Changes of the bronchial lining of rats caused by noise

Conference Paper · January 2003

CITATIONS
0

READS
25

7 authors, including:

Laura Guimarães
University of Porto
125 PUBLICATIONS 1,587 CITATIONS
SEE PROFILE

António P Carvalho
University of Porto
137 PUBLICATIONS 692 CITATIONS
SEE PROFILE

CHANGES OF THE BRONCHIAL LINING OF RATS CAUSED BY NOISE

M.J.R. Oliveira[1], A.S. Pereira[1], L. Guimarães[2], D. Freitas[3], A.P.O. Carvalho[3], N.R. Grande[1], A.P. Águas[1]
[1]Depart. Anatomy and [2]Population Studies, ICBAS, Abel Salazar Institute for Biomedical Sciences, UMIB and IBMC; [3]Engineering Faculty, University of Porto. 4099-033 Portugal.

Introduction Chronic exposure to excessive noise may cause systemic disorders, in addition to the well-established damage to hearing (Melamed *et al.*, 1996; Nicholas *et al.*, 1998). Noise-related disorders have been identified in exposed workers and to the concept of Vibroacoustic Disease (VAD) (Castelo Branco and Rodriguez, 1999).Textile workers show increased frequency of respiratory infections (Simpson *et al.*, 1998; Raza *et al.*, 1999). We have investigated whether the bronchial epithelium undergoes any cytological change in animals chronically exposed to cotton-mill-room noise. To perform quantitative cytology of the bronchial epithelium of noise-exposed and control rats we have used scanning electron microscopy (SEM).

Materials and Methods Thirty-five rats were divided into 4 experimental groups and submitted to different periods of noise exposure, ranging from 1 to 7 months, according to an occupationally simulated time schedule (8 hours/day; 5 days/week with weekends in silence). The different groups of noise-exposed rats were sacrificed after 1, 3, 5 and 7 months of exposure to cotton-mill-noise. The remaining 20 Wistar rats were used as age-matched controls and sacrificed when they were 3, 5, 7 and 9 months old. The rats were sacrificed by a lethal intravenous injection of sodium-pentobarbital (40 mg/kg) and the left lung excised and processed for SEM. The samples were fixed *in toto* in a solution of 3% glutaraldehyde in 0.1 M phosphate buffer, pH 7.2, washed in several changes of 5% sucrose in 0.1 M phosphate buffer, pH 7.2, dehydrated, critical point-dried and coated with gold-palladium (Oliveira *et al.*, 2002a).Random SEM micrographs of the samples were obtained at a magnification of 1000. Ten micrographs were made of each sample; a total area of 0.11 mm^2 of the bronchial epithelium was used for quantitative analysis of each sample. The relative area of the bronchial surface that was coated by ciliated cells, secretory cells, brush cells or other unidentifiable cells was determined with the help of a transparent grid of 20 points, spaced 4 cm from each other, that was superimposed on the printed micrographs (Oliveira *et al.*, 2002a,b). The numerical values of the relative area of the pleura that showed microvilli were calculated using the following formula: total points of ciliated or other cell types/total points of the grid inside the micrograph.

Results SEM micrographs were randomly taken of the bronchial lining of both noise–exposed and control groups of rats. Based on these micrographs, we have determined the relative area occupied by the several cells types that make up the luminal surface of the bronchi.). In control rats, we found an increase with age (from 3 to 9 months) of the relative area occupied by ciliated cells on the bronchial lining. In fact, 7 and 9 months old animals had a larger proportion of the bronchial surface covered by ciliated cells than what was observed in younger control rats (3 and 5 months old animals). Chronic exposure of rats to textile-mill noise inhibited this enhancement in the cilia-coated area of bronchi. This phenomenon was also observed after 7 months of noise exposure of the animals. Therefore, it can be concluded that

the herein reported differences in bronchial cytology between noise-exposed and control rats is the result of abrogation by noise of the physiological enhancement in relative area of ciliated cells that is observed on bronchial epithelium of young rats as they grow a few months older.

Discussion We report that exposure of Wistar rats to textile noise is associated with a statistically significant differences between the noise-exposed and control age-matched rats, after 5 and 7 months of treatment of the animals. This finding is due to the noise-induced arrest in the normal increase in the proportion of ciliated cells that coat the bronchial lining in young adult rats as they grow a few months older. We thus propose that noise exposure interfere with ciliated cells expansion on the bronchial epithelium. This is of particular importance because ciliated cells are pivotal players in the mucociliar clearance of the respiratory tract. We have documented before that chronic exposure of experimental animals to the same type of textile noise alters the ciliated/secretory cell ratio on the trachea: the excessive noise caused loss of ciliated cells with a compensatory enhancement in secretory cells (Pereira *et al.*, 1999; Oliveira *et al.*, 2002b) The herein data taken together with these previous findings, leads us to suggest that a moderate impairment of the mucociliary apparatus may occur in the respiratory tract in response to chronic exposure to textile noise.

Keywords: scanning electron microscopy, morphometry, environmental noise, membrane, textile industry

References

Castelo Branco NAA, Rodriguez E. 1999. The vibroacoustic disease – An emerging pathology. Aviat Space Environ Med 70:A1-A6.

Melamed S, Bruhis S. 1996. The effects of chronic industrial noise exposure on urinary cortisol, fatigue and irritability: a controlled field experiment. J Occup Environ Med 38:252-256.

Nicholas JS, Lackland DT, Dosemeci M, et al. 1998. Mortality among US commercial pilots and navigators. J Occup Environ Med 40:980-985.

Oliveira MJR, Pereira AP, Castelo Branco NAA, Grande NR, Águas AP. 2002a. In utero and postnatal exposure of Wistar rats to low frequency/high intensity noises depletes the tracheal epithelium of ciliated cells. Lung 179:225-232.

Oliveira MJR, Pereira AP, Guimarães L, Freitas D, Carvalho APO, Grande NR, Águas AP. 2002b. Chronic exposure of rats to cotton-mill-room changes the cell composition of the tracheal epithelium. J Occup Environ Med 44:1135-1142..

Pereira AS, Águas AP, Grande NR, Mirones J, Monteiro E, Castelo Branco NAA. 1999. The effect of chronic exposure to low frequency noise on rat tracheal epithelia. Aviat Space Environ Med 70:A86-A90.

Raza SN, Fletcher AM, Pickering CA, Niven RM, Faragher EB. 1999. Respiratory symptoms in Lancashire textile weavers. Occup Environ Med 56:514-519.

Simpson JC, Niven RM, Pickering CA, Fletcher AM, Oldham LA, Francis HM. 1998. Prevalence and predictors of work related respiratory symptoms in workers exposed to organic dust. Occup Environ Med 55:668-672.