia, tachypnea, orthopnea and dyspnea at rest
- Pink or blood-tinged sputum is a very late finding
- Crackles usually start in right axilla

Clinical Presentation of HAPE

- Symptoms and Signs
- Weakness / Decreased Exercise Performance
- Dyspnea at rest, worse lying down
- Cough, bloody sputum
- gurgling
- Chest tightness or congestion

- Heart rate > 90/min
- Resp rate > 25/min
- Cyanosis, SpO2 < 70% (4500m)
- Lungs: Crackles or wheezing
- Body Temperature > 37.4 °C

Clinical diagnosis of high altitude pulmonary edema

		without HAPE	with HAPE
		122	32
Dyspnea at rest		9%	91%
(> 25 breath/min)		55%	45%
Lung auscultation:			
no rales	(127)	85%	15%
rales +	(18)	61%	39%
rales ++	(9)	33%	67%

(Data were obtained from 60 subjects studied during 3 consecutive days at the altitude of 4559 m)

The Lake Louise consensus on definition of altitude illness

High altitude pulmonary edema (HAPE)

Symptoms: (at least two)

- Dyspnea at rest
- Cough
- Weakness or decreased exercise performance
- Chest tightness or congestion

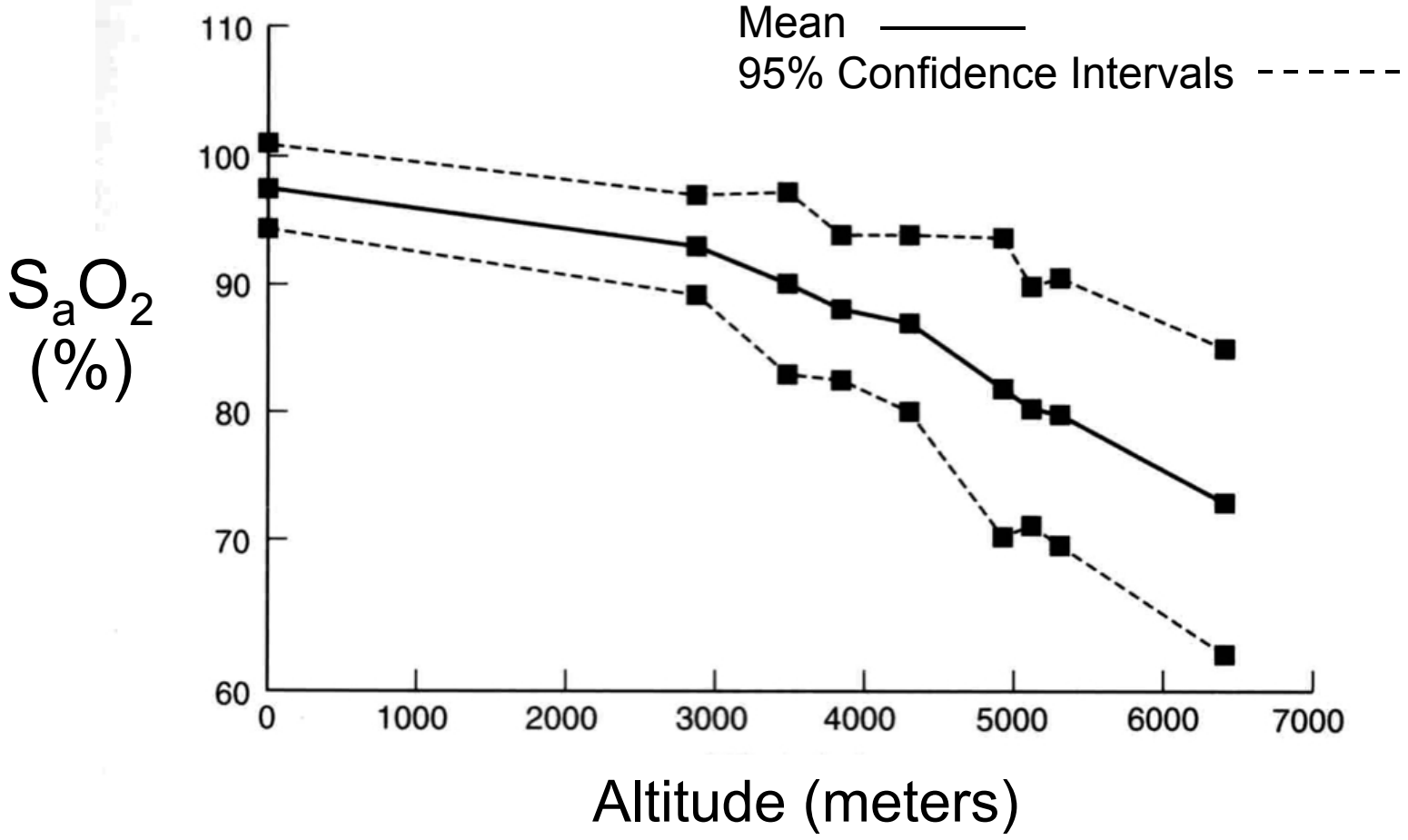
Signs: (at least two)

