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ACUTE MOUNTAIN SICKNESS, TWO CASES AND THEIR TREATMENT IN THE FIELD

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Abstract
Objective: The number of lowland dwellers traveling at high altitudes has greatly increased in recent decades. Business travelers flying to La Paz or Lhasa are at risk of altitude illnesses, similarly to miners and soldiers transported to high altitudes. Traveling to high altitude requires adaptation and if this process fails due to too rapid an ascent rate or susceptibility of the climber, acute mountain sickness (AMS) may result. Doctors and nurses in travel clinics, health centers and occupational health care clinics may face patients asking advice on how to plan their trips or manage AMS, or the health care personnel may take part in a travel to high altitude environment. **Methods:** Two patients, aged 29 and 47 years, who fulfilled the criteria for AMS were studied. The clinical findings and treatment in the field are described including the review of the current recommendations for prevention and treatment of AMS. **Results:** Both patients developed a severe AMS due to too rapid ascent and their denial of the symptoms. **Conclusions:** Prevention is the safest and the most efficient method in the care concerning AMS. Realizing the risk of mountain sickness, active inquiry about the symptoms and correctly timed reaction to them, in other words interrupting the ascent or descending, help to reduce and even to prevent the development of serious problems.

Key words:
High altitude, Acute mountain sickness, Altitude illness

Traveling to high altitude requires acclimatization to both lower air pressure and diminished partial pressure of oxygen [1]. If this process fails, due to too rapid ascent rate or susceptibility of the climber, one or a combination of three illnesses may result: acute mountain sickness (AMS), high altitude cerebral edema (HACE) or high altitude pulmonary edema (HAPE). AMS is the most common of these problems affecting 25% of those who ascend the altitudes of 1850 to 2750 m [2], 42 % of people at altitudes of 3000 m [1], and as many as 75% at Mount Kilimanjaro (5984 m) where the most common reason for high prevalence for AMS is the rapid ascent [3]. AMS usually develops after 1–3 days of sojourn at high altitude. If the ascent is halted, AMS usually ceases within 1–2 days, but substantial discomfort and inconvenience are still common. The Lake Louise Self-Report Score and Clinical Assessment Score Questionnaire (LLS) is widely used for the diagnosis of AMS [4]. AMS is diagnosed according to a recent gain in altitude, the presence of headaches and at least one of the following symptoms: gastrointestinal (GI) upset, fatigue, dizziness or insomnia. The symptoms and clinical findings such peripheral edema, the difficulties concerning

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walking along the straight line or standing and changes in the mental state were graded from 0 to 4, with 0 meaning no symptoms at all, 1–4 meaning mild, moderate, severe and extremely severe symptoms, respectively. A sum of the self-reported symptom points equaling 3 or above, including headache, indicated AMS (Table 1) [1].

Doctors and nurses in health centers, travel clinics and occupational health care clinics may be approached by patients asking advice on how to plan their trips or treat either themselves or a friend at high altitude, or the health care personnel may take part in an expedition to high altitude environment. In this article, we present two cases of AMS patients and their treatment in the field including the review of the current recommendations for prevention and treatment of AMS.

Table 1. Lake Louise acute mountain sickness questionnaire*

Symptom	Score
Headache	
no headache	0
mild headache	1
moderate headache	2
severe, incapacitating	3
Gastrointestinal symptoms	
no gastrointestinal symptoms	0
poor appetite or nausea	1
moderate nausea or vomiting	2
severe nausea and vomiting, incapacitating	3
Fatigue/weakness	
not tired or weak	0
mild fatigue/weakness	1
moderate fatigue/weakness	2
severe fatigue/weakness, incapacitating	3
Dizzy/light-headedness	
not dizzy	0
mild dizziness	1
moderate dizziness	2
severe, incapacitating	3
Difficulty with sleeping	
slept well as usual	0
did not sleep as well as usual	1
woke up many times, poor night's sleep	2
could not sleep at all	3
Clinical assessment	
change in mental status	
no change	0
lethargy/lassitude	1
disoriented/confused	2
stupor/semi-consciousness	3
ataxia (heel to toe walking)	
no ataxia	0
maneuvers to maintain balance	1
steps off line	2
falls down	3
cannot stand	4
peripheral edema	
no edema	0
one location	1
two or more locations	2

