Maternal Electronic Cigarette Exposure Induces Inflammation, Oxidative Stress and Alters Mitochondrial Function in Postnatal Brain

Sabrina Rahman Archie,¹ Ali Sifat,² David Mara,² Yong Zhang,² and Tom Abbruscato³
¹Texas Tech Univ Hlth Sci Ctr; ²Texas Tech University Health Sciences Center; and ³Texas Tech Univ HSC Sch of Pharm

Abstract ID 22490 Poster Board 463

Purpose: Electronic nicotine delivery systems (ENDS), also commonly known as cigarettes (e-Cig) are often considered as a safer alternative to tobacco smoke and therefore have become extremely popular among all age groups and sex. Around 15% of pregnant women are now using e-Cigs in the US which keeps increasing at an alarming rate. Harmful effects of tobacco smoking during pregnancy are well documented for both pregnant and postnatal health, however a lack of preclinical and clinical studies exist to evaluate the long-term effects of prenatal e-Cig exposure on postnatal health. In our previous study, we have observed disruption of blood-brain barrier integrity and deteriorated motor, learning and memory function in prenatally e-Cig exposed offspring. In this study, we have evaluated the consequences of maternal e-Cig use on postnatal neuro-inflammation, oxidative stress, hypoxia and mitochondrial function at different age including evaluation of both male and female offspring.

Method: In our study, pregnant CD1 mice (E5) were exposed to e-Cig vapor (2.4% nicotine) till postnatal day (PD) 7. Body and brain weight were measured at PD7, PD23, PD45 and PD90. Immunobead assay was performed to measure the level of pro-inflammatory cytokines at PD7, PD23, PD45 and PD90. The expression level of oxidative phosphorylation or OXPHOS Complex (I, II, III, IV and V), hypoxia inducible factor (HIF-1α), antioxidant glutathione (GSH), mitochondrial protein TOM20, Manganese superoxide dismutase (MnSOD), EGR1 and NRF2 were analyzed in offspring brain using western blot at PD7 and PD23.

Results: Significantly reduced brain to body weight ratio was observed at PD7 in prenatally e-Cig exposed offspring. Significantly increased expression of OXPHOS complexes and HIF-1α and reduced expression of MnSOD, GSH and NRF2 were observed in prenatally e-Cig exposed offspring compared to control (P<0.05). However, no difference was observed in expression level of TOM20 and EGR1. Additionally, prenatally e-Cig exposed offspring had higher level of pro-inflammatory cytokines (IL-6, TNF-α) at PD7, PD45 and PD90 (P<0.05).

Conclusions: Our findings suggest that prenatal e-Cig exposure induces neuroinflammation and oxidative stress on neonatal brain by increasing cytokines level, oxidative stress and disrupting mitochondrial function which may alter fetal brain immune function and mitochondrial activity that make such offspring more vulnerable to brain insults. Currently, we are evaluating mitochondrial activity in primary neuron from prenatally e-Cig exposed offspring.

Support: NIH R01DA049737 and R01DA02912.

Impact of maternal electronic cigarette use on postnatal brain A) Oxidative Phosphorylation (B) HIF-1α (C) SOD (D) TOM20 and (EGR1). Prenatally e-cig exposed offspring showed higher level of OXPHOS complex I and II, HIF-1α and lower level of SOD at PD7 (n=6), P<0.05.