Elemental distributions in human coronary arteries affected by different degrees of atherosclerosis

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The formation of fatty streaks in the intimal part of the vessel wall is a potential candidate for the onset of atherosclerosis. This results in intimal broadening, stiffening and thickening of the vessel wall. The calcification probably occurs during progression of atherosclerosis and increases the risk of myocardial infarction.

Autopsy specimens of human coronary arteries degenerated to different stages of atherosclerosis, are investigated by nuclear microprobe methods to explore vascular calcification and the role of trace metals, in particular Fe, Cu, and Zn.

On-axis STIM offers information of tissue morphology, and is used as a guideline to select the region of interest for elemental analysis using PIXE, Rutherford backward scattering and Rutherford forward scattering.

The samples from early stages of atherosclerosis exhibited small (5 to 10 μm) particles of Ca-P bearing minerals dispersed in the intima and they are spatially co-localised with traces of Fe and Zn. Trace amounts of Cu are also identified in the lesion, but they seem to be located at the periphery of such particles. These elements are quantified and are in the range between 50 and 400 ppm. Larger calcified structures are found in more advanced lesions, which are mostly observed near the intima – media boundary of the vessel wall. The measured Ca/P ratio (~1.95) of the calcified structure is in good agreement with that of hydroxyapatite (~2.15). Concentrations of S, K and Cl, which are attributed to cellular constituents, are found to be 30 to 40% lower in the lesion site than in the media.

In this paper the role of Ca, P and trace elements, in particular, Fe, Cu, Zn in the process of atherosclerosis in human coronary arteries will be described.