* An individual has acute mountain sickness as assessed by the Lake Louise self-assessment scoring system if they fulfill the following criteria: 1 – recent ascent at high altitude, 2 – headache present, 3 – the total symptom score above 3 [1,4].

CASE 1. Physical stress, dehydration and too rapid ascent

A 29-year-old, healthy, non-smoking and experienced Finnish mountaineer participated in an expedition to a mountain over 8000 m high in Tibet. It took him four days to reach the altitude of 5000 m by car and he spent three days there to acclimatize. He had no previous history of AMS. The heart rate (HR) at rest was 60 per minute and the LLS showed no altitude-related symptoms. There was a 400 m ascent to the next camp, and the distance to be covered was 15 km. The weather was first sunny and warm, later it was cloudy, and at times there was a slight snowfall. The climber drank 1900 ml of fluid during the trek. During the day, he excreted 500 ml of urine. On arrival at the campsite – at the height of 5425 m – he was accompanied by one fellow climber. He felt a little tired with a slightly slowed coordination, but the camp routines went fast.

After putting up the tent, he felt very tired and shivering cold. In the sleeping bag, his body temperature under the arm rose to 37.8°C. He consumed fluids in the form of food and drink – in total 2 400 ml. During the following night,

he did not urinate at all. On falling asleep at 8:00 p.m. his HR was 120/min and respiratory rate (RR) – 30/min. After he fell asleep, his companion soon perceived periodic breathing caused by high altitude which is similar to Cheyne-Stokes type breathing, and at 10:00 p.m., his HR rose to 130/min.

Furthermore, the shortness of breath and the feeling of compression were found in the chest. The breathing sounds were bubbling when auscultated. The arterial oxygen saturation (SpO_2) was 59%, LLS 8 and AMS and HAPE were diagnosed. 250 mg of Asetatzolamide and 20 mg of nifedipine began to be administered every eight hours and the development of the situation was monitored during the night at intervals of 1–2 hours. The subject drank 600 ml of water during the night. When the symptoms eased at 2:00 a.m., with RR 21/min and HR – 115/min, he was given permission to sleep in spite of a slight headache. In the morning, he was feeling well, except for slight faintness and headache. He excreted 750 ml of urine, his RR was 20/min, SpO_2 – 71% and HR – 105/min. At lung auscultation no sounds of edema were heard at any stage. 8 points on the LLS scale indicated moderate mountain sickness and the patient should have been treated with descent, oxygen or a portable hyperbaric chamber. At this camp, they had no oxygen treatment or evacuation facilities. They communicated via satphone with their travel clinic. According to the doctor's instructions, he stayed at this altitude because descent was not possible. After two days' rest, all symptoms disappeared, SpO_2 was 74%, HR – 95/min and he continued four kilometers on to the next camp, which was 200 m higher and had better facilities. The ascent went without problems and no further symptoms of AMS or HAPE occurred. The medication was discontinued after three nights without any problems in a 5650 m camp when his HR was 75/min, RR 18/min and SpO_2 – 85%. After this, the subject participated in the expedition normally without any restrictions.