- Rales and wheezing in at least one lung field
- Central cyanosis
- Fast breathing
- Fast heart rate

Low oxygen saturation!

J.R. Sutton, G. Coats, C.S. Houston
Advances in the Biosciences: Hypoxia and Mountain Medicine Vol 84 1992

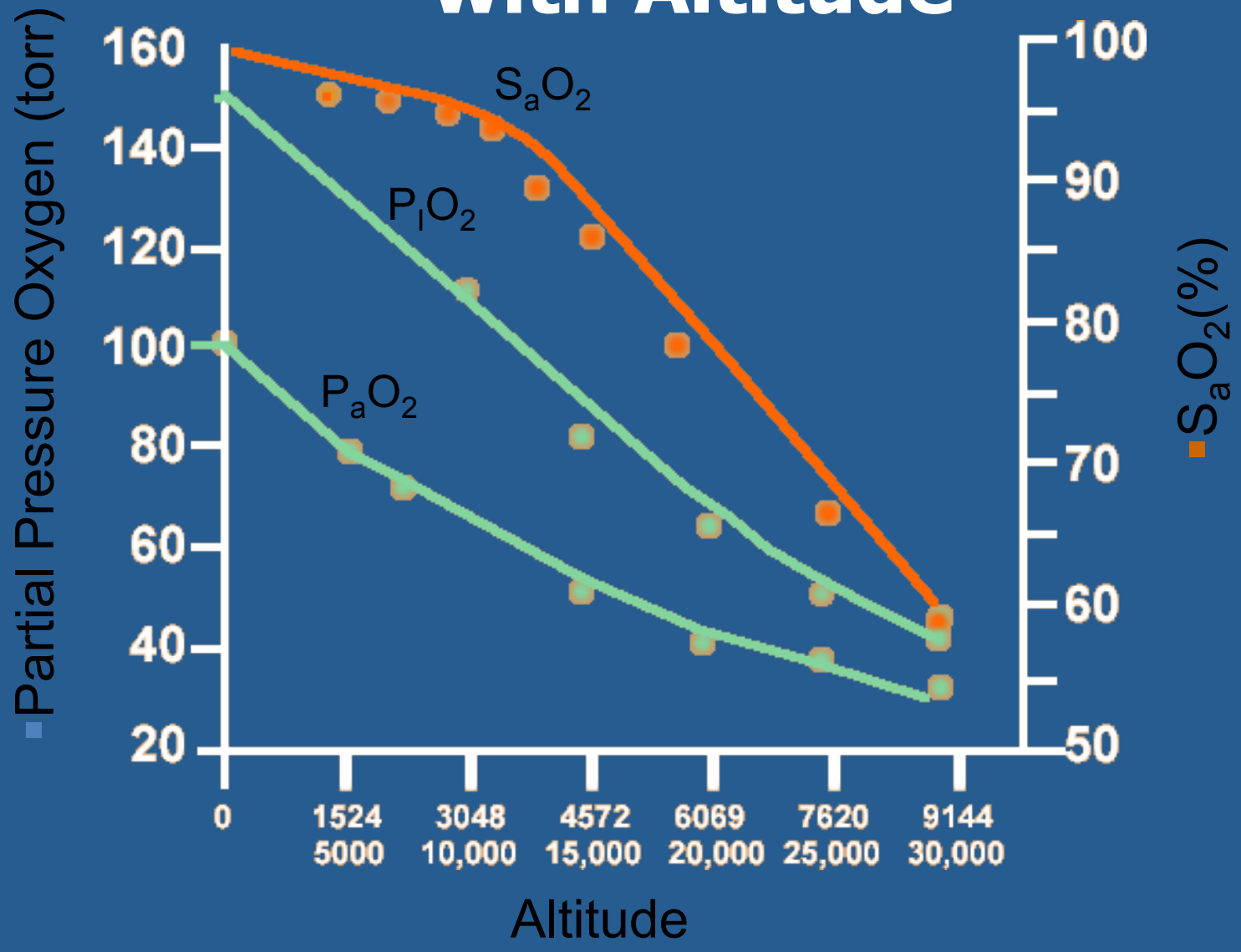
A Wide Range of Oxygenation at Altitude



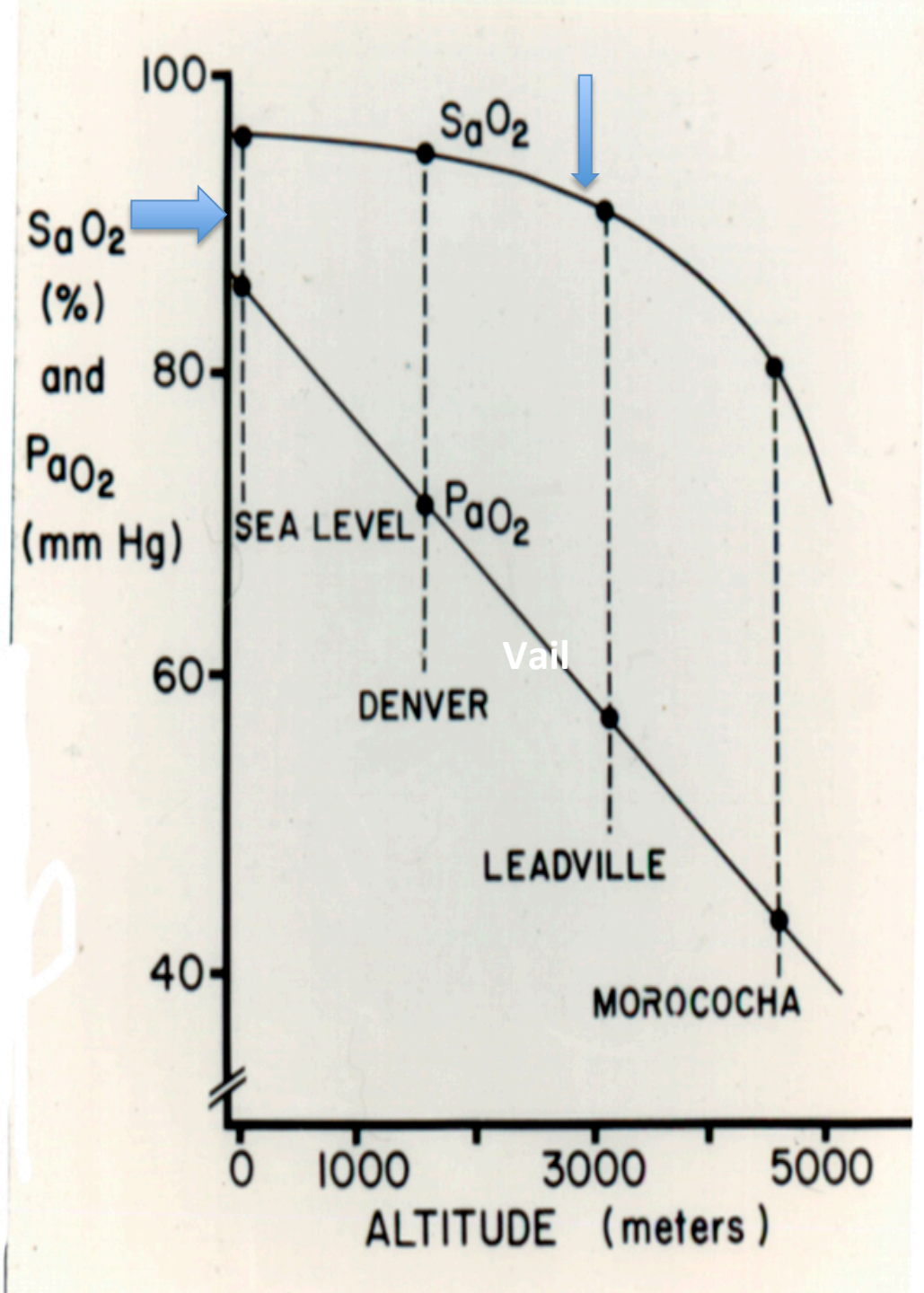
What is normal SpO2 at altitude?

