PERICARDIAL FEATURES IN VIBROACOUSTIC DISEASE PATIENTS

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Introduction Vibroacoustic disease (VAD) is a whole-body pathology caused by long term (years) exposure to low frequency noise (LFN) (≤500 Hz, including infrasound) [1]. Pericardial thickening was first observed in autopsy of a VAD patient [2], and subsequently through echocardiography [3]. Previous studies have demonstrated that anatomical pericardial thickening exists in VAD patients [4]. Indeed, pericardial thickening in the absence of an inflammatory process, and with no diastolic dysfunction, is the hallmark of VAD [5]. This study explores the morphological features of the pericardial response to LFN exposure.

Methods *Pericardial Fragments.* Pericardial fragments were removed from 11 VAD patients (LFN-exposed professionals for >10 yrs), with their informed consent, at the beginning of cardiac surgery (for other reasons), and always from the same location: anterior, ventral portion of the parietal leaflet. There were no visual adherences or inflammatory aspects. Fluid amounts were normal and pericardia were grossly thickened. Fragments were divided in two and pinned in dentist wax with the serosal surface facing up. *Microscopy*. Specimens for light microscopy were formalin-fixed, paraffin-embedded, hematoxylin, eosin and fuchsin-rhesorcin stained. For transmission electron microscopy (TEM), sections of pericardia were fixed at room temperature in an aldehyde mixture, washed in buffer, postfixed in ferricyanide-reduced osmium solution, dehydrated through graded ethanol series, and embedded in Epon. Samples were sectioned in an LKB ultramicrotome, stained with uranyl acetate and lead citrate, and viewed with a JEOL 100C electron microscope.

Results All fragments were over 2mm thick.

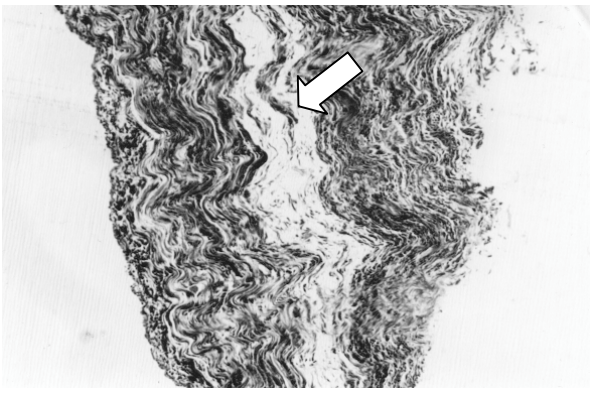

Fig. 1. (Light microscopy) VAD patient parietal pericardium. The loose tissue layer (arrow) is sandwiched by two halves of fibrosa thickened with collagen arranged in wavy bundles. Mesothelial layer on the left and epidpericardium on the right. (x100).

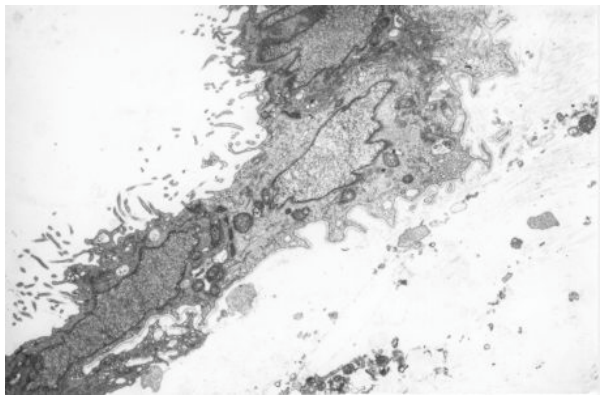

Fig. 2. (TEM) VAD patient parietal pericardium. Mesothelial cells have abundant microvilli and inter-cellular junctions posess numerous desmosomes. Nuclei shape is irregular reflecting cellular stress. Cellular debris is visible in the submesothelial layer. (x2800)

Normal pericardial fragments are a translucid sheath of tissue, less than 0.5 mm thick. A newly formed loose tissue layer, sandwiched between both thickened layers of fibrosa, was quite evident. No cilia in the mesothelial layer were identified. Both fibrosa layers, on either side of the loose tissue sublayer, were distinctly composed of wavy collagen bundles, and with numerous elastic fibers. The loose tissue layer contained adipose tissue cells, neural and blood vessels, and collagenous and elastic fibers. None of the layers had the typical cellularity of inflammation. However, a large amount of cellular debris are scattered thoughout both fibrosa layers and the new loose tissue layer.

Discussion. The response of the pericardium to LFN is

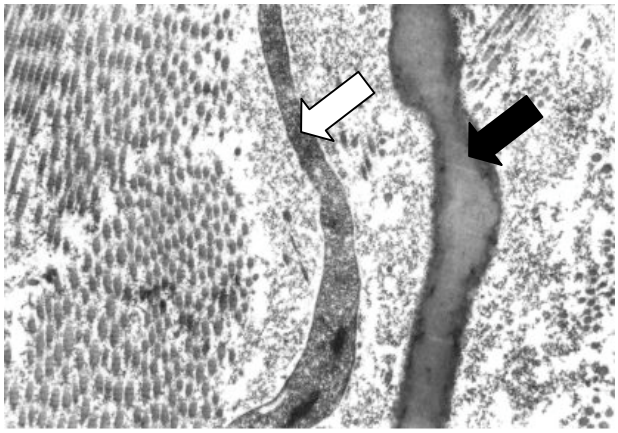

Fig.3 (TEM) VAD patient parietal pericardium. Collagen bundles with different orientations, cytoplasmic extensions of a myofibroblast (white arrow), and an elastic fiber (black arrow) deep in one of the halves of the fibrosa layer. (x10000)

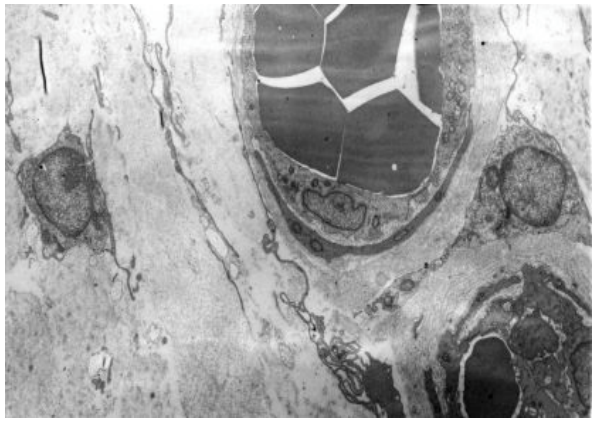

Fig. 4. (TEM) VAD patient parietal pericardium. Loose tissue layer showing two blood vessels with thickend walls and two myofibroblasts, and numerous cytoplasmic extensions surrounding bundles of collagen. (x2800)

certainly an adaptation response. This does not exclude the loss of functional capabilities, for example, not a single cilium was found in mesothelial cells. Instead of three tissue layers of the normal pericardia, VAD patients pericardia exhibit five layers, where the fibrosa layer has divided in two and sandwhiches a newly formed layer of loose tissue. Despite the dramatic alterations of the pericardia, heart function is normal and no diastolic dysfunction exists in VAD patients. It would seem that this newly formed loose tissue layer, rich in vessels and adipose tissue, with numerous elastic components, plays a very important role, possibly of a pneumatic nature, in maintaining normal function of the heart in these patients.

Keywords: low frequency noise, fibroblasts, collagen, elastin, electron microscopy, noise exposure, occupational, pathology

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