

Low Frequency Noise Exposure Destroys Tubulin- and Actin-based Structures

Mariana Alves-Pereira, MSc¹ and Nuno Castelo Branco, MD²

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

BACKGROUND. Low frequency noise (LFN, ≤ 500 Hz) is a physical agent of disease responsible for the development of vibroacoustic disease (VAD) [1]. In order to better understand VAD, LFN-exposed animal models have been under study since 1992, using scanning (SEM) and transmission (TEM) electron microscopy. Pericardia of VAD patients have also been under scrutiny [1].

PURPOSE. To compile information on the behavior of actin-based structures (cochlear cilia and respiratory microvilli) and tubulin-based structures (respiratory tract and pericardial cilia) in LFN-exposed rat trachea and VAD patient pericardia, possibly contributing to future pharmacological interventions.

METHODS. Populations of rats were exposed to LFN for varying amounts of time while controls were kept in silence. VAD patients submitted to cardiac surgery donated pericardial fragments [1]. Ultrastructural imaging was obtained for all fragments.

RESULTS: Brush cell (BC) microvilli in rat tracheal and bronchial epithelia were fused, with morphological changes leading to cell death. The same behavior was observed in rat cochlear cilia, fused amongst themselves *and* with the upper tectorial membrane. Pericardial cilia were virtually non-existent. Rat tracheal cilia populations were greatly reduced, with remaining cilia appearing sheared and shaggy. (See Figs.)

CONCLUSIONS. Actin- and Tubulin-based structures are a target for LFN.



Rat tracheal BC. (CONTROL): Two BC (arrows) are seen with microvilli evenly distributed and uniformly covering the BC apical surface. (LFN-EXPOSED): BC with fused microvilli are seen spreading outward from the center. Individual microvilli are still identifiable around edges.



Rat tracheal epithelia. (CONTROL): Arrows point to center of BC, surrounded by long and uniform cilia. (LFN-EXPOSED): Ciliary fields are greatly reduced and depleted.

1. Alves-Pereira M, Castelo Branco NAA. Vibroacoustic disease: Biological effects of infrasound and low frequency noise explained by mechanotransduction cellular signaling. *Prog Biophy Molec Biol*, 93:256-279, 2007.