

Production of Functional Collagen Units in the Absence of Inflammatory Processes as a Response to Low Frequency Noise Exposure

Nuno Castelo Branco, MD¹ and Mariana Alves-Pereira, MSc²

¹Center for Human Performance, R. Prof. Dias Amado, No. 5, 1B, 1600 Lisbon, Portugal, phone: +351-93-7584261, email: vibroacoustic.disease@gmail.com. ²ERISA-Universidade Lusófona, R. do Telhal aos Olivais, 1900 Lisbon, Portugal, phone:+351-218621060, email: m.alvespereira@gmail.com.

BACKGROUND: In 1989, echocardiography imaging in low frequency noise- (LFN, ≤ 500 Hz) –exposed workers revealed thickened pericardia in the absence of diastolic dysfunction and with no evidence of pre-existing bacterial infections [1]. Beginning in 1992, individuals occupationally-exposed to LFN and who were recommended for cardiac surgery through the National Healthcare system, donated (with informed consent and Hospital Ethics Committee approval) pericardial fragments for histological and ultrastructural studies.

PURPOSE: To gather real anatomical data that would justify the cardiac dynamics observed in echocardiography images.

APPROACH: To date, 12 fragments have been collected from 3 aircraft technicians, 4 aircraft pilots, 4 helicopter pilots, 1 truck driver (avg. age 48 ± 9.5 yrs, >10 yrs of occupational exposure to LFN). Scanning (SEM) and transmission electron microscopy were used to analyze pericardial fragments, all taken from anterior portion of the parietal leaflet.

RESULTS: Five layers of tissue, instead of three, are present in LFN-exposed pericardia. See Figs 1, 2 (note that scale is the same). Both fibrosa layers (internal, closer to pericardial sac, and external) consist almost entirely of wavy, interwoven collagen bundles. Elongated connective tissue cells with long and thin nuclei are present, and in most cases are parallel to the orientation of the collagen bundles. Elastic fibers are also present in the split fibrosa layers, and their diameters seem to vary independent of relative position to sample cutting.

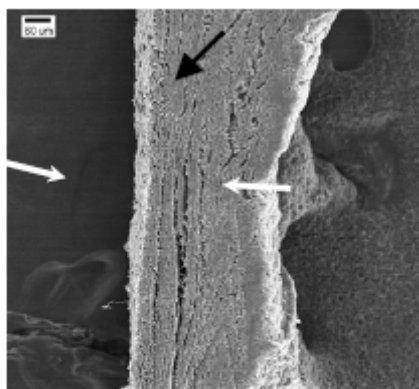


Figure 1. SEM of non-exposed patient pericardium. Normal three layers are visible: mesothelium (left arrow), fibrosa (black arrow) and epi-pericardium (right arrow)

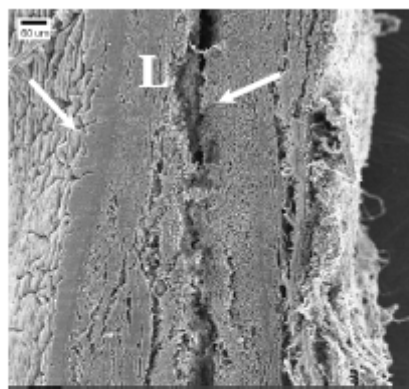


Figure 2. SEM of LFN-exposed patient pericardium. Fibrosa has split into two halves (white arrows) that sandwich a newly-formed layer of loose tissue (L)

CONCLUSIONS: The anatomical justification of the echo-dense pericardia is the abnormal growth of collagen concurrent with the morphogenesis of a previously inexistent layer of loose tissue.

REFERENCE:

1. Marciniak W, Rodriguez E, Olsowska K, Botvin I, Araujo A, *et al.* Echocardiography in 485 aeronautical workers exposed to different noise environments. *Aviat Space Environ Med*, 70 (3, Suppl): A46-53, 1999.