TACSM Abstract

Effects of 14 Day E-Cigarette Exposure on Ventilation and Circulating Pro-Inflammatory Cytokines in Adolescent Rats

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ABSTRACT

Electronic nicotine delivery systems or e-cigarettes are devices used to deliver vaporized liquids often containing nicotine and other chemicals. These devices were originally created as a way to assist with smoking cessation in adults; however, use of these devices is increasing in adolescent and young adult populations. Recent research suggests that exposure to the chemicals in e-cigarette vapor may cause harm to adolescent lung tissue and promote a proinflammatory immune response in the lungs. These molecular changes may lead to functional changes in terms of lung volumes or gas exchange at the respiratory membrane. **PURPOSE**: The purpose of this study was to investigate the effects of 14 days of e-cigarette vapor exposure in adolescent rats on lung function and lung tissue proinflammatory cytokine expression, specifically IL-1β. **METHODS**: Using random assignment, 20 adolescent male Long Evans rats were assigned to vape (experimental) or air (control) groups. The animals were exposed to either air (n = 10) or 5% nicotine vapor (n=10) using a whole-body exposure chamber, once a day for ten minutes for fourteen consecutive days. Ventilation recordings were completed on day 0 (before exposure) and day 15 (after exposure) using unrestrained whole-body plethysmography. Minute ventilation/100g, tidal volume/100g, and breathing frequency were assessed. Blood was collected on day 15 and processed to serum. Serum samples were analyzed for circulating levels of the nicotine metabolite, cotinine, and the proinflammatory cytokine, IL-1β, using enzyme linked immunosorbent assays (ELISA). **RESULTS**: Cotinine was found to be present in the serum samples of the vape groups (20.71 ng/ml +/- 6.875 ng/mL) but not the air groups (0.007 +/- 0.019 ng/mL) confirming nicotine and vapor exposure. Baseline ventilation data collected on day 0 and post-exposure ventilation data collected on day 15 were compared between air and vape groups across three different parameters: minute ventilation/100g , frequency, and tidal volume/100 g. These parameters were compared resulting in three distinct 2x2 (time x treatment) Mixed Model ANOVAs. Between baseline and post-treatment measurements, for both groups, there was a significant decrease in values in minute ventilation ($F(1,15) = 5.647$, $p = 0.0312$) and tidal volume ($F(1,15) = 12.38$, $p = 0.0031$). Between treatment groups there was also a significant difference in minute ventilation ($F(1,15) = 7.979$, $p = 0.0128$) and frequency ($F(1,15) = 11.35$, $p = 0.0042$). There was also significantly lower levels observed in the inflammatory cytokine IL-1β ($p < 0.0136$) for the vape group (22.13 +/- 19.96 pg/mL) in comparison to the air group (3.28 +/- 3.52 pg/mL). **CONCLUSIONS**: Following 14 days of e-cigarette vapor exposure, ventilation patterns were altered in the vapor exposed animals, specifically decreasing tidal volume and minute ventilation. Additionally, in these same vapor exposed animals, circulating levels of the pro-inflammatory cytokine, IL-1β, was decreased suggesting dysregulation of immune pathways. Taken together these results suggest that the use of e-cigarettes may lead to both functional and molecular changes in adolescent lungs, interfering with pulmonary function and affecting one's quality of life.