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Immediate effects of electronic cigarette use on coronary circulation and blood carboxyhemoglobin levels: comparison with cigarette smoking

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Purpose: Cigarette smoking causes an acute elevation in carboxyhemoglobin levels (HbCO) and has immediate adverse effects on coronary circulation. The goal of this study was to evaluate the effects of electronic cigarette (EC) use on coronary microcirculation.

Methods: We recruited 60 healthy participants (age 20-55 years), 30 smokers and 30 ex-smokers who were daily users of EC. Smokers were asked to smoke 2 cigarettes (0.7mg nicotine) and use an EC device with nicotine-containing liquid (9mg/ml) for 15 minutes, in a randomized cross-over design. Coronary flow velocity reserve (CFVR) and coronary vascular resistance index (CVRI) were measured at baseline (after 8 hours abstinence from smoking and caffeine use), 20-30 minutes after smoking two cigarettes and after using the EC device, by intravenous administration of adenosine (140µg/kg/min). HbCO levels were also measured. EC users were evaluated before and after EC use only.

Results: Both groups had similar baseline characteristics. Blood pressure and heart rate were similar at baseline and after smoking and EC use. HbCO levels were significantly higher in smokers compared to EC users at baseline (2.93±1.15% vs. 0.81±0.20%, $P < 0.001$). No elevation in HbCO levels was observed in both groups after using the EC, while smokers had significant elevation in HbCO after smoking (3.50±1.11%, $P < 0.001$ compared to baseline). Overall, no difference was observed in CFVR (2.94±0.52 vs. 2.99±0.62, $P = 0.265$) and CVRI (0.346±0.064 vs. 0.345±0.077, $P = 0.870$) before and after EC use in all 60 participants. Evaluating each group separately, in EC users no difference was found in CFVR (2.99±0.55 vs. 3.05±0.64, $P = 0.299$) and CVRI (0.341±0.062 vs. 0.337±0.075, $P = 0.691$) before and after EC use. Similarly, in smokers no difference was observed in CFVR (2.90±0.49 vs. 2.93±0.62, $P = 0.593$) and CVRI (0.351±0.067 vs. 0.353±0.079, $P = 0.891$) before and after EC use. However, after smoking 2 cigarettes there was a significant decrease in CFVR (2.45±0.45, $P < 0.001$ compared to baseline) and an increase in CVRI (0.416±0.077, $P < 0.001$ compared to baseline).

Conclusion: Significant elevations in HbCO and CVRI and decrease in CFVR were observed in smokers after smoking 2 cigarettes. On the contrary, no difference was observed in all parameters after EC use in both smokers and ex-smokers. Research in this field should be intensified because EC may have the potential to significantly reduce the adverse health effects associated with smoking.