The Impact of Tobacco Exposure on the Lungs Innate Defense System
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Abstract:

Unlike regular tobacco products, e-cigarettes (e-cigs) do not use combustion, and instead, heat is required for the generation of the vapor (aerosol) that is inhaled by the user. E-cig users can chose to heat their e-liquids at different temperatures. Little is known about the thermal decomposition of e-liquids. Novel and potentially toxic chemicals can be generated following heating of e-cigarette liquids. Because temperature is a major factor in decomposition of e-liquid ingredients, its evaluation as toxic factor is fundamental to understanding any potential e-cig toxicity. Knowledge is lacking regarding (i) how different pyrolysis temperatures affect the chemical constituents of the resulting vapors and (ii) how vapors resulting from different pyrolysis temperatures affect cellular functions important for lung homeostasis. To date, we have analyzed 13 common flavors of e-liquid by mass spectrometry for constituent chemicals. We have detected up to 40 compounds per e-liquid using GC/MS. However, other compounds have been detected using real-time analysis during e-liquid pyrolysis. We have also begun to characterize the biological effects of these e-liquids on airway epithelia. We have found that some of these liquids affect cell growth and cell signaling. Thus, we hypothesize that it is important to determine any changes in biological effects of vaporized e-liquids that may occur following pyrolysis and the generation of novel e-liquid-derived compounds.

For this administrative supplement, we propose to determine the effect of temperature-dependent pyrolysis on the composition of the resulting vapors of e-liquids, and to evaluate the biological effects of the resulting vapors on airway epithelial and macrophage functions. We anticipate that these data will inform the FDA of any potential toxic effects of pyrolysis of e-cig liquids. To achieve these goals, we propose the following specific aims:

Aim 1. To determine the vapor composition resulting from e-cig liquids subjected to different pyrolysis temperatures. We will evaluate two e-cig liquids, menthol tobacco and vanilla tobacco, with and without nicotine. Vapors from these e-liquids will be generated using a pyrolysis apparatus where we can vary the heating temperature. Aerosols will be analyzed in real-time using mass spectrometry. Aerosols will also be collected for Aim 2 and collected aerosols will also be analyzed by mass spectrometry.
Aim 2. To determine the biologic effects of vapors resulting from different pyrolysis temperatures on airway epithelial and macrophage function. We will measure the effect of the different aerosols generated in the studies outlined in Aim 1 on cell growth, signaling, viability, oxidative stress and inflammatory responses of Calu-3 airway epithelia and dTHP macrophage cultures. Cellular functions evaluated following exposure to e-cig liquids not subjected to pyrolysis will serve as controls.