Innere Medizin VII / Sportmedizin

UniversitätsKlinikum Heidelberg

Acute Mountain Sickness

Peter Bärtsch

www.klinikum.uni-heidelberg.de/sportmedizin

AMS: Clinical Picture

- Symptoms:
  - Headache
  - Loss of appetite, nausea, vomiting
  - Dizziness
  - Sleep disturbance
  - Peripheral edema

- Delayed onset: 4-8 hours

- Definition of AMS:

  Headache + 1 additional symptom

Reviews: Hackett, NEJM 2001; Basnyat, Lancet 2003; Bärtsch, HAMB 2004

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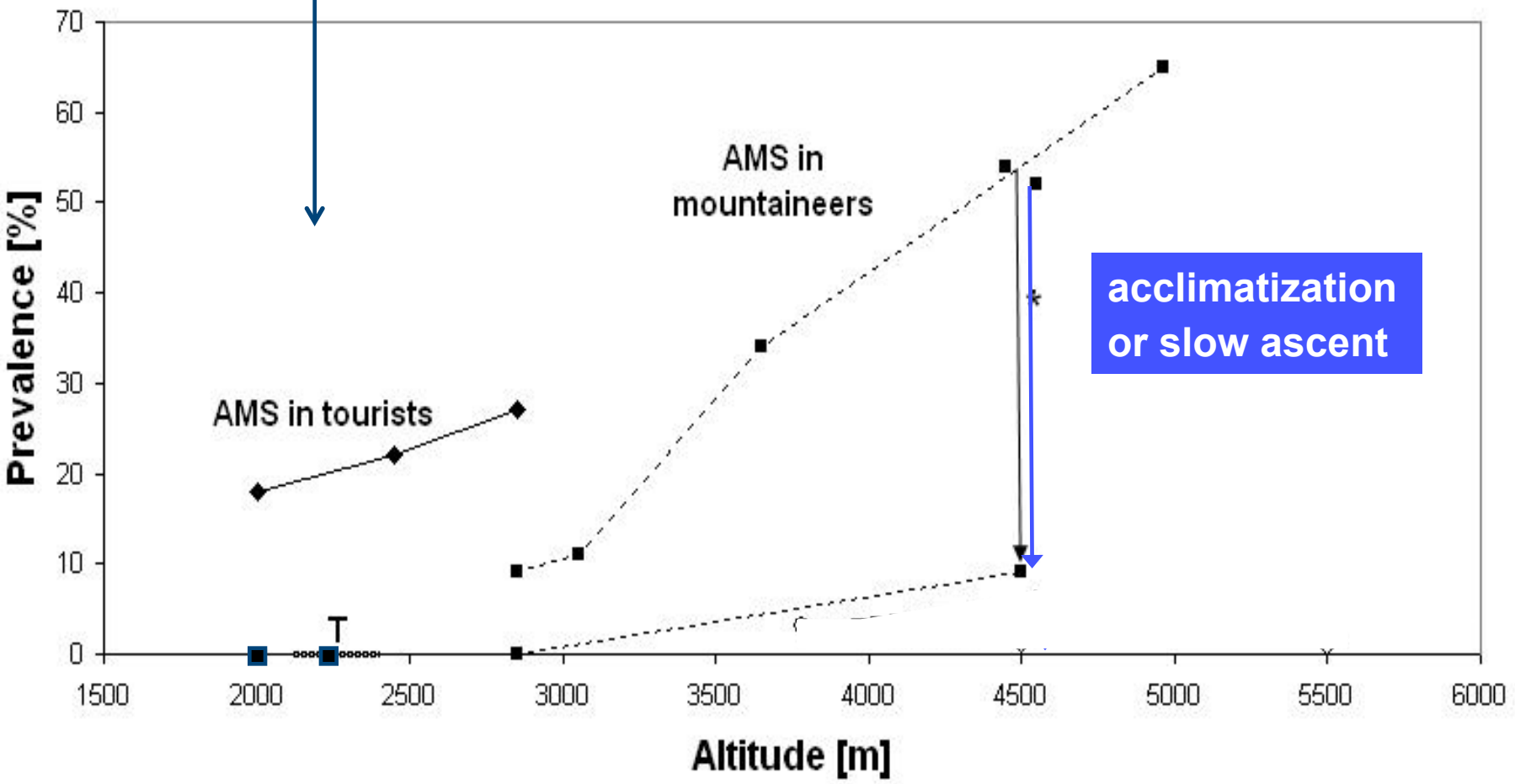
AMS in Relation to Altitude