CASE 2. Too rapid ascent and denial of the symptoms

A 47-year-old, non-smoking and experienced mountaineer, who, however, had not earlier been above the altitude of 4000 m, participated in a car drive in the highlands of Tibet. The road went to the highlands from 1500 m to a village at 2930 m, where he spent two nights to acclimatize. The next day he got a headache and did not feel well when the expedition continued the ascent. The patient did not tell anyone about his symptoms. During the following day, the road rose to 4800 m and the headache symptoms increased. Because of the headache, the patient started to take paracetamol (500 mg three times a day) as pain medication. When the doctor of the expedition talked to him, he reported that he was well and had no symptoms of AMS at all. During the following morning, the man had a severe headache, faintness and moderately strong light-headedness which impaired his co-ordination and caused ataxia. The previous night, his sleep had been extremely fragmentary and he had slept only a few hours. SpO_2 was 58% at rest, there were crackles and bubbling in the lung auscultation, HR was 110/min and LLS was 6. At this moment, AMS, HAPE and HACE were diagnosed and the following treatment was initiated: 250 mg of acetazolamide, 20 mg of nifedipine and 8 mg of dexamethason once, and then 4 mg every eight hours. Because of restricted oxygen capacity, oxygen was given to him at intervals of a couple of hours for 20 min as adjuvant care 4 l/min. The patient's urgent evacuation was necessary but since the vehicles broke down then, the evacuation was delayed by 2 days. During the day, the situation deteriorated. Based on the auscultation and percussion, it was determined that the right lung was half full and the left lung was full of fluid. SpO_2 was still 58% in spite of the treatment, the skin was extremely pale and the lips cyanotic. There was no fever. Urine excretion was at a standstill. Lake Louise score was 8. In the evening, the man's health improved a little, even though SpO_2 was still only 68%. He could not lie down because of an increase in dyspnea, so he had to spend his

night in a sitting position. During the following morning, he was relatively healthy, there was still cyanosis in the lips, but slighter. The night elapsed, while he was sitting on a chair, and he did not need additional oxygen. SpO_2 was 64% and HR – 124/min. Urine excretion started abundantly in the morning. In the lungs there was a bubbling sound on both sides, by percussion, the right lung seemed to be full of fluid. The patient's evacuation and descent was begun the following day and he was accompanied by a doctor. During transportation, HR was 125/min all the time. SpO_2 and HR returned to normal (SpO_2 – 91%, HR – 64/min) at 1500 m where breathing was trouble-free and lung auscultation produced only a slight sound from the right basal area. He still had minor ataxia and light-headedness. Acetazolamide and nifedipine were discontinued. Four weeks later, the patient was totally symptom-free and healthy.

DISCUSSION

Normally, lowland dwellers make their first ascents to high altitude via the easiest or most popular ways by using commercial tour operators. In the Himalayas, it may take 10–15 days for the trekkers to reach about 5000–6000 m. The ascent of Kilimanjaro (5984 m) usually takes five or 6 days. Some international airports like Lhasa or La Paz are even situated 3650–4058 m above the sea level. Most tour operators have experienced guides with them, but – for example – business travelers may choose to travel alone. It is important for all doctors and nurses who give health advice to travelers to have the basic knowledge of AMS. Patients may ask advice when planning a trip to highlands or mountains or health care professionals may have to cope with and treat AMS in their own patients. The medicines and treatment of AMS are presented in Table 2 and 3 [1,5,11,12].

Table 2. Recommended dosages for medications used in the prevention and treatment of altitude illness [1,5,11]

Medication	Indication	Preventive dosage	Treatment dosage
Acetazolamide	AMS, HACE	oral 125 mg twice per day	250 mg *PO* twice per day*
Dexamethasone	AMS, HACE	oral 2 mg every 6 h or 4 mg every 12 h	AMS – *PO*, *IV*, *IM*: 4 mg, every 6 h HACE: 8 mg once, then 4 mg every 6 h
Nifedipine	HAPE	oral 30 mg SR version, every 12 h or 20 mg of SR version every 8 h	oral 30 mg SR version, every 12 h or 20 mg of SR version every 8 h
Sildenafil	HAPE	oral 50 mg every 8 h	no recommendations, preventive dosage has been administered
Tadalafil	HAPE	oral 10 mg twice per day	no recommendations, preventive dosage has been administered
Salmeterol	HAPE	inhaled 125 μg twice per day	
Oxygen		usually only at > 8000 m expeditions, 2–4 l/min by mask or nasal cannulas	2–4 l/min by mask initially, then 1–2 l/min or titrate dose until SaO_2 > 90%
Portable hyperbaric chamber, Gammow bag®			depends on the model; 13–26 kPa for a minimum of 2 h; continued as long as necessary
Descent	AMS, HACE, HAPE	to ascend only 300–600 m per day and to have an acclimatization day for every 1000 m of the altitude gained	500 m at least, in mild cases stop, rest and acclimatize 1–2 days

