

Dependency of Arterial Stiffness Indicators on Acute Blood Volume Changes

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Increased arterial stiffness is associated with greater risk for cardiovascular disease. It is unknown if indicators of stiffness are dependent on acute changes in cardiovascular conditions (such as altered central blood volume).

Objectives: To examine if arterial stiffness indicators change with acute reductions in stroke volume (SV) within normal physiological variability.

Methods: Seven young healthy volunteers (4M, 3F) were recruited to participate in this study. To acutely alter blood volume, subjects were sealed from their waist down into a lower body negative pressure (LBNP) box and a vacuum was used to create a pressure gradient of 30mmHg. Heart rate (HR) was continuously monitored and SV was obtained with Doppler ultrasound. Aortic and femoral artery velocity profiles were obtained with Doppler ultrasound to determine central pulse wave transit time (cPWTT). cPWTT was calculated by subtracting the time between the peak of the R-wave and the foot of the aortic velocity profile from the time between the peak of the R-wave and the foot of the femoral velocity profile. Common carotid distensibility (cDa) was determined with simultaneous tonometry to determine pulse pressure (PPcar) and ultrasound imaging to determine diastolic and systolic diameters ($cDa = \text{systolic area} - \text{diastolic area} / \text{PPcar} - \text{carotid diastolic area}$).

Results: The increase in HR from baseline to LBNP was not significant while SV was significantly lower at LBNP ($45 \pm 13 \text{ mL/beat}$) compared to baseline ($69 \pm 11 \text{ mL/beat}$; $p=0.002$). PPcar was lower at LBNP ($43 \pm 6 \text{ mmHg}$) compared to baseline ($48 \pm 5 \text{ mmHg}$; $p=0.007$). While cDa was significantly decreased (Baseline = $0.00732 \pm 0.00186 \text{ mmHg}^{-1}$ vs. LBNP = $0.00592 \pm 0.00219 \text{ mmHg}^{-1}$; $p=0.033$), cPWTT tended to get faster with LBNP (baseline = $95 \pm 17 \text{ sec}$ vs. LBNP = $87 \pm 13 \text{ sec}$; $p=0.089$).

Conclusions: The arterial stiffness indicators, cDa and cPWTT, might be affected by acute changes in central blood volume and cardiac SV within normal physiological variations.