Threshold altitude: 6500 – 8000 feet



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Football and Altitude, Scand J Med Sci Sports, Suppl 1, 2008

AMS: Treatment and Evolution

Treatment - Day of rest

- Simple pain killer
- Persistence of symptoms: descent, re-ascent possible after improvement

Evolution

- Maximum: day 2 - 3 at given altitude
- Spontaneous complete resolution within 2 - 3 days, rarely persistence of symptoms
- Progression to HACE: possible when no adequate therapy, usually not below 13’000 feet

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High Altitude Cerebral Edema (HACE)

Symptoms and signs: - progressive AMS (not compulsory!)
- ataxia (assistance for walking)
- clouded consciousness → coma
- often fever around 38°C

Occurrence: at 15'000 feet ≈ 0,5 - 1%

Clinical course: - usually rapid deterioration
→ emergency with highest priority
- death within 1-2 days if untreated
- recovery can be delayed at LA

Therapy: - immediate descent as low as possible
- dexamethasone
- supplemental O_2.

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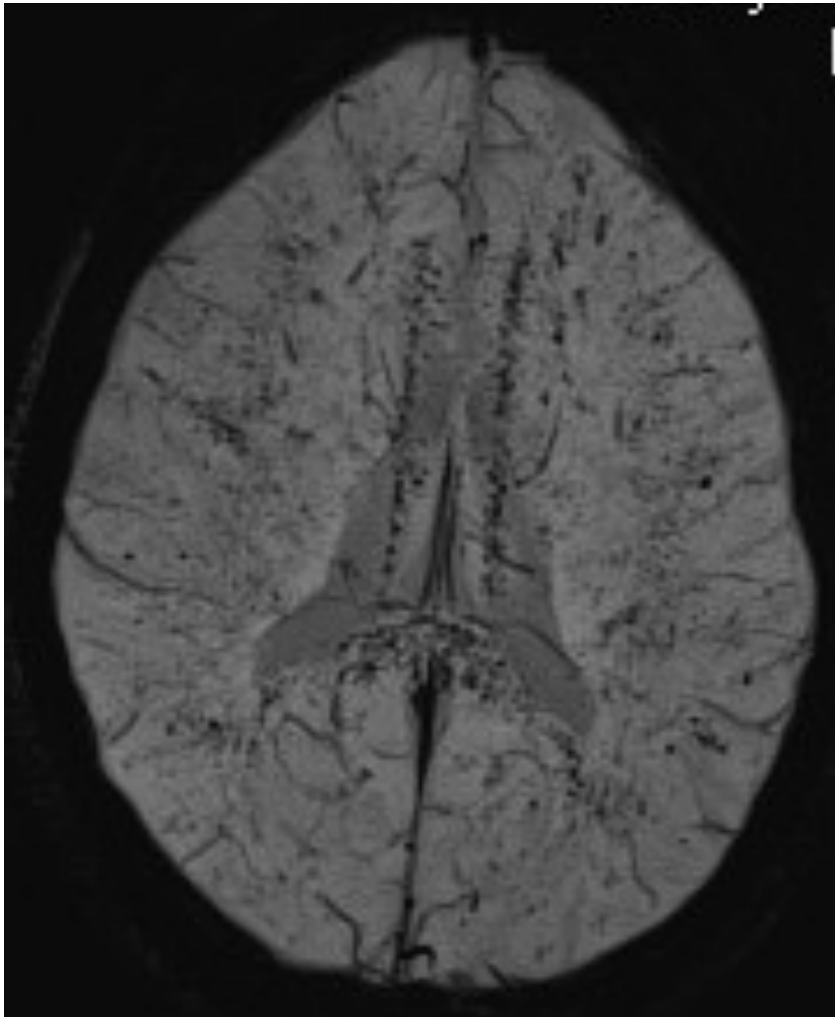
MRI with Microbleeds in HACE



