Adaptations of aortic and pulmonary artery flow parameters measured by phase-contrast magnetic resonance angiography during supine aerobic exercise

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Abstract: Purpose: Increased oxygen uptake and utilisation during exercise depend on adequate adaptations of systemic and pulmonary vasculature. Recent advances in magnetic resonance imaging techniques allow for direct quantification of aortic and pulmonary blood flow using phase-contrast magnetic resonance angiography (PCMRA). This pilot study tested quantification of aortic and pulmonary haemodynamic adaptations to moderate aerobic supine leg exercise using PCMRA.

Methods: Nine adult healthy volunteers underwent pulse gated free breathing PCMRA while performing heart rate targeted aerobic lower limb exercise. Flow was assessed in mid ascending aorta and main pulmonary artery during exercise at 180% of individual resting heart rate. Flow sequence analysis was performed by experienced operators using commercial offline software (Argus, Siemens Medical Systems).

Results: Exercise related increase in HR (rest: 69±10 b·min⁻¹, exercise: 120 ±13 b·min⁻¹) resulted in cardiac output increase (from 6.5±1.4 L·min⁻¹ to 12.4±1.8 L·min⁻¹). At exercise, Ao systolic peak velocity increased from 89±14 cm·s⁻¹ to 122±34 cm·s⁻¹ (p=0.016), PA systolic peak velocity from 86±18 cm·s⁻¹ to 140±48 cm·s⁻¹ (p=0.007), Ao systolic peak flow rate from 415±83 ml·s⁻¹ to 550±135 ml·s⁻¹ (p=0.002) and PA systolic peak flow rate from 410±80 ml·s⁻¹ to 577±180 ml·s⁻¹ (p=0.006).

Conclusion: Quantitative blood flow and velocity analysis during exercise using PCMRA is feasible and detected a steep exercise flow and velocity increase in Ao and PA. Exercise PCMRA can serve as a research and clinical tool to help quantify exercise blood flow adaptations in health and disease and investigate patho-physiological mechanisms in cardio-pulmonary disease.

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