AMS – acute mountain sickness, HACE – high altitude cerebral edema, HAPE – high altitude pulmonary edema, SR – sustained release. *PO* – per os, *IV* – intravenous, *IM* – intramuscular.
* 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.

Table 3. Treatment of altitude illness [based on 11]

Illness	Treatment
Mild AMS	stop, rest and acclimatize 1–2 days, consider descent
	painkiller medicine (Paracetamol, Ibuprofen)
	antiemetics may be useful (metoclopramid)
	acetazolamide if needed
Severe AMS and/or HACE	descent, oxygen, evacuation
	dexamethason
	pressure bag if immediate descent is not possible
HAPE	descent, oxygen, evacuation
	nifedipine
	pressure bag if immediate descent is not possible
Severe AMS that cannot type for HAPE or HACE	descent, oxygen, evacuation
	dexamethason
	nifedipine
	pressure bag if immediate descent is not possible

Abbreviations as in Table 2.

When climbing the altitudes over 3000 m, the current recommendations are to ascend only 300–600 m per day and to have an acclimatization day for every 600–1200 m of altitude gained [1,5], so that the body can adapt to the altitude. In practice, travelers and climbers usually ascend considerably faster than commended [3]. Slight symptoms of AMS may become more serious if the symptoms and warning signs are ignored. Continuing the ascent may lead to HAPE or HACE, which are life-threatening conditions. There have been HAPE cases at 1400–2400 m even though, usually, these problems are found at altitudes over 2500 m [6]. The symptoms may increase throughout a few hours and the patient may no longer be capable of descending himself.

During the ascent, one of the most important actions to avoid mountain sickness is to have sufficient food and drink intake [7]. Lack of oxygen causes hyperventilation, and thus dehydration increases while breathing [8]. The adequate amount of fluid at high altitude is not precisely defined, but 5–7 l of fluids per day are usually consumed. Often, the trip is made in a hygiene environment different from the travelers' country of origin and diarrhea and vomiting may disturb the fluid and energy balance of the body [8]. Lack of oxygen makes logical thinking more difficult, which may predispose one to serious miscalculations [9]. Young healthy males are often at the greatest risks of AMS as they may ascend too fast too high because of their good physical condition. Physically heavy exertions, such as downhill skiing or climbing, are often begun before the body has had time to adapt at certain altitude [10]. Traveling in groups gives extra security, but in some cases there may occur an unwise competitive spirit. In a group, the objective analysis and reporting of the climber's own feelings may be forgotten and problems can accumulate when the climbers continue upwards. Tight schedules are also dangerous. It would be good to include in the schedules extra days for rest and adaptation.

Prevention is the safest and the most efficient method in the care of AMS. The symptoms may not be easily noticed, and thus curative measures may be delayed. Remedying the situation requires radical actions such as interrupting

the ascent, descending, patient evacuation etc. The possibilities for medical treatment are limited and a portable pressure chamber and administering additional oxygen bring only temporary relief [11,12]. Realizing the risk of AMS, making realistic and safe ascent plans, active elicitation of symptoms and timely reaction to them, in other words, discontinuing the ascent or descending help to reduce and even to prevent the development of serious problems.

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