Microbleeds afte HACE

Normal MRI

Schommer, Neurology, in press

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Major Risk Factors for AMS at a Given Altitude

Mountaineers	**Tourists**
- Previous history of AMS	- Previous history of AMS
- No pre-acclimatization	- Living altitude > 900 m
- Fast rate of ascent	- Obesity (BMI > 30)
- Exertion (most likely)	- Chronic lung disease

Schneider, Med Sci Sports Exerc 2002

Honigman, Ann Intern Med 1993

→ Prevention: ascend slowly, pre-acclimatize, avoid exertion

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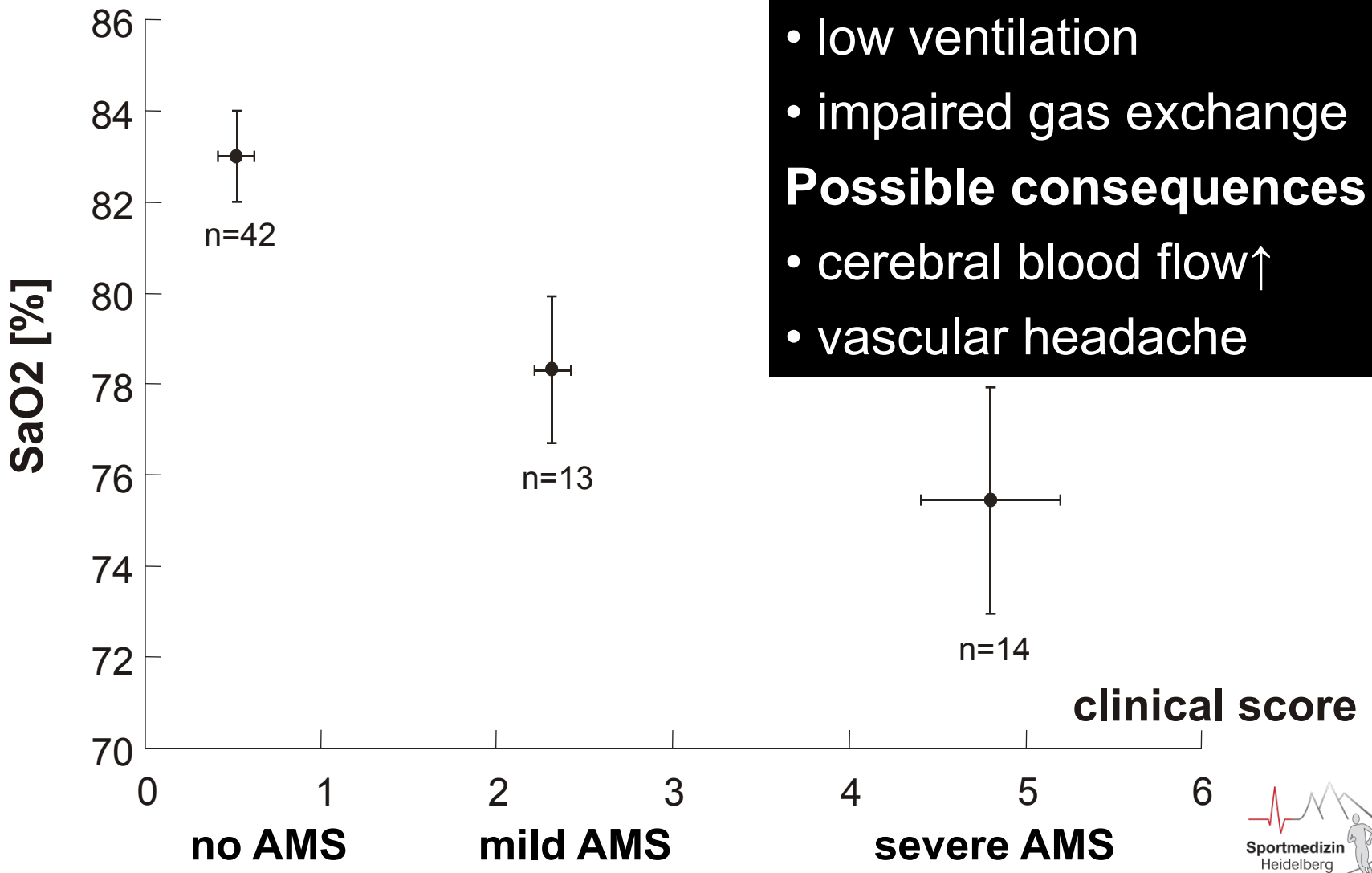
Cause of AMS: Lower SaO_2?

