

Altered Vessel Hemodynamics at Rest and After Acute Physical Stress in Young Smokers

Alexandra B. Cooke, Department of Medicine, McGill University; Andrew F. Mutter, Department of Medicine, McGill University; Yessica-Haydee Gomez, Department of Medicine, Research Institute of the McGill University Health Centre; Robert J. Doonan, Department of Medicine, McGill University; Simon L. Bacon, Department of Exercise Science, Concordia University; Stella S. Daskalopoulou, Department of Medicine, Research Institute of the McGill University Health Centre

Objectives: Long-standing smokers have stiffer arteries at rest; however the extent of the underlying vascular dysfunction in young healthy smokers has not been fully established. We aimed to examine the acute and chronic effect of smoking and nicotine exposure, on arterial stiffness at rest and in response to acute physical stress in young healthy individuals.

Methods: Young healthy smokers (n=43) and non-smokers (n=80) underwent the 'arterial stress test': blood pressure and arterial stiffness before and after (2, 5, 10, 15, 20 minutes) an exercise test to exhaustion on a treadmill. Several indices were assessed: central and peripheral systolic blood pressure (SBP) and pulse pressure (PP), PP amplification (PPA), augmentation index corrected for a heart rate (HR) of 75 beats/min (Alx75), subendocardial viability ratio (SEVR), as well as carotid-femoral and carotid-radial pulse wave velocity (cfPWV and crPWV). Smokers were assessed under 3 conditions: a) after 12h smoking abstinence (chronic smoking), b) immediately after smoking one cigarette (acute smoking), and c) immediately after chewing nicotine gum.

Results: Smokers at rest had elevated Alx75 ($p<0.001$), and decreased PPA ($p<0.001$) compared to non-smokers. Smoking a single cigarette increased central SBP, HR, and PPA, and lowered SEVR (all $p<0.001$). In response to acute maximal exercise, smokers failed to achieve comparable exercise time ($p=0.015$) and maximal HR ($p<0.001$) as non-smokers. Furthermore, smokers on all 3 conditions demonstrated lower exercise-induced changes in Alx75 (all $p<0.001$) and SEVR (chronic $p=0.003$, acute and nicotine $p<0.001$) compared to non-smokers. After acute smoking, the exercise-induced increase in cfPWV was lower when compared to the chronic condition ($p=0.010$).

Conclusions: These findings demonstrate that acute and chronic smoking lead to an altered vessel hemodynamic response even in young healthy smokers. Therefore, the 'arterial stress test' may serve as a useful tool to identify vascular impairment in young smokers at an early subclinical stage.