

Acute Effects of Smoking and Vaping on Markers of Vascular Function via Quantitative MRI, An Expanded Cohort

PURPOSE

This work aims to evaluate the acute effects of tobacco smoking, nicotized- and non-nicotized e-cigarette vaping challenges on vascular function in healthy smokers and vapers via quantitative MRI. Pre-inhalation challenge markers are compared to baseline data from non-smokers/non-vapers.

METHODS AND MATERIALS

Participants undergo three study visits involving two suites of MRI scans separated by inhalation challenges: (1) tobacco cigarette smoke, (2) nicotized e-cigarette aerosol, (3) non-nicotized e-cigarette aerosol. Thirty-one healthy smokers and vapers (17 males), ages 21-49 years, have been studied to date. Twenty-two participants completed all three visits, eight participants completed one visit, and one participant completed two visits. Ten non-smokers/non-vapers (two males), ages 21-33 years, also underwent a baseline scan protocol only. Most elements of the protocol have been described in previous literature published by our laboratory. In brief, a cuff occlusion was applied at the proximal thigh to assess flow-mediated dilation (FMD). Following deflation, femoral artery flow velocity and venous oxygen saturation (SvO₂) were quantified. Aortic arch pulse wave velocity was evaluated with complex difference signals from velocity-encoded projections. Phase-contrast MR at the superior sagittal sinus (SSS) during a breath-hold challenge yielded a measure of cerebrovascular reactivity. Cerebral metabolic rate of oxygen was derived from the SSS flow velocity and SvO₂. Finally, neurovascular compliance of the brain's arterial tree was measured from time-resolved carotid flow rates. Pre- versus post-inhalation markers from each of the three interventions were then compared using unpaired t-tests.

RESULTS

The study is ongoing and double-blinded. Therefore, data from all three interventions were combined. Following inhalation there were significant decreases in the superficial femoral artery baseline velocity and time of forward flow, suggesting impaired vascular reactivity (both $p < 0.05$). At the femoral vein, baseline SvO₂ was reduced ($p = 0.01$). The comparison of biomarkers from smokers/vapers pre-inhalation to non-smokers/non-vapers (no inhalation) showed NVC was greater (+37%; $p < 0.005$) and FMD lower (-42%; $p < 0.05$) in smokers/vapers.

CONCLUSIONS

This MRI protocol was able to detect acute effects of smoking and vaping on markers of vascular function.

CLINICAL RELEVANCE/APPLICATIONS

The data highlight the deleterious effects of smoking and vaping.