Possible causes:

- low ventilation
- impaired gas exchange

Possible consequences:

- cerebral blood flow↑
- vascular headache



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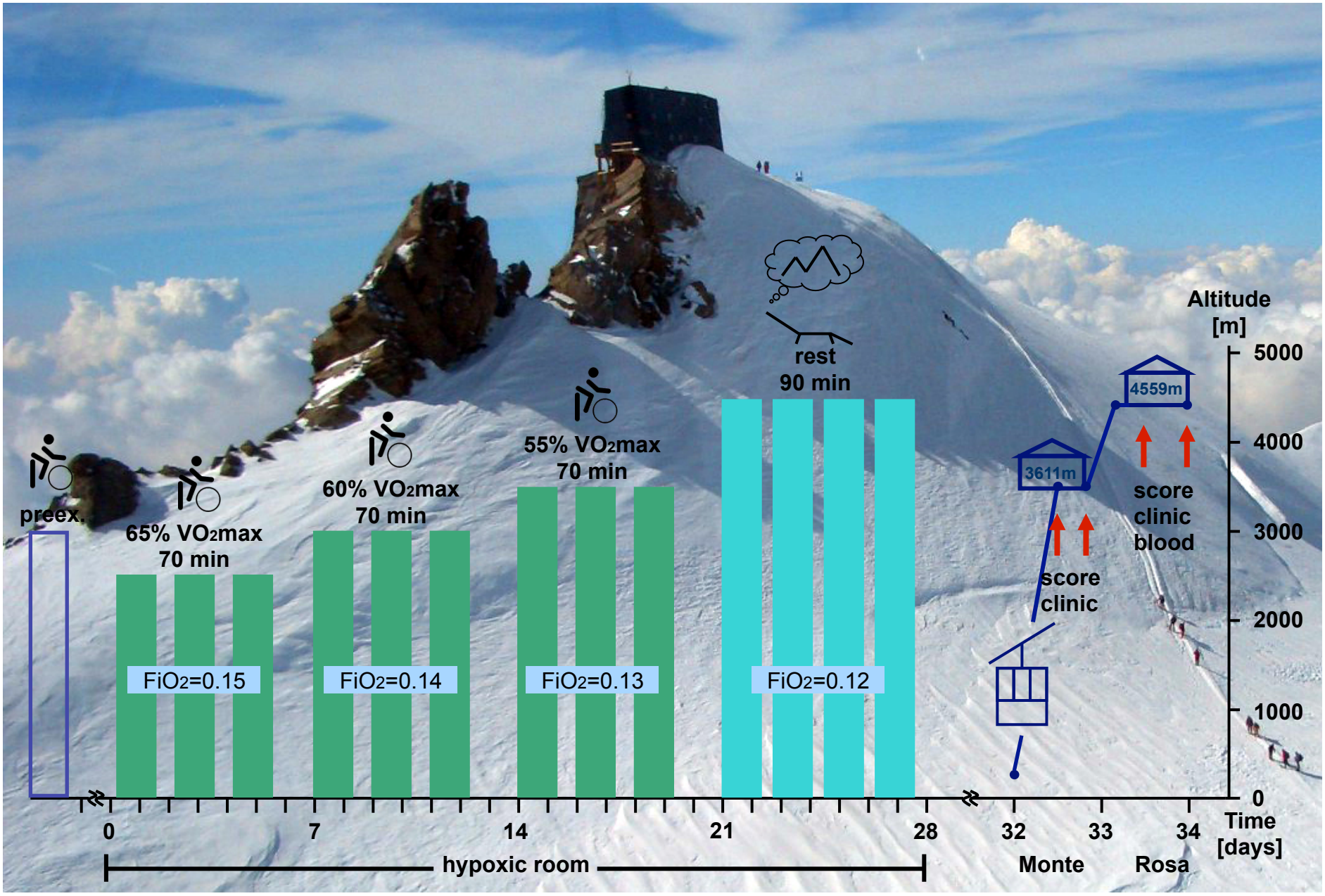
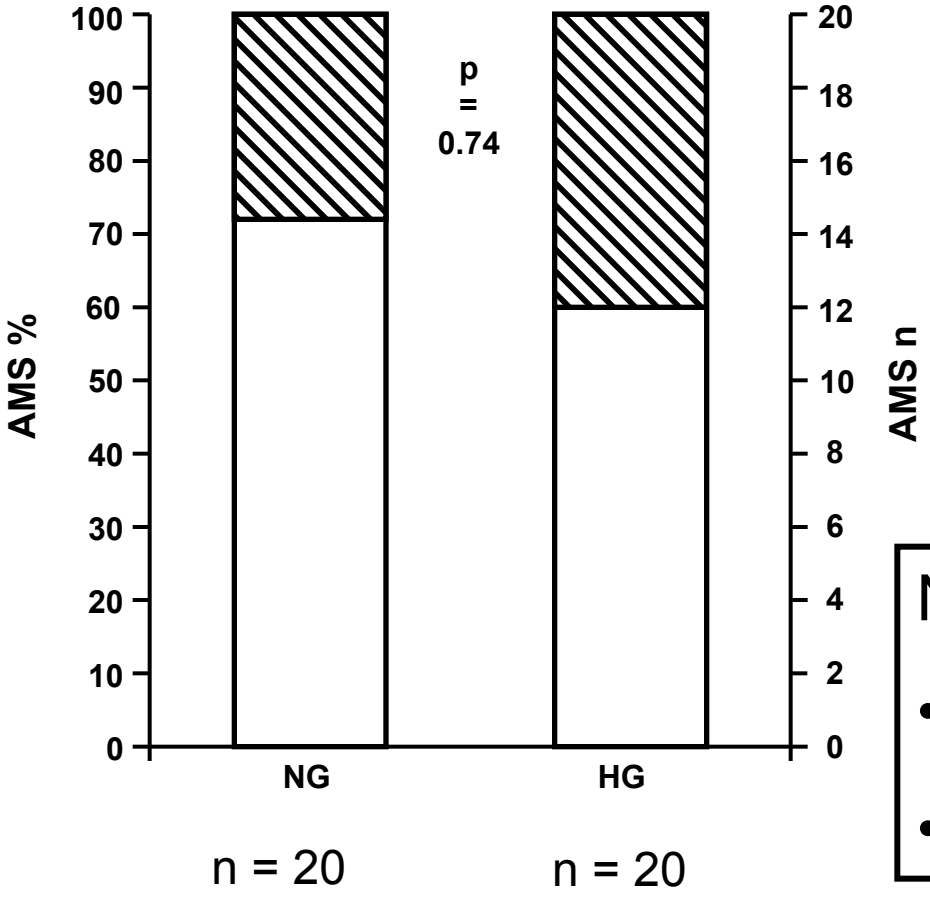
Training in Hypoxia for Prevention of AMS



