INTRODUCTION AND OBJECTIVES

The harm caused by cigarette smoke (CS) exposure to the lower and upper respiratory tracts is widely known. Electronic cigarettes (ECs) are growing in popularity, and exposure to the aerosol generated by such products has been suggested to exert less harm than CS exposure. Many studies have assessed the potential toxicity of ECs in vitro. However, most have tested only the effects of the liquid formulations applied directly on cell cultures but not the effects of the formulations as vapor/aerosol. In this study, we comparatively examined the effects of acute exposure to whole aerosol generated by a novel EC device using the MESH™ technology (IQOS® MESH™, Philip Morris Products S.A., Switzerland) and to mainstream CS on human organotypic buccal epithelial cultures. In nine independent experiments, cell cultures were exposed at the air–liquid interface to undiluted aerosol of the “Classic Tobacco” flavor generated from the EC for 12 min or to diluted CS for the same puff number in vitro. Secretory and oxidative stress biomarkers in the exposure chamber were measured as an exposure marker. Using a systems toxicology approach, we complemented histological findings with quantitative findings on molecular changes within 48 h following exposure (global expression profiles of miRNA and mRNA and targeted protein profiles, including those of secretory proteins).

METHODS

Study design: The effects of an acute 28-min (112-puff) exposure to CS (from the 384F reference cigarette, University of Kentucky, USA) and exposure to aerosol from an EC device (112 and 224 puffs) using the MESH™ technology (IQOS® MESH™) were assessed in human organotypic buccal epithelial cultures (reconstituted from the buccal epithelial cells of a 40-year-old male non-smoker donor). A paired design was implemented. In parallel to exposure to CS or EC aerosol, cell cultures were also exposed to filtered air in the same exposure module. A series of nine experimental runs was conducted to increase the assessment robustness.

RESULTS

Tissue damage was not observed in cultures exposed to the IQOS® MESH™ Classic Tobacco aerosol even when exposure doubled the number of puffs as CS (224 vs 112 puffs). By employing a systems toxicology approach, we were, however, able to detect molecular changes in the IQOS® MESH™ aerosol-exposed cultures. The profiles of secreted proteins showed that CS and IQOS® MESH™ Classic Tobacco aerosol elicited different inflammatory responses. Global miRNA profiles following CS exposure pointed towards alterations in mechanisms related to cellular fate, proliferation, and stress, which were noticeably less following exposure to the IQOS® MESH™ aerosol (except for the inflammatory processes at 24 h post-exposure). The results of miRNA analysis of the tissue and targeted proteomics analyses demonstrated no changes in cultures exposed to the IQOS® MESH™ aerosol. Overall, the findings suggested that, compared with the impact of CS exposure on buccal epithelial cultures, undiluted IQOS® MESH™ Classic Tobacco aerosol exposure was much smaller.

CONCLUSIONS

Exposure to an aerosol generated by an electronic cigarette using MESH™ technology causes lesser biological alterations than cigarette smoke in buccal organotypic epithelial cultures.

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