
SHORT COMMUNICATION

Cardiovascular Changes During Sudden Ascent in a Cable Cabin to the Moderate Altitude

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Summary

Our aim was to test the hypothesis that the occurrence of extrasystoles in higher decennia is proportional to the altitude. The occurrence of supraventricular (SVPB) and ventricular (VEB) extrasystoles, values of systolic and diastolic blood pressure and the heart rate were studied in 20 healthy elderly men (50-64 years) during cable cabin transportation to a moderate altitude. These values were measured in stations located at 898 m, 1764 m, and 2632 m above sea level during the transportation in both directions. Our records show that the values of blood pressure and heart rate were within normal limits during the whole period of transportation. Both SVPB and VEB were increasing during the ascent and decreasing to the initial values during the descent compared to the values at altitude of 898 m. The highest values (6 to 7-times exceeding the initial ones) were measured at the summit. The results have demonstrated that the occurrence of SVPB and VEB is proportional to the altitude. The increased incidence in the number of extrasystoles is suggested to be mediated by beta-adrenoceptors.

Key words

Electrocardiography • Holter monitoring • Arrhythmias • Blood pressure • Altitude hypoxia

The moderate altitude (1000 to 3000 m above sea level) causes hypoxic (altitude) hypoxia stimulating the respiratory and cardiovascular system, and induces hematological changes (Henry and Meehan 1971. Minors 1994). In our previous paper (Kujaník et al. 2000) we found that a moderate altitude had increased the occurrence of cardiac arrhythmias in healthy elderly men compared to a lowland. The aim of our study was to test the hypothesis that the number of extrasystoles in healthy subjects at moderate altitude in higher decennia is proportional to the altitude.

Twenty healthy non-acclimatized men (age 50-64 years), without history of any cardiovascular or chronic respiratory diseases (proved by a negative preventive examination, including ECG, at the general practitioner's office) were followed in our study. Their physiological findings were assessed during auscultation of the heart and lungs, the blood pressure on the brachial artery under 150/90 mm Hg (= 20/12 kPa) before the ascent, without drugs. They permanently lived at an altitude under 800 m. The heart rate (HR), systolic and diastolic blood pressures (BP), and the occurrence of

supraventricular (SVPB) and ventricular (VEB) extrasystoles were measured. The ECG was recorded continually (Memoport C Hellige) during passive cable cabin transport by 1734 m. The number of extrasystoles

per 10 min was evaluated at 5 stations. The measured data were compared with those at the start (898 m above sea level, for details see Table 1) evaluated by the paired t-test.

Table 1. Cardiovascular parameters during cable cabin transport in healthy elderly men.

Parameter	Tatranské Lomnica	Skalnaté pleso	Lomnický štít	Skalnaté pleso	Tatranská Lomnica
	Start	Upward	Top	Downward	End
Altitude	898 m	1764 m	2632 m	1764 m	898 m
Systolic BP [kPa]	17.45 ±2.45	17.97 ±2.70 P<0.006	17.81 ±3.01	17.84 ±2.87	17.42 ±2.68
Diastolic BP [kPa]	11.61 ±1.51	11.84 ±1.51	11.59 ±1.47	11.97 ±1.47	11.45 ±1.47
Heart rate [min ⁻¹]	69.9 ±9.06	67.4 ±8.51	71.9 ±7.75	72.9 ±8.44	70.6 ±5.81
VEB per 10 min	2.8 ±6.36	8.35 ±13.26 P<0.05	17.84 ±22.67 P<0.001	8.05 ±8.09 P<0.001	3.45 ±5.44
SVPB per 10 min	0	0.06 ±0.22	0.4 ±0.49	0.15 ±0.67	0

Mean ± S.D., n = 20, paired t-test (compared to initial values at the start), BP – blood pressure.

All average values of BP and HR were within the normal range. SVPB and VEB were proportional to the altitude, they increased during the ascent and decreased during the descent (Table 1). One of our subjects (excluded later from the evaluation), who did not admit his cardiac ischemia, had one short episode of ventricular tachycardia recorded at 2632 m.

Our results during cable cabin transport correlate with those of Dukát *et al.* (1988) and of Savonitto *et al.* (1991). Generally, passive cable cabin transport at moderate altitude increases the SVPB and VEB occurrence but does not substantially alter hemodynamic functions and cardiovascular hormone levels.

The main action of moderate altitude is that it leads to the normocapnic (altitude) generalized hypoxia. It provokes the development of cardiac electrical heterogeneity and conduction delay which may predispose cardiac tissue to reentrant arrhythmias

(Hayashi *et al.* 1997). Increased sympathetic activity produced by hypoxia stimulates the alpha- and beta-receptors. Beta-adrenergic stimulation is arrhythmogenic, it elevates the intracellular level of calcium and causes the delayed afterdepolarization (Aronson 1991). The sympathetic stimulation causes cardiac conduction disturbances and the occurrence of ventricular ectopic beats (Henry and Meehan 1971). The ventricular ectopy is facilitated in hypoxic patients. The application of oxygen decreases the ectopy, normalizes the ST segment depression and shortens the QTc interval (Tirlapur and Mir 1982).

The heart is a heterogenic excitatory system already under physiological conditions and it can react by dysrhythmia under altered conditions (including hypoxia). The target structure for arrhythmogenic influences probably involves the functional alteration of ionic channels. The incidence of dysrhythmias can be

facilitated, if an elderly man ascending to the moderate altitude is suffering from some cardiovascular or respiratory disease and is under ascertain physical or psychological stress.

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Reprint requests

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