AMS after Training in Hypoxia

Endpoint in 14‘600 feet



Clinical Course of AMS

AMS incidence	NG [%]	HG [%]	p
evening at 11850 ft	47	11	0.05
morning at 11850 ft	47	6	0.01*
evening at 14600 ft	55	44	0.32
morning at14600 ft	55	50	0.98

No effects on:

- blood gases and SpO_2
- physical performance

Schommer K, High Alt Med Biol (2011)

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Sleeping in Hypoxia for Prevention of AMS

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AMS at 4300 m after Sleeping in Hypoxia

- Placebo controlled, double blind (n=14/9)
- 7 nights 7.5 h at 7200 → 10200 ft, normobaric hypoxia, SaO2 during/after night increases with study
- In 25 hours to 14100 with ≈ 16 hours at 9600 ft (over night)
- No difference between groups in ventilation at 14100 ft
- No significant effect on AMS
- **Conclusion: procedure insufficient, effect may be equalized by 16 hours continuous exposure at 9600 ft**

Fulco CS, AJP R428 – 36, 2011

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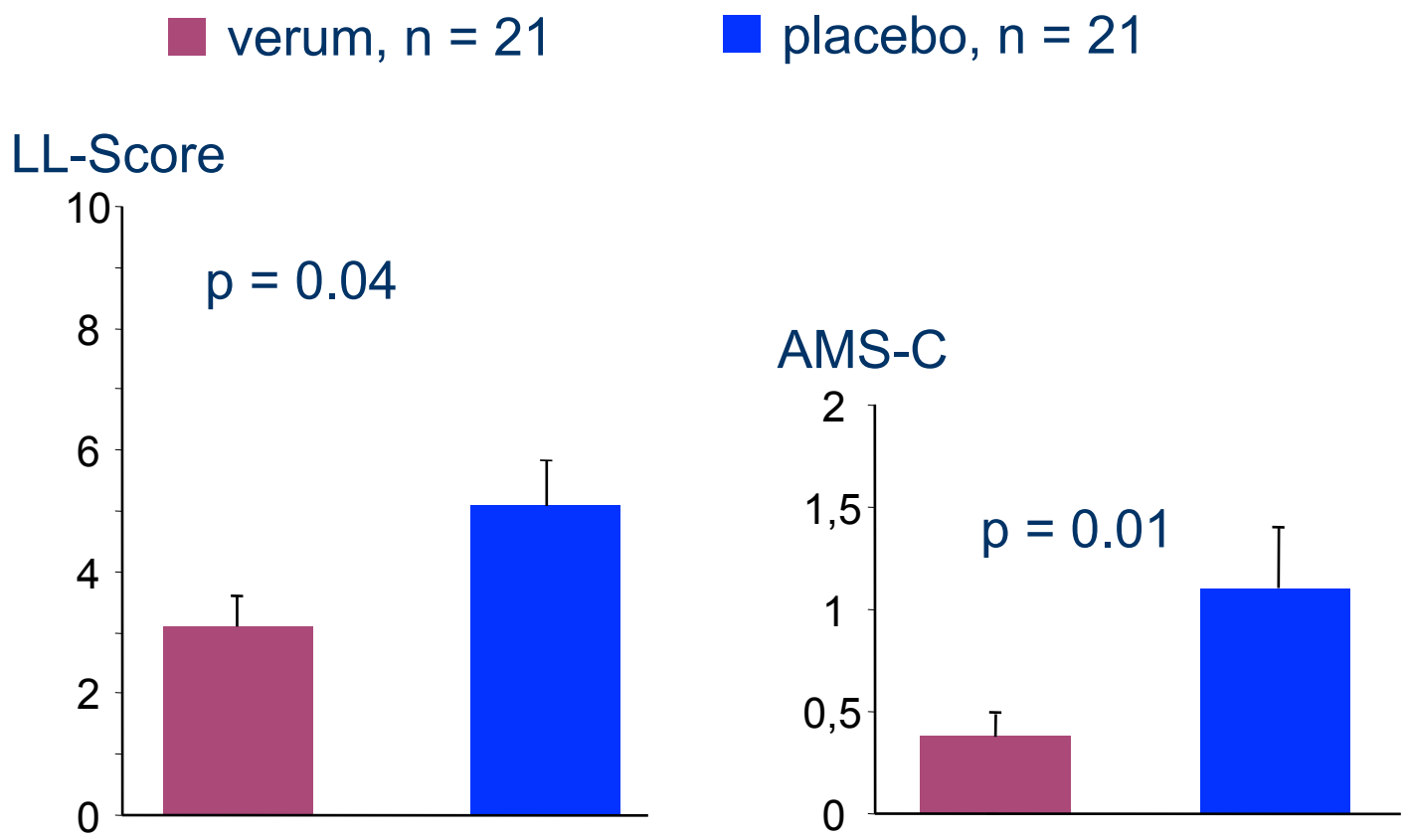
AMS in 14700 ft after 2 Weeks of Sleeping in Hypoxia Tent (average hypoxia ~8500 ft)



