Exposure to Vape Smoke Enhances Sperm Mitochondrial Respiration in Mature Mice

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Abstract:

Background: Although paternal mitochondria degenerate in the zygote, sperm mitochondria are essential for fertilization in that they produce ATP necessary for sperm motility. Therefore, sperm fertility is highly dependent on mitochondrial efficiency. Here we explored whether exposure to secondhand cigarette or e-cigarette (e-cig) smoke in mature mice affects sperm mitochondrial respiration.

Methods and Results: Mature mice (3-5 months old) were exposed to secondhand cigarette smoke or e-cig smoke five days a week for two weeks. After smoke exposure, mice were anesthetized, and a bilateral dissection of the testes was performed to isolate the caput, corpus, and cauda epididymis and the vas deferens. All mature sperm collected from each portion of the reproductive tract were pooled for analysis. High resolution respirometry was subsequently performed by following a substrate-uncoupler inhibitor-titration (SUIT) protocol. We observed a significant increase in maximum oxygen consumption capacity in sperm from e-cig-treated mice, and a trend toward significance in secondhand smoke-treated mice compared to controls from the addition of FCCP during the respirometry.

Conclusion: This experiment indicates that there are mitochondrial effects under conditions of smoke exposure. These data are limited insofar as they do not indicate whether this increase in oxygen consumption is associated with an increase in ATP or ROS production so further analysis will be necessary. However, these findings suggest that exposure to e-cig smoke affects sperm mitochondria, which may have negative effects on male fertility.

Results:

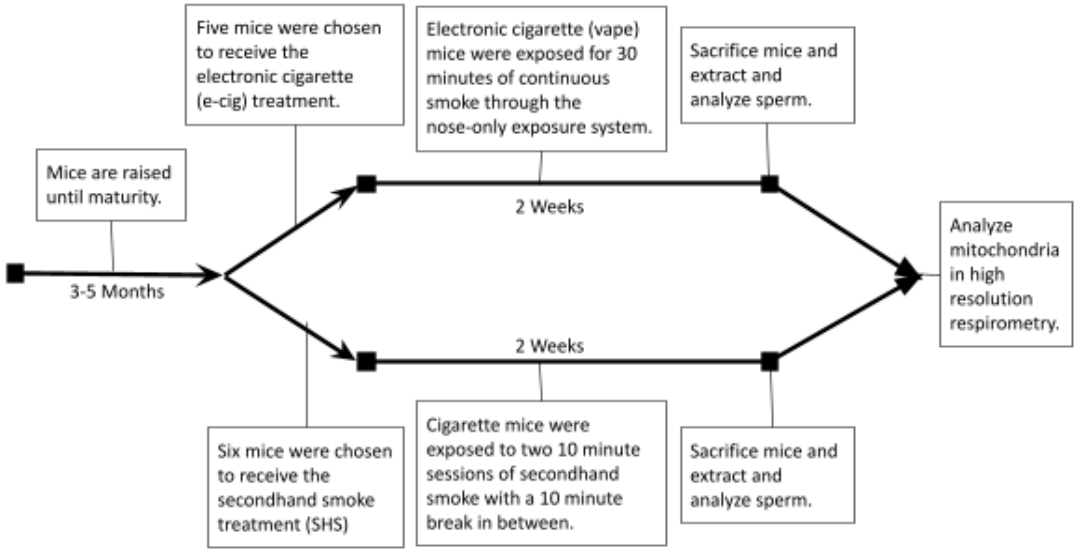

Figure 1: Timeline of Experiment.

B

Name	Substrate
GM	Glutamate (10 mM) Malate (2mM)
ADP	+ ADP (2.5 mM)
S	+ Succinate (10 mM)
F	+ FCCP (2 mM)

Figure 2: Oroboros Control Respiration. High resolution respirometry control runs of sperm from 2 adult male mice (A). Vertical lines throughout the experiment indicate the addition of substrates; GM, Glutamate (10 mM) + Malate (2 mM); ADP, + ADP (2.5 mM); SUCC, + Succinate (10 mM); F, + FCCP (2mM) shown in B.

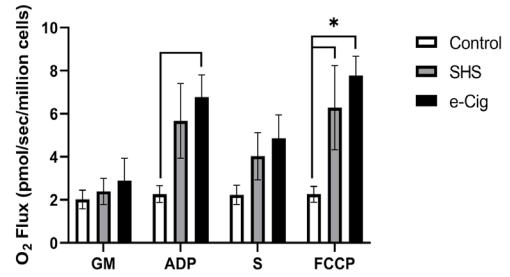

Figure 3: Significant increase of oxygen consumption in electronic cigarette exposure. Measurement of mitochondrial respiration in response to substrates (Fig. 2B).