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EXPERT OPINION

Atherosclerosis across 4000 years of human history: the HORUS study of four ancient populations

A report based on presentations delivered by Professor **Dr John Harold**, Immediate Past President, American College of Cardiology

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Summary
Traditionally, atherosclerosis is considered to be a disease of modern human beings, which is caused by the combined action of many negative factors from today's environment on the body. Nevertheless, as it was shown in an American study of four ancient populations of different geographical locations and lifestyles, the prevalence of atherosclerosis in our ancestors was also quite high.

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When did mankind first face with atherosclerosis in the long history of its development? Whether this disease is caused by lifestyle, organism aging, or any other reason? These and other issues for many years have been interested not only to cardiologists, but to other specialists. On the background of doubling life expectancy in developed countries in the period from 8 to 10 centuries, atherosclerotic lesions of vessels displaced infectious diseases as the leading cause of mortality. In this regard, for a long time in the scientific community there was a view that the onset of atherosclerosis was associated primarily with the influence of environmental factors. Consequently, simulation of pre-industrial and even before agricultural lifestyles allows the modern mankind to avoid if not atherosclerosis, but its clinical manifestations.

In the ancient human societies who lived in very dry, hot or cold climates there was a tradition of mummification of the dead independently of each other. Thus, the various pre-industrial cultures created to modern scientists all conditions for a natural experiment, which was to examine the well-preserved mummies by computed tomography (CT) for the presence of atherosclerotic lesions in the vascular system. Such lesions in the form of calcium salt deposits are a typical feature of mature atherosclerotic plaques and perfectly visible on CT images.

Pronounced signs of atherosclerosis found at autopsy of several Egyptian mummies of 18th dynasty (1550-1292 BC), were mentioned in 1911 by Sir Mark Armand Ruffer, who is the founder of the Egyptian paleopathology. The results of his work published in the Pathology and Bacteriology journal, indicate the presence of foci of calcification in the aorta, which were identified by direct examination of mummies.

Ancient Egyptians knew quite a lot about heart and vascular diseases. The Ebers Papyrus (1555 BC), which is a kind of ancient Egyptian medical encyclopedia, provides, perhaps, the very first in general in the history of cardiology and mankind description of myocardial infarction: «If thou examinst a man for illness in his cardia, and he has pains in his arms, in his breast and on one side of his cardia...it is death threatening him...».

It is believed, however, that particular culture and lifestyle played a special role in the predisposition to the development of atherosclerosis in ancient Egypt. Besides, mummification was distributed mainly among people of high socio-economic status, which also reflected on their life experiences and risk factors.

In this context, a group of US experts led by Professors Randall C. Thompson and Gregory Thomas Gregory S. Thomas conducted a study of four ancient populations that lived in various climatic and geographical areas in the time interval of 4000 years. The results of the HORUS (named after the Egyptian god Horus) study were published in the Lancet in March 2013 [1]. The purpose of the study was to examine the prevalence of atherosclerosis among ancient cultures of different geographical and temporal residence.

Using CT scan of the whole body, experts studied 137 mummies from completely different geographical regions. Only mummies in good condition and presumably belonged to adults were selected for this study. 76 Egyptian mummies (pre-dynastic era, around 3100 BC) were obtained for the study from the *Egyptian Museum of Antiquities* in Cairo, the *Bowers Museum* in California, and the *Nelson-Atkins Museum of Art* (Missouri, USA). Mummies of ancient Peruvians (51 bodies), who lived on the territory of modern South America, gave the *Museo de Sitio Arturo Jiménez Borja – Puruchuco* (Lima, Peru), situated very high in the mountains, which contributes to the conservation of natural bodies. Peruvian tradition of burying their dead in a sitting position in bags also contributed to the preservation of tissues.

5 Unangan mummies (Aleuts, lived on the volcanic Kagamil Island, which is located in the Bering Sea, not far from modern Siberia) were obtained from the *National Museum of Natural History* (Washington, USA). Mummies of the Pueblo Indians (5 mummies) were excavated from caves in predominantly modern Utah (South West of North America) and made available to researchers by the *Museum of Archaeology and Anthropology*, *University of Pennsylvania* (Philadelphia, USA).

Thus, all examined mummies belonged to people of completely different habitat, lifestyle, nutrition, physical activity and social status. Unlike the Egyptians, where the upper class prevailed among the mummified individuals, representatives of other nations belonged to farmers and hunter-gatherers.