MW ± SEM

Dehnert C, unpublished data

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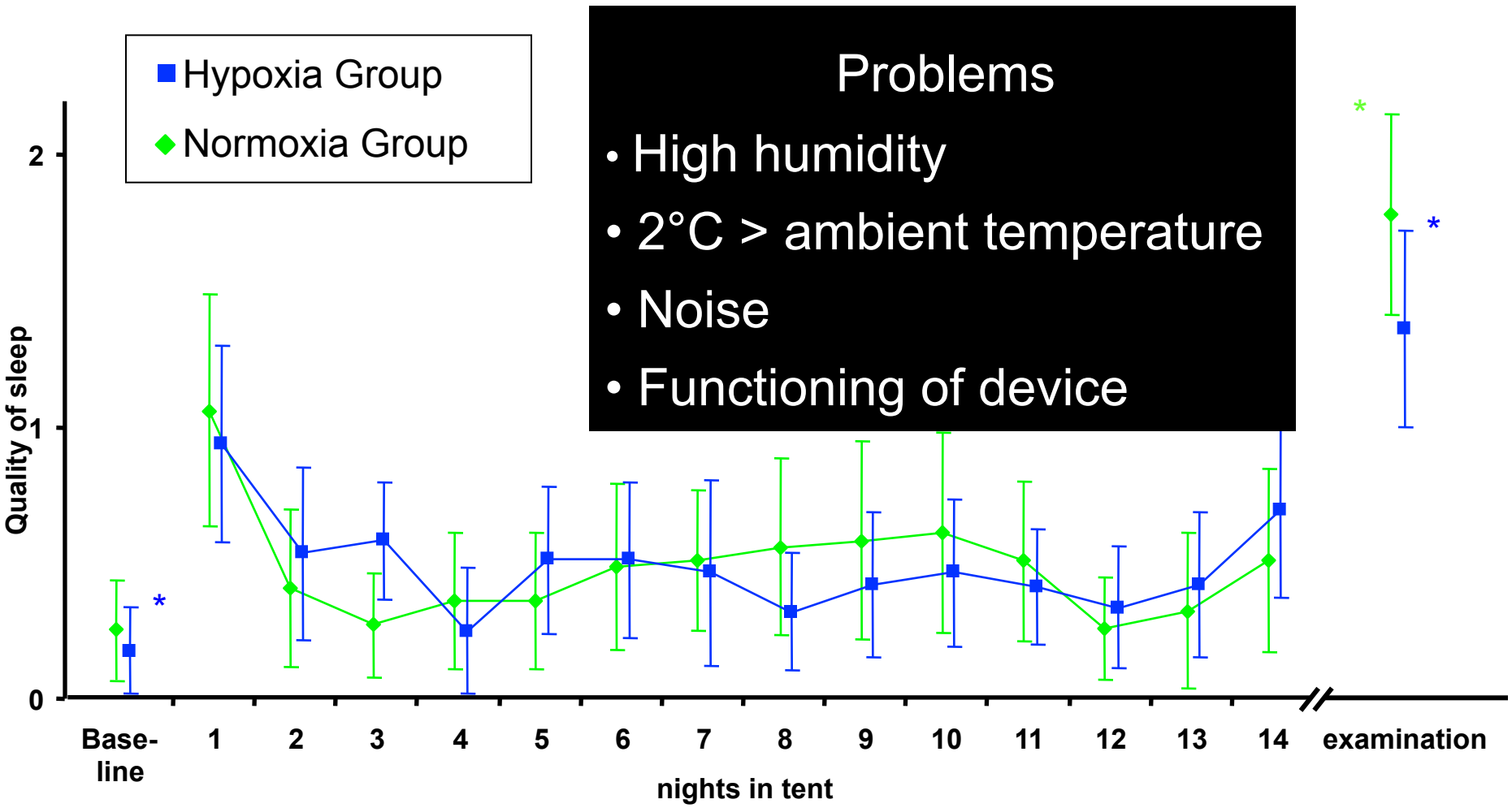
Tent Study: Quality of Sleep



