Effect of Acute Isokinetic Resistance Exercise On Systemic Arterial Hemodynamics And Cerebral Blood Flow Dynamics: Is There a Mismatch?

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Resistance exercise (RE) is currently recommended for most adults and is important for reducing risk factors for cardiovascular and metabolic diseases, and improving quality of life. Despite functional and musculoskeletal benefits, high-intensity RE has been shown to acutely increase arterial stiffness and blood pressure, with reduced cerebral blood flow velocity and greater flow pulsatility in the cerebral circulation, which may be detrimental to cerebral microvasculature. Objective: The purpose of this study was to investigate the effects of an acute bout of RE on hemodynamics and cerebral vascular responses in recreationally active, young adults.

Methods: Fifteen healthy adults aged 18-35 years (~26 years, male=7) performed RE, which consisted of 3 sets of 10 repetitions of isokinetic concentric/concentric unilateral knee flexion/extension. All measurements were obtained at baseline and post-exercise (1,5,30-minutes). Beat-to-beat heart rate (HR), brachial blood pressure (bSBP, bDBP, bMAP), cardiac output (CO), stroke volume (SV), total vascular resistance (TVR) and end-tidal CO2 were collected. Cerebral vascular blood flow velocity (CBFv) was measured by Transcranial Doppler technology. Central blood pressures (cSBP, cDBP, cMAP), and central pulse wave velocity (PWV) were obtained using an automated ambulatory blood pressure monitor. Carotid artery beta-stiffness index was measured by ultrasonography.

Results: Mean CBFv increased at 1-minute post ($p<0.01$), but decreased below baseline values post 5-minute ($p<0.001$). In contrast, CBFv pulsatility increased following RE and remained significantly elevated at 5-minute post ($p<0.001$). TVR decreased post-RE ($p<0.001$), and returned back to baseline at post 30-mintue (See Table). PWV increased 1-minute post RE ($p<0.001$), returning to baseline values at 5-minutes. There were no increases in beta-stiffness index.

Conclusion: RE increased aortic stiffness, mean CBFv and CBFv pulsatility. Despite an increase in CO at 5-minute, mean CBFv drops below baseline values and CBFv pulsatility continued to rise further above baseline. This temporary disruption in cerebral autoregulation may impact brain health.

Variables	Baseline	1-minute	5-minute	30-minute
Heart Rate (bpm) *	68 ± 9 [abc]	89 ± 11 [bc]	78 ± 11	76 ± 9
CO (L/min) *	5.2 ± 1.0 [ab]	8.1 ± 1.5 [bc]	6.3 ± 1.2 **c**	5.5 ± 1.1
SV (ml/min) *	76.0 ± 17.5 [a]	90.0 ± 20.0 [bc]	80.1 ± 16.8 **c**	72.2 ± 17.0
bSBP (mmHg) *	122 ± 10 [a]	139± 12 [bc]	124± 11	123± 8
bDBP (mmHg) *	73 ± 7 [a]	77 ± 8 [b]	72 ± 6	75 ± 5
bMAP (mmHg) *	93 ± 8 [a]	102 ± 9 [bc]	93 ± 7	95 ± 5
TVR (mmHg*min / L)	18 ± 3 [ab]	13 ± 2 [bc]	15 ± 2 **c**	18 ± 3
cSBP (mmHg) *	108± 11 [a]	120± 11 [bc]	113± 8	109± 9
cDBP (mmHg) *	79± 9 [a]	87± 8 [bc]	81± 6	81± 8
cMAP (mmHg) *	97± 9 [a]	107± 8 [bc]	100± 7	98± 7
PWV (m/s) *	5.2 ± 0.5 [a]	5.6 ± 0.5 [bc]	5.3 ± 0.5	5.2 ± 0.4
Carotid Max Diameter (mm) *	6.90 ± 0.54 [abc]	6.61 ± 0.54	6.62 ± 0.54	6.70 ± 0.55
Carotid Min Diameter (mm) *	6.39 ± 0.50 [ab]	6.04 ± 0.54	6.10 ± 0.50	6.23 ± 0.53
Beta-Stiffness Index	6.3± 1.6	5.9 ± 1.5	6.1± 1.2	6.4 ± 1.3
CBFv Mean (cm/s) *	59 ± 15 [ab]	70 ± 23 [bc]	55 ± 13 **c**	58 ± 13
CBFv Pulsatility Index *	0.86 ± 0.09 [b]	0.97 ± 0.19 [c]	1.02 ± 0.12 **c**	0.84 ± 0.11
End-Tidal CO2 *	1.95 ± 0.44 [ac]	2.23 ± 0.55 [bc]	1.82 ± 0.47	1.75 ± 0.53

All Data are mean ± SD, * Exercise effect, $p<0.05$. **a** significantly different from 1 min, **b** significantly different from 5 min. **c** significantly different from 30 min, $p<0.05$.