A CONTRIBUTION TO THE STUDY OF PATHOLOGICAL BIOMINERALIZATION OF AORTIC VALVES

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In this study we aimed to the analysis of pathological biomineralization (PB) of explanted human aortic valves during cardiosurgery indicated for their stenosis. The aortic valve stenosis is the most frequently operated valve dysfunction at present. An inorganic analysis (and photodocumentation) of 20 explanted aortic valves was carried out using a polarizing microscope, electron microscope (BSE), infrared spectroscopy (IR), Cameca electron microprobe, X-ray analysis to provide a qualitative determination of inorganic substances in aortic valves. Imaging by low-velocity electrons was applied in the case of one sample.
Using these methods was proved that the most common inorganic substances in pathologically mineralized parts of the valves are phosphorus and calcium in the form of hydroxylapatite. Fluorine is less common, being represented by fluorapatite and hydroxylfluorapatite. The content of inorganic component in the degeneratively altered valves ranges from 65 to 90 wt. %. In each of the 20 samples, polarizing and electron microscopy proved that the mineralization process is a multi-stage one, and is equivalent to the process of bone reconstruction. At the same time, test analyses using X-ray fluorescence analysis and IR spectroscopy were performed: they verified the determination of inorganic substances in the explanted aortic valves. Orientation study by IR spectroscopy revealed that outer layers of the degenerated valve tissues contain an organic component with peptide bonds close to polyamides with an admixture of fatty acids and, in the central part, calcium phosphate $Ca_3(PO_4)_2$.
In a set of 20 samples, pathological biomineralization of altered aortic valves was proved to be characterized – from the viewpoint of inorganic chemistry – by multistage formation of a mass of hydroxylapatite ($Ca_5(PO_4)_3(OH)$), to a lesser degree by fluorapatite (Ca5(PO4)3F) and hydroxylfluorapatite.
Financial support of the grant project AV OZ 20710524 is kindly acknowledged.

Keyword: biomineralization aortic valves