Assessment of sleep at night:
0 = as usual; 1 = not so good; 2 = bad; 3 = did not sleep at all;

*** Significant difference to average value of nights 4 to 14**

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Prevention of High Altitude Illnesses

Acclimatization prior to Exposure	- Sojourning several days at intermediate altitudes at or above 6500 ft (staging) - Hiking or climbing on day tours above 8200 – 10000 ft - Combination of both
Ascent during Exposure	- Ascent rate 1000 – 1600 ft/day above 8200 – 10000 ft with a day of rest about every 4 days - Appropriate treatment of early symptoms of AMS for prevention of severe high altitude disease

Bärtsch, New Engl J Med 2013

Drugs for Prevention of AMS and HACE

- **Indication**: Moderate to high likelihood of acute high altitude illness according to risk assessment

- **Drugs:**
  - moderate risk: diamox 2 x 125 mg/day
  - high risk: diamox 2-3 x 250 mg/day
  - intolerance or contra-indication for diamox: dexamethasone 2 x 4 mg/day

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Recommendations for a safe ascent

- The individual safe ascent rate depends on degree of susceptibility and pre-acclimatization
- Physical fitness is not protective
- Trial and error situation
- Error signal: symptoms of AMS or beginning HAPE
- Day of rest with AMS
- Immediate descent when signs of beginning HACE or HAPE
- Never leave a sick person alone

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Risk Assessment for Acute High Altitude Illnesses

Low	- Slow ascent (≤ 500 m/day above 2500 m) - No history of AMS, HACE or HAPE with comparable previous exposure - Ascent > 500 m/day above 2500 m in pre-acclimatized individuals (exposure < 3000 m in preceding weeks)
Moderate	- Unknown history of AMS, HACE or HAPE and ascent > 500 m/day above 2500 m - Unknown history of AMS and ascent to over 3000 m in one day
High	- Unknown history of AMS, HACE or HAPE and very rapid ascents (considerably > 500 m/day) and final altitude > 4000 m - History of AMS, HACE or HAPE with comparable previous exposure

Altitudes given in the table refer to sleeping altitudes

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