

ERYTHROCYTE SHAPES AND PEROXIDATION DURING HIGH ALTITUDE ADAPTATION ON TIEN-SHAN-PAMIR REGION

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ABSTRACT

Immigrants (adults) and aborigens (adults, new-borns, children) of several Tien-Shan-Pamir zones have been studied. Stomatocytes and degenerative forms are increased 2-3-fold in immigrants of the Internal Tien-Shan zone, with a simultaneous peroxide stimulation in erythrocyte membranes. (Acta Andina 1996, 5:57-60)

Key words: Pamir-Shan mountains, immigrants, erythrocyte membranes, adaptation.

RESUMEN

Fueron examinados los inmigrantes (adultos) y los aborígenes (adultos, niños y recién nacidos) en unas zonas de la región de Tian-Shan y Pamir. Fue registrado un crecimiento considerable (en 2-3 veces) de los estomatocitos y de las formas degenerativas en las células de los inmigrantes que viven en la región de Tian-Shan Interno, con la estimulación paralela de los procesos de peróxido en las membranas de los eritrocitos. (Acta Andina 1996. 5:57-60)

Palabras claves: Pamir-Shan, inmigrantes, membrana eritrocitaria, adaptación.

Introduction

There is little knowledge of the cellular membrane mechanisms of adaptation in alpine zones. Erythrocytes suitable object for this research. The complex geographical-ecological ranking made previously (Khodjamberdiev et al., 1994) is used in this work.

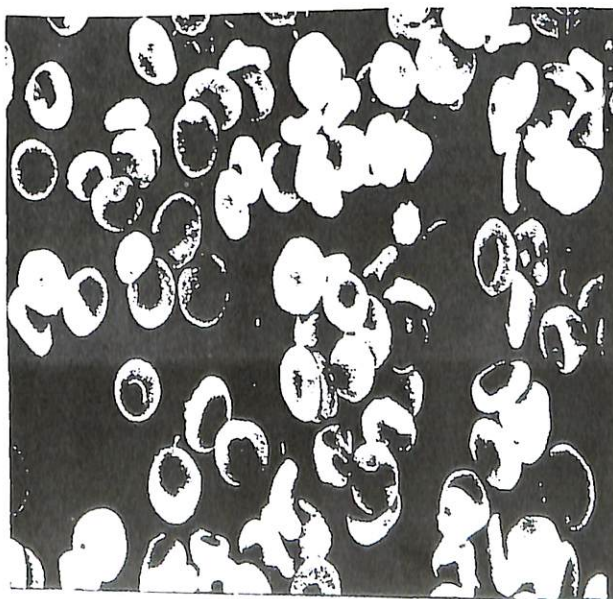
Material and Methods

Aborigin-mountaineers (adults, newborns, children) and immigrants (adults) of several Tien-Shan-Pamir zones have been studied. One group of anaemic child-mountaineers has been added. Erythrocytes have been examined: 1) for shape - by scanning electron microscopy, SEM, (glutaraldehyde-fixed and dehydrated with "critical point" apparatus) at 20 kv in JEOL (Dewar, 1982) and sometimes by phase-contrast wet drop microscopy, 2) for membrane characteristic - by transmission electron microscopy (glutaraldehyde-OsO₄-fixation, epon-araldyt for hardening, ultramicrotomy) in JEM-100, 3) for membrane elasticity - by the microcapillary technique (parallel using 3uk and 7uk), 4) for lipid structure of membrane by thin layer chromatography of lipid fraction, previously purified membranes 5) for lipoperoxide processes by luminol dependent hemiluminescence, by malonyldialdehyde estimation., 6) for antiperoxide

antiperoxide (antiradical) processes membranes by superoxydismutase activity (adrenochrome method), 7) for peroxide substrate by free fatty acids estimation (with Rhodamine 6G), 8) for energetic of erythrocyte by ATP content in erythrocyte cytoplasm (Boehringer Chemicals, with HAD/HAD H).

Results

We calculated percent of different forms per 1 thousand cells (by Bessis classification) in SEM pictures. In samples from immigrants there were many spherocytes and planocytes (photo 1).



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We found some "lumbar" forms of cells, in immigrants and in children-mountaineers with iron deficient anaemia, especially. There are wider fluctuations of microcytes-macrocytes variation in newborn mountaineers. Sometimes we found cytoplasmic ponticuli among erythrocytes forming adhesion groups in immigrants and newborn, child mountaineers. Membrane loosening and exfoliation were present in immigrants.

The prevailing tendency in the erythrocyte peroxide system of mountaineers and immigrants is of higher levels (in both peroxid and antiradical systems in membranes). But if altitude factors are complicated with iron deficient anaemia in children, peroxide levels rise moderately.

The most visible damaging effect on the erythrocyte shape and chemistry was observed (table 1) in samples from the hazard climate part of Tien-Shan-

Pamir (if geographical region are compared), and in immigrants in the initial stage of adaptation (if human groups are compared).

Discussion

We suppose that there are two stages in the immigrants high altitude adaptation. First stage, "emergency", with two variants, with a physiological one percent of abnormal erythrocytes and filterability sharply increases, due to membrane peroxide rise. With a pathological one - hemolysis occurs. The second stage, stabilization, (after the first stage by the physiological variant) is characterized by moderate increase of echinocyte levels and partly reversed filterability due to inert membrane lipid concentration rise ("biomechanic balance system" autonomic mechanism (khodzhamberdiev, 1994).

Table 1. Erythrocyte shapes and chemistry in adult persons after the first week of altitude adaptation

Physico geographic region	Middle asian desert plain country	Country of middle-asian mountains		
		Province of North and Central Tien-Shan	Mountain province of Tien- Shan sirts	Mountain province of Pamir sirts
Ecology rank	I	II	IV	IV
Observation point, m. above sea level	740	2,200	3,100	3,300
Echinocytes I, %	9.1	9.4	10.0	12.6*
Echinocytes II, %	3.3	2.3	13.9	8.1*
Stomatocytes and degenerated forms, %	1.67	3.1*	7.18*	6.37*
ATP, nmol/ml	640	628	467*	434*
FFA, nmol/mg protein	16.2	25.3*	31.0*	46.1*
Cholesterol/phospholipid	0.86	0.96	0.62*	0.72*
MDA, nmol/g Hb	26.8	22.0	31.2*	33.1*

FFA: Free fatty acids; MDA - malonildialdehyde; (*): a statistically significant difference from a control plain group.

Our results suggest the use of the morphological criteria as the most constant and adequate indicator for diagnosis of adaptation-cost, specially if it is complicated by geochemical anemia.

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