

On the Pathogenesis of Atherosclerosis: The Role of the Blood Temperature, Phase Transitions of Lipoproteins and Turbulence of the Blood Flow

A. I. Ibraimov

*Laboratory of Human Genetics, National Center of Cardiology and Internal Medicine,
Togolok Moldo str. 3, Bishkek, 720040, Kyrgyzstan, C.I.S.
Fax: + (996 312) 66-03-87' E-mail: ibraimov_1@msn.com*

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ABSTRACT The natural history of atherosclerosis is considered at present to be a strictly biological process. We call into question the existing views asserting that: (a) the blood temperature in the left heart and the right heart should always be equal although no one and nowhere has specially checked such a possibility; (b) a high content of atherogenous substances in plasma is a sufficient and necessary condition for development of common forms of atherosclerosis. We believe that some physical processes such as: (a) local blood temperature drop; (b) phase transition of lipoproteins and fibrous elements in plasma from “liquid” to “solid” state, and (c) turbulence of the blood flow in a small section at the beginning of systemic circulation: aorta, coronary and cerebral arteries, are of major importance in the development of common forms of the atherosclerosis. The core idea is based on the following prerequisites: 1) man was and remains the only tropical biological species whose ancestors, with the exception of the last 30 000-50 000 years, lived permanently under the conditions of a tropical climate; 2) the atherosclerotic process can develop into a pathology under conditions different from the climate of tropics, i.e., there where man breaths cold air during a definite period of the day or year; 3) the frequency and severity of the atherosclerotic process increase as the geographical latitude and altitude above sea-level increase; 4) the possible cause of the deposition of “fatty streaks” in vascular walls is blood cooling after pulmonary circulation; 5) the first and greatest portion of cooled blood first enters into the aorta and then into coronary and carotid arteries and so on; 6) a possible role of a brief lowering of the arterial blood temperature in the short section at the beginning of systemic circulation (where atherosclerotic plaques are most frequently formed) after inhaling cold air, and related to it phase transition of atherogenous substances in plasma from “liquid” to “solid” state; 7) in the process of breathing with cold ambient air the arterial blood temperature in the initial section of the beginning of systemic circulation (in the lung capillaries, the vein, the left heart, coronary vessels and aorta) may drop by tenths and hundredths of a degree Celsius, which is sufficient for making phase transition of atherogenous lipids from “liquid” to “solid” state irrespective of their concentration in the plasma; 8) the “atherogenic” effects of cooled blood should be, for thermophysical and hydrodynamic reasons, most pronounced in those vascular areas where prevails turbulent and not laminar blood flow, in other words, where there are bifurcations and branching, and in the heart contraction of ventricular muscles also creates regular squeezing of the coronary vessel lumen. Atherosclerosis as a pathological process is a consequence of a successful adaptation of a certain part of modern man to the temperate and cold climatic conditions of the northern and southern hemisphere of the Earth.