Response of Nasal Epithelial Cells to Different Environmental Conditions

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The goal of this research was to investigate the biological response of cultured nasal epithelial cells to airflow induced wall shear stresses (WSS) under different humidity and temperature conditions which correspond to various environments. For this purpose we developed an experimental setup for exposure of the ALI cultured cells to oscillatory WSS under different temperature and humidity conditions. This setup is composed of three parts: 1) a computerized respiratory pump which can produce different profiles of breathing airflow; 2) a flow chamber for exposing of the cultured cells to WSS; and 3) an air-conditioning apparatus for setting the environmental conditions (Fig. 1). Nasal epithelial cells were cultured under air-liquid interface (ALI) conditions (following the protocol that we have developed in our lab), which mimic their *in vivo* conditions. The flow chamber was designed to ensure a direct contact of the cells with the culture medium throughout the experiment and to allow undisturbed flow of air on the cell surface. The air-conditioning apparatus is fully computerized and allows online monitoring and control of desired temperature and humidity conditions to be applied to the cells.

Experiments at different environments (e.g., 25°C and 40%RH; 25°C and 80%RH; 40°C and 40%RH; 40°C and 80%RH) and different WSS (e.g., peak values of 0.5 and 5 dyne/cm^2) revealed increased mucus secretion immediately after exposure to oscillatory WSS and that mucin secretion was increased with increased temperature and decreased with increased humidity level. The level of microtubule fibers integrity was significantly lower in the stressed cultures in comparison to the unstimulated ones. The stressed cells regained their normal cytoskeleton appearance 24 hours after the exposure to WSS. These results emphasize the importance of the biomechanical micro-environment of the respiratory epithelium side by side with the biochemical environment. This study provides new evidence on cellular mechanisms that are responsible for hyper-secretion conditions (i.e., allergy or other states of 'running nose'). In addition, the experimental setup that was developed for the study, together with the biological system, comprises a basic controlled *in vitro* model that can be used to investigate the effects of various pharmaceutical treatments for respiratory system diseases as well as of different air-pollutants, on airway epithelial cells, under conditions similar to the *in vivo*.

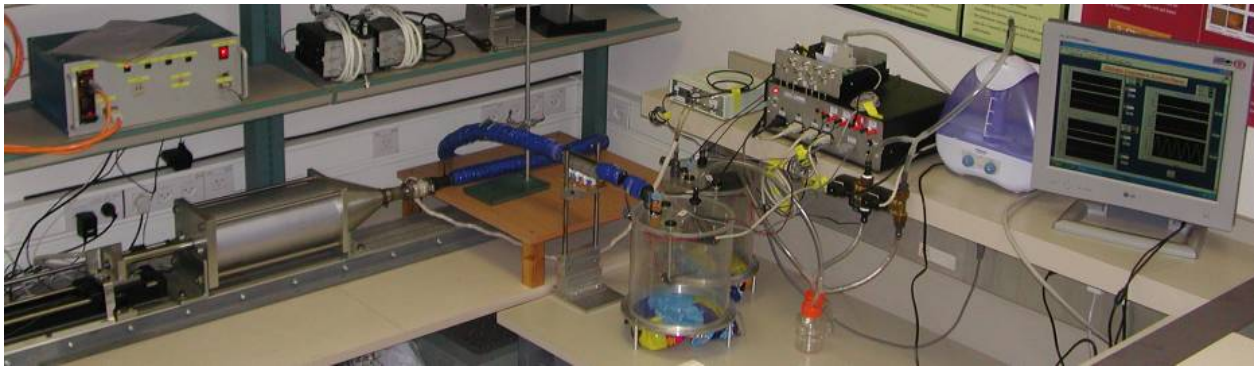

Figure 1. Experimental setup for exposing ALI cultured nasal epithelial cells to conditioned WSS.