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Title: Breathing patterns in mountaineers climbing to extreme altitude (7546m)

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Body: Background We investigated breathing patterns and oxygenation in mountaineers climbing to extreme altitude to evaluate effects of hypoxemia and acclimatization. Methods In 34 mountaineers (mean age 45y, 7 women) portable recordings of respiratory inductive plethysmography, pulse oximetry and ECG were performed during a climb to the summit of Muztagh Ata, China (7546m). Breath by breath ventilation was analyzed and periodic breathing quantified by spectral analysis. Results Repeated recordings during 2 climbs from 4497-5533m within 5-8 days revealed an increase in oxygen saturation and periodic breathing and a decrease in heart rate (table). During the climb from 6865-7546m hypoxemia was pronounced. Conclusions Mountaineers were able to climb to extreme altitude despite severe hypoxemia. The heart rate reserve was utilized to a greater extent than the ventilatory reserve. With acclimatization, periodic breathing increased despite a higher oxygen saturation, consistent with a persistently high ventilatory drive while the heart rate reduction suggested a decrease in sympathetic tone.

Physiologic adaptation during ascent to 7546m

	Climbs from 4497-5533m	Climb from 6865-7546m

	day 4 n=33	days 9-12 n=32	days 17-19 n=19
Oxygen saturation, %	73±4	77±4*	68±3**
Minute ventilation, L/min	33.1±8.1	35.3±7.5	31.1±9.6
Minute ventilation, %MVV	25±11	24±11	22±8
Mean inspiratory flow, L/min	1.1±0.3	1.2±0.3*	1.1±0.3
Power of periodic breathing, arbitrary units	0.6±0.1	0.7±0.1*	0.6±0.1
heart rate, 1/min	122±15	112±14	122±11**
Heart rate, %HRmax	85±13	80±12*	86±9**

Means±SD during 6-8h climbs;*P<0.05 vs day 4;**P<0.05 vs 4497m, day 9-12; MVV=40*FEV1 at corresponding altitude; %HRmax=% of heart rate during maximal exercise at 5533m (Latshang 2011)