- Depends on altitude, latitude, weather
- Depends on time at altitude
  - Lowest first 1-2 days
  - Takes 4-5 days to maximize
- Best to compare to others in the group
- Varies markedly with breathing
  - Low with lazy breathing, high with brisk breathing

Change in Oxygen Concentrations with Altitude



Saturation drops below 90% rapidly above 9000ft



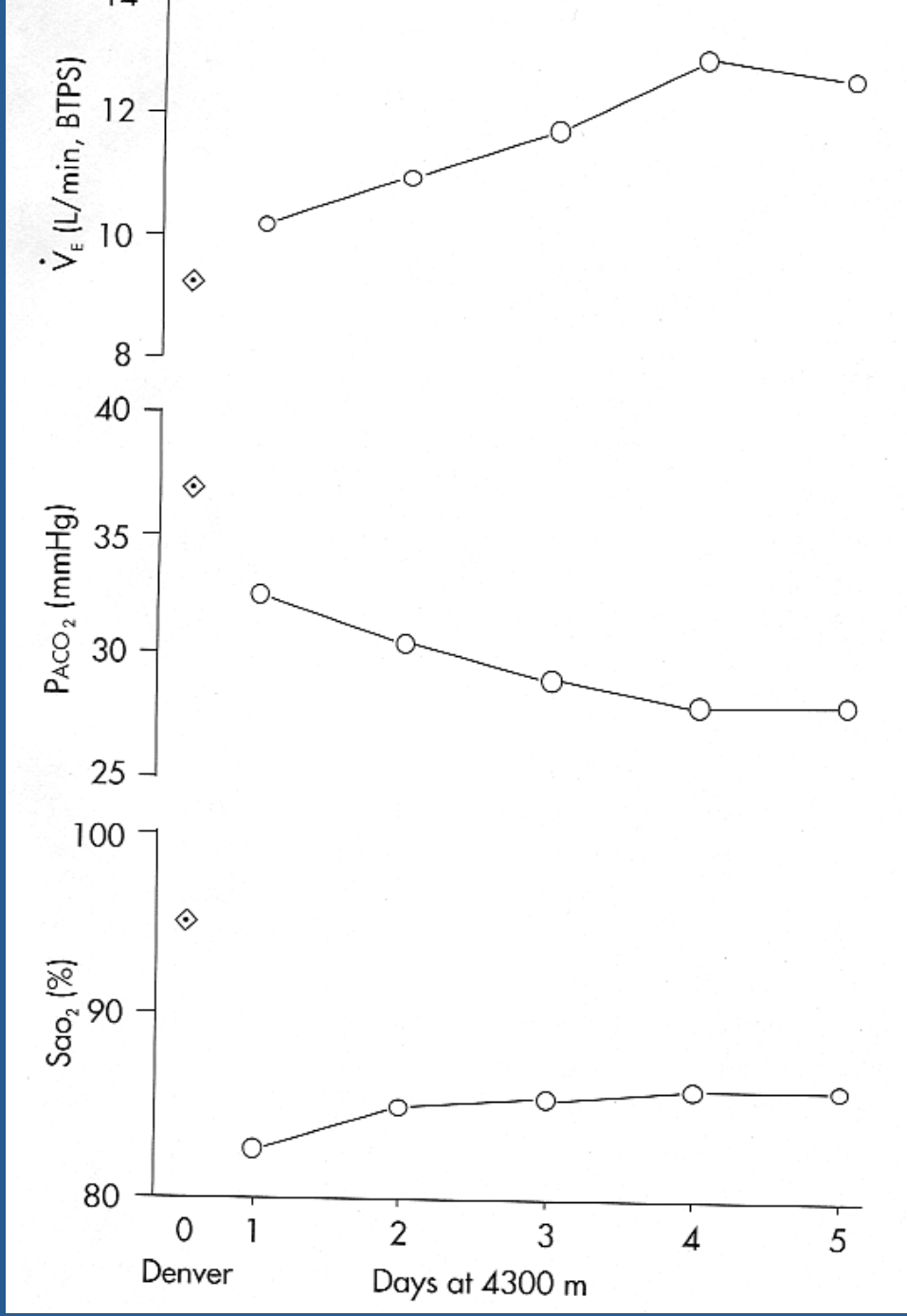
Ventilation –

Breathing increases on ascent to altitude (ventilatory acclimatization)

PCO2 drops

pH increases

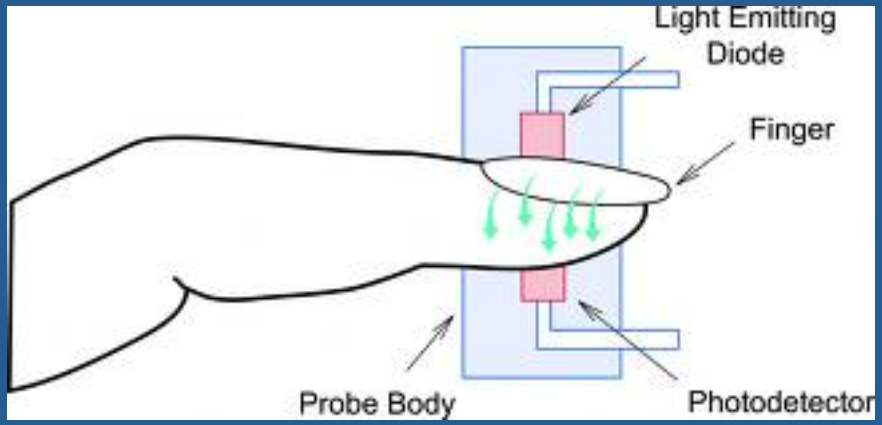
SaO2 improves with time



Pulse oximetry

- Detects oxygen saturation of blood
  - The % of hemoglobin that has oxygen attached to it
  - The more Hb with oxygen, the more oxygen in blood

  The more oxygen, the more red the blood



Pulse oximetry

- Spo2 more unstable at altitude, wider range
- Accuracy goes off below 70%
- Have to have a pulse in the finger
  - Best to have a warm fingertip
- It does not detect carbon monoxide
- Clinical decisions based on large deviations: 10 points in SpO2%, not 2-3 points

Pulse oximetry uses at altitude

- Diagnosis of HAPE: SpO2 > 10 points below normal, usually less than 70%
  - SpO2 drops with mild exercise in early HAPE
- Severity of HAPE: rough correlation with severity
- To rule-out HAPE: SpO2 near normal
- Assess effect of descent, treatment
- Manage oxygen therapy
  - Ideal SpO2 around 90% for Rx

High Altitude Guiding and the Pulse Oximeter

by Scott Woolums

You're at 19,000 ft., a client is complaining of nausea, has the runs, is tired, has a resting pulse of 100-110. What do you do? Is it intestinal, the altitude, or difficult.

I have found myself in these situations many times, and to help make tough case, you could probably either stay another night where you're at, or continue in the absence of more altitude-related symptoms (be certain to monitor things