Letters to the Editor

Controlled Hyperventilation After Training May Accelerate Altitude Acclimatization

To the Editor:

On January 28, 2014, a group of 26 trekkers (aged 29 to 65 years), under the supervision of the authors, ascended one of the world's highest mountains (Mt. Kilimanjaro, 5895 m) in 48 hours (Figure 1). While doing so, the group appears to have broken new medical ground, utilizing a new method to largely prevent, and as needed, reverse, symptoms of acute mountain sickness (AMS).

Seemingly an unlikely group of people for such a feat, the group consisted of nonathletes with little or no prior climbing experience, inhabitants of low altitudes, some with typically handicapping diagnoses such as multiple sclerosis, rheumatoid arthritis, and metastasized cancer. The team was predicted by mountaineering experts to fail owing to those demographics. It was assessed at the highest risk for exhaustion and altitude sickness due to very rapid ascent (>500 m per day), high final altitude (>4000 m), and unknown history of AMS (according to a recent literature review).[1]

To offset these significant disadvantages, the group received special training, including mindset coaching, cold exposure, and breathing technique practice, as previously described and currently under investigation by the authors.[2] The trekkers used breathing techniques (permanent controlled hyperventilation aimed at keeping oxygen saturation (Spo_2) greater than 90% during the ascent both prophylactically and therapeutically. At regular intervals, all trekkers participated in 30-minute breathing sessions, filled out a safety checklist based on the Lake Louis Scoring System (LLSS [Figure 2]) with a "buddy," and were examined by the medical doctor.[3]

The results were remarkable. First, the ascent is typically completed by 61% of trekkers and takes 4 to 7 days.[4] Of our group, 92% completed the ascent (2 had to stop at 5681 m). Second, the group reached the summit (5895 m) in only 48 hours. Third, none of the trekkers had severe AMS following the LLSS nor reported symptoms of hypocapnia due to the hyperventilation. None had used any method of prevention other than the training and techniques described above.[3,4] The LLSS remained 4 or less for 22 trekkers (mild AMS). Four had an LLSS of 5 or 6 (moderate AMS) at 1 check-up, and the LLSS decreased to 4 or less after a 30-minute breathing session. Two had clinical signs of physical/respiratory exhaustion at 5681 m, which resolved after 15 minutes of oxygenation (12 L/min) and descent; of whom one had transient mild hypothermia, and a third had suspected mild high-altitude pulmonary edema (LLSS 5, pulse 97 beats/min,

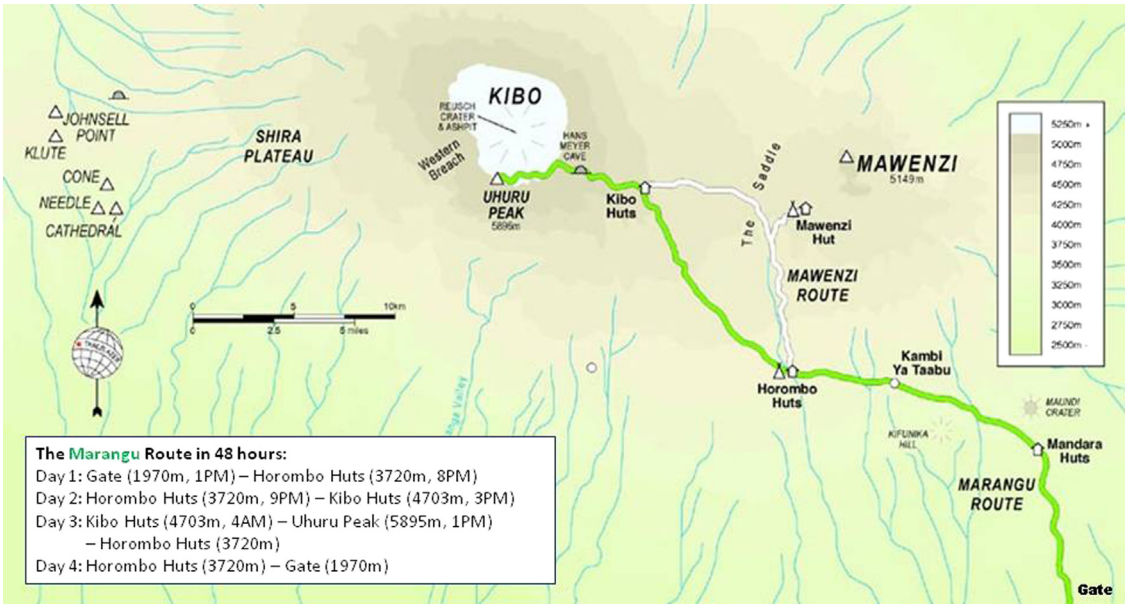

Figure 1. Map of the Marangu route showing ascent versus time.

Spo_2 73%, respiratory rate 18 breaths/min, frothy sputum, but absence of crepitations on auscultation of the lungs) upon descent to a rest camp (3760 m), and it resolved within 3 hours after oral administration of nifedipine 30 mg.

