MICROMECHANICAL PROPERTIES OF CALCIFIED DEPOSITES – PRELIMINARY STUDY

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Introduction

The most striking signs of atherosclerosis is deposition of minerals within blood vessels walls. The appearance of calcified deposits causes a change of the mechanical properties and structure of blood vessel walls. The mechanical properties in the indentation tests of calcified deposits were analyzed by Marra [2006] and Kot [2011]. To the best of authors knowledge, for the first time the results of mapping of the mechanical properties of calcified deposits acquired with atomic force microscopy correlated with scanning electron microscopy and EDS analysis will be presented here. This has important practical significance, since the structural analysis of mineral aggregations revealed compositions complexity.

Methods

Calcium deposits samples have been acquired during *post mortem* pathological procedure. The SEM analysis allowed to observe specific areas on the surface of naturally created fracture perpendicular to the blood vessels symmetry axis. Additionally, the chemical composition of selected features have been investigated using EDS feature. Afterwards, the samples have been moved to AFM (measurements performed in air) and the topography and the stiffness of the surface was imaged. In order to provide the spatially coherent data, the scanning process was performed in the same areas for both: SEM and AFM techniques. Therefore the data interpretation was more reliable than in case of independently analysed areas.

Results

Performed procedure allowed to obtain crucial information about the composition and mechanical properties of the calcium deposits in the blood vessels walls. Obtained data clearly show that the deposits are not uniform, therefore their growth process contains certain stages that has to be carefully investigated. The correlation between the compositional data and the stiffness of the surface confirmed earlier observations concerning internal, soft core and stiff surrounding area containing mostly calcium compounds [Kobielarz, 2012].

Discussion

The complexity of the structure of the calcium deposits indicates the need for the analysis of the mechanical properties at different levels of scale. AFM in combination with the SEM and elemental analysis allows the realization of the this objective. This is especially importance to the medical practice because the modern technique of treatment of atherosclerosis include chelation - the technique of applying the bloodstream EDTA compound, which removes calcium deposits from arteries. In light of the latest information on calcium deposits, keep in mind that the removal of calcium compounds is insufficient, because in the artery wall remain soft core, which can again become the centre of mineralization.

References

Marra et al, Acta Biomater, 2:515-520, 2006.
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Acknowledgment

This publication is part of project „Wrovasc – Integrated Cardiovascular Centre", co-financed by the European Regional Development Fund, within Innovative Economy Operational Program, 2007-2013 realized in Provincial Specialized Hospital, Research and Development Center in Wroclaw.