Inter-individual differences in blood pressure responses to stressors: mental versus physical tasks

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Introduction. Elevated blood pressure (BP) responses to stressors in young people have been associated with greater risk of hypertension later in life. Evidence suggests that inappropriately large increases in BP in response to mental stress may be involved in the development of hypertension. However, what causes elevated cardiovascular reactivity to stress in some individuals but not others remains unclear. The aim of this project is to determine what drives the BP responses to mental and physical stresses in healthy young individual males.

Methods. Muscle sympathetic nerve activity (MSNA) (*via* microneurography), BP and heart rate (HR) responses to mental stressors (Stroop colour-word test and mental arithmetic) and physical stressors (cold pressor test, static handgrip exercise, and post-exercise ischaemia) were recorded in 16 healthy young (19-25 year old) males. Mean responses during each 2 min stressor test were compared to resting values for the 2 min period immediately prior to the task. The time course of each stressor task was examined over 15 s intervals. Repeated measures ANOVAs were performed to determine whether BP, HR and MSNA were significantly greater than the baseline values during the stressors and to compare the changes in these variables between stressors. Individuals who exhibited increases in systolic BP ≥10 mmHg were defined as 'responders,' while individuals who exhibited increases <10 mmHg were defined as 'non-responders'.

Results. We found that physical stressors elicited larger increases in BP, HR and MSNA than mental tasks. All subjects were defined as responders to physical tasks, but there was considerable inter-individual variability in the responses to mental stressors, with some subjects categorised as responders and others as non-responders. The increases in MSNA during the mental tasks were significantly lower than those during the physical tasks, for both responders and non-responders. The cold-pressor task elicited a significant increase of 6.45 ± 1.088 mV in total MSNA. Changes in total MSNA during the Stroop test were 1.37 ± 0.45 (responders) and 2.60 ± 1.61 (non-responders). Based on the time course plots, it was found that BP, HR and MSNA increase concurrently in response to handgrip exercise. During post-exercise ischaemia HR returned to baseline levels whilst BP and MSNA remained elevated. During the cold-pressor test, HR responded with a rapid increase, but there were gradual and concurrent increases in BP and MSNA, peaking at the end of the 2-min task period. For the Stroop test there were large increases in HR but changes in MSNA were modest and variable between subjects. Increases in HR were greater in responders (14.8 ± 4.5 beats/min) than non-responders (10.0 ± 2.9 beats/min). Similar responses were seen during mental arithmetic.

Conclusions. We conclude that during the cold-pressor test and post-exercise ischaemia, BP increases are driven primarily by the increases in MSNA. Increases in BP during handgrip exercise are driven by both HR and MSNA, whereas during the mental stressors the increases in BP are driven predominantly by HR. Interestingly, the HR response appears to be the dominant factor in determining whether an individual is a responder or a non-responder to mental stress.