The technique used by the trekkers is named the Wim Hof method, after the inventor who has been inspired by Tummo meditation. First, by intense mindset coaching, one can gain more confidence in one's physical potential and is continuously challenged to push physical boundaries and improve health control. Second, decreasing pCO_2 by controlled hyperventilation can stimulate this process as it improves endurance and enhances perceived energy levels. Third, generation of body heat during

Conquer Your Challenges - Safety Checklist

Name of Climber:	
Time:	
Altitude (m):	
Oxygen saturation (%):	
Pulse (beats/min):	
Body temperature (^oC):	
Symptoms:	
1.Headache:	
No headache 0	
Mild headache 1	
Moderate headache 2	
Severe, incapacitating 3	
2.GI:	
No GI symptoms 0	
Poor appetite or nausea 1	
Moderate nausea or vomiting 2	
Severe N&V, incapacitating 3	
3.Fatigue/weak:	
Not tired or weak 0	
Mild fatigue/weakness 1	
Moderate fatigue/weakness 2	
Severe F/W, incapacitating 3	
4.Dizzy/lightheaded:	
Not dizzy 0	
Mild dizziness 1	
Moderate dizziness 2	
Severe, incapacitating 3	
5.Difficulty sleeping:	
Slept 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	
Clinical (Buddy) Assessment:	
6.Change in mental status:	
No change 0	
Lethargy/lassitude 1	
Disoriented/confused 2	
Stupor/semiconsciousness 3	
7.Ataxia(heel to toe walking):	
No ataxia 0	
Maneuvers to maintain balance 1	
Steps off line 2	
Falls down 3	
Can't stand 4	
8.Peripheral edema:	
No edema 0	
One location 1	
Two or more locations 2	
Total Lake Louise Criteria Score:	
Mild AMS: score of <4 Moderate AMS: score of 5-6 (stop further ascent)	
Severe AMS: score of 7 or more (descent)	

Figure 2. The Acute Mountain Sickness Safety Checklist. AMS, acute mountain sickness; GI, gastrointestinal; F/W, fatigue/weakness; N&V, nausea and vomiting.

gradual cold exposure using breathing techniques is one of the fundamental exercises of the method (Tummo). The method seems to have a direct biological effect on the autonomic nervous system, and warrants further investigation.[2]

The exact pathophysiology of AMS remains unclear. In the authors' opinion, the severity and duration of hypobaric hypoxia play a key role. The remarkable results are most likely explained by the continuous controlled hyperventilation reducing hypoxia severity. However, the resultant state of respiratory alkalosis may cause symptoms such as dizziness and visual disturbances. The fact that none of the trekkers experienced such symptoms is most likely due to the long-term training.

In comparison with previous studies,[4,5] this report may suggest that acclimatization, as well as AMS symptom relief, can be safely accelerated. Based on previous data, it was expected that the majority of our group would experience severe AMS. All 26 trekkers had symptoms of AMS to some extent, but even without prophylaxis, none had severe AMS. Even though we discourage (very) rapid ascent because of potentially lethal risks, we consider these outcomes of potentially great relevance for the prevention and treatment of AMS, as well as for rescue teams needing to ascend fast with little time for acclimatization. Further research is warranted to expand or revise our understanding of the physiology and treatment of these conditions.

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Symptoms and Treatment of Acute Conjunctivitis Caused by Skin Secretions of Veined Tree Frog (*Trachycephalus Venulosus*)

To the Editor:

We would like to describe our experience of treating a case of acute toxic conjunctivitis caused by a veined tree frog (*Trachycephalus venulosus*), which to our knowledge, has not been previously documented in the medical literature.

A 22-year-old, previously healthy man with no known allergies and not taking any daily medicines, was working on a conservation project in Mexico. His job was to examine and record the different amphibian and reptile species as well as their characteristics. To protect the sensitive fauna against the potentially harmful effects of human contact, the herpetologist did not apply any insect repellent or other chemical substance to his hands or forearms while handling the specimens. On a scheduled daytime trek, the herpetologist captured a veined tree frog (*Trachycephalus venulosus*) and made detailed measurements of the amphibian, including weight and length, during which the herpetologist directly handled the frog without wearing protective gloves. Once measurements were completed, the frog was released unharmed.

Immediately after the release (without washing or wiping his hands), the patient brushed a mosquito off his forehead. One minute later, as sweat ran from his forehead to his eyes, he began to feel an intense burning sensation, more dominantly in the right eye. The pain increased to a maximal level in 2 minutes. It was described as a very intense, burning, sharp pain, localized exclusively to the eyes. The pain was so severe that the patient had difficulty opening his eyes, although his sight was not affected. He immediately tried to wash his eyes with available drinking water. He used approximately 1 liter of water, but because of the pain, still could not open his eyes and primarily washed his eyelids and face. Because his symptoms did not improve, he was escorted with the help of his colleagues back to the field camp for medical assistance.

Upon arrival to the camp, the patient continued to have severe ocular pain. He described a continuous sharp, burning, intensive pain localized to both eyes.