In the interpretation of obtained CT images seven highly qualified specialists – 5 cardiologists and 2 radiologists – took part. Their task was to, first, detect most cardiovascular tissue, and secondly, to determine the presence or absence of calcification in the vessel wall and the heart. Diagnosis of atherosclerosis was considered significant when foci of calcification were found in the wall of exactly determined by CT scanning artery. When areas of calcification were on the proposed course of the artery (which itself was absent), the diagnosis of atherosclerosis was seen as possible.

The most studied mummy was the body of Ahmose-Meritamon, an Egyptian princess who lived in Thebes during the 18th Dynasty (1580-1550 BC) and died at the age of 40. Her name translated from the ancient Egyptian means «Child of the Moon, Beloved of Amun». A thorough investigation of her mummy with CT image reconstruction showed widespread atherosclerosis with lesions of the main large arteries, which in the modern world would certainly require surgery.

Results of the HORUS study

In 47 (34%) of 137 examined mummies, the signs of overt or possible atherosclerosis were showed in: 17 (39%) of 44 female mummies and 30 (39%) of 77 male mummies. The disease was found in all 4 investigated populations, and the differences between them were insignificant – the prevalence of atherosclerosis varied from 38% in the Egyptian population to 60% of the Unangan population. As expected, the incidence of atherosclerosis and the severity of its manifestations increased with age.

Because the heart tissues of many mummies (61%) were absent, to estimate the true prevalence of atherosclerotic lesion of the heart and coronary arteries was not possible.

What is the reason for such a high incidence of atherosclerosis among ancient people? Should immediately eliminate tobacco use, as in the ancient world it was not common, and therefore can not serve as a risk factor for cardiovascular disease.

With regard to a lifestyle, the ancient Egyptians and the inhabitants of Peru were farmers who raised domesticated cattle; Pueblo Indians engaged in farming and gathering; Unangan – gathering and hunting, and agriculture was not known to them. Vegetarianism for representatives of all 4 cultures was not typical. Physical activity due to the lack of means of transport was very high (except for the upper class of ancient Egypt).

Food, as well as climatic conditions, for all 4 populations differed greatly. Availability of fish and wildlife was high everywhere, but if cattle served as the main source of protein for ancient Egyptians, the Unangans had almost exclusively fish diet. Thus, the Egyptian diet of those who held in their lifetime a high socioeconomic status consisted mostly from saturated fats, which serves as a risk factor for atherosclerosis. In parallel with this, for all 4 populations a huge consumption of the most diverse plant foods was characteristic.

For all ancient people, included in the study, the use of fire for cooking and heating homes was typical. However, while the ancient Egyptians and Peruvians prepared food outdoors, Pueblo Indians and Unangan preferred closed hearths as they lived underground or in semi-dugouts. And this, in turn, contributed to the constant inhalation of smoke and combustion products that could play some role in the development of atherosclerosis.

Certain meaning in atherogenesis researchers assigned to infections which were an integral aspect of everyday life of ancient people and the leading cause of mortality. The high prevalence of chronic infections and inflammation in the old days could provoke inflammatory aspects of atherosclerosis. This is consistent with a more rapid emergence of atherosclerotic lesions in modern humans suffering from systemic connective tissue diseases. In this regard, the researchers plan in future to conduct DNA analysis and biopsy of tissues from all mummies to assess the immune status and other genetic risk factors for atherosclerosis.

Conclusion

The HORUS study experts revealed the presence of atherosclerosis in different cultures of very wide geographical spread on a large historical period of time: about 4,000 years. Atherosclerosis, including coronary artery disease, has been found even in those ancient populations where this disease was not expected, namely hunters-gatherers, who had a very active life.

The study results allowed experts to conclude that atherosclerotic disease among ancient peoples was quite common, and in the cultures which were different not only geographically and genetically, but also in lifestyle, food, farming, and etc.

The presence of atherosclerosis (quite pronounced in some cases) in living long before the modern human people suggests that the disease may be a natural component of the aging process, not just a characteristic of a particular lifestyle or diet.

Conflict of interest: None declared

References

1. Thompson RC, Allam AH, Lombardi GP, et al. Atherosclerosis across 4000 years of human history: the Horus study of four ancient populations. Lancet. 2013 Apr 6;381(9873):1211-22.