

Swiss High Altitude Medical Research Muztagh Ata 12 June 2005 – 18 July 2005

Pulmonary Research

The team consisted of four pulmonologists: Prof. Konrad Bloch, Dr. Alexander Turk, Dr. Thomas Hess, and Dr. Otto Schoch. Our aim was to investigate the mechanisms of cardio-pulmonary acclimatization in healthy climbers during an ascent to Muztagh Ata (7546m) in Western China. In particular, physiologic adaptation was compared among two groups ascending with different rates. The results are expected to provide a scientific basis for recommendations on altitude acclimatization, and prevention of altitude related illness. In addition, the observations may provide insight into physiologic mechanisms of physical impairment in patients with various cardiac and pulmonary diseases.



Pulmonary research team on Muztagh Ata. Left to right: Konrad Bloch, Alexander Turk, Otto Schoch, Thomas Hess

1. Clinical evaluation of acute mountain sickness

Daily assessment comprised a questionnaire evaluation, a physical examination focusing on signs of high altitude sickness, and measurement of the arterial oxygen saturation by pulse oxymetry (Onyx® 9500, Nonin, USA).



Participant Brigitte Kröni measuring the arterial oxygen saturation with a finger probe

2. Assessment of lung function

By using a portable ultrasound transit time flowmeter that provides accurate estimates of airflow and dynamic lung volumes even during extreme changes in ambient pressure and temperature (EasyOne, ndd Medizintechnik AG, Zürich) we performed daily spirometry in the base camp (4500m), camp one to three (5500m, 6300m and 6800m) and on the summit (7546m). Changes in spirometry may give clues to identify exercise and cold air induced airflow obstruction and subclinical fluid accumulation in the lungs (high altitude pulmonary edema, HAPE).



Participant Hans Spring performing a spirometry at 6200m

3. Cardiopulmonary exercise testing

Participants performed incremental bicycle exercise tests to exhaustion before departure, and 2 to 3 times (group 1 and 2, respectively) over the course of the expedition. The results will demonstrate the effects of altitude adaptation on maximal work capacity, oxygen consumption, breathing pattern and heart rate. At camp 1 (5500m) the tests were performed in a tent using high performance bicycle ergometers and a metabolic unit (ZAN, Oberthulba, Germany).



Participant Laurent Koglin performing a cycle cardiopulmonary exercise test in a tent at 5500m

4. Monitoring of breathing patterns, arterieal oxygen saturation and heart rate

The goal was to examine breathing patterns during typical activities of mountaineers during the ascent on skis, and over the nights while sleeping in a tent at various altitudes. A special snugly fitting elastic body garment (LifeShirt) incorporating sensors for monitoring of lung volume changes, along with the electrical activity of the heart (ECG), and arterial oxygen saturation by a finger probe was connected to a miniaturized data processing and recording unit which was the size of a palm top computer (LifeShirt Monitor, Vivometrics, USA). This device allowed breath by breath analysis of breathing patterns over the course of acclimatization. Analysis of this physiologic data in correlation to symptoms and physical signs will provide insight into determinants of mountain sickness in the two groups ascending at different rates.



Participant Stefan Wüthrich wearing the LifeShirt during ascent to 6800m