

### Reproducibility of a steady-state submaximal CMR-guided exercise test

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**Background:** We have designed an exercise test to assess cardiac function and hemodynamic changes by cardiovascular MR (CMR) during steady-state submaximal physical stress at 25% of maximum oxygen consumption. The aim of this study was to prove the reproducibility of this exercise test.

**Method:** We twice examined ten healthy volunteers ( $24 \pm 3$  years old) with the CMR steady-state submaximal stress test. To do this, we fixed a pulley to a special frame, which we mounted on the MR-table. The volunteers' legs were connected by a rope passing over the pulley. Steady-state exercise was defined as 144 up and down strokes of the extended legs per minute, directed by an electronic metronome. We measured Heart Rate (HR), Blood Pressure (BP), enddiastolic volume of the left ventricle (LV-EDV) and Cardiac Index (CI) first under rest and then under stress and compared the stress results of both tests; we also compared the change from rest to stress in both examinations.

**Results:** HR increased by  $36 \pm 26\%$  during the first, and by  $31 \pm 18\%$  during the second examination ( $\Delta 5\%$ ). During the first stress test, stress HR was  $13 \pm 8\%$  higher than it was at the second time. Systolic and diastolic BP increased by  $12 \pm 6\%$  and  $24 \pm 17\%$  at the first, and by  $8 \pm 5\%$  and  $16 \pm 15\%$  at the second test, respectively ( $\Delta 4\%$  and  $\Delta 8\%$ ); during the first test, BP was  $14 \pm 8\%$  and  $21 \pm 12\%$  higher than at the second one, respectively. LV-EDV decreased by  $5 \pm 4\%$  during the first, and by  $13 \pm 9\%$  during the second examination ( $\Delta 8\%$ ). The first stress LV-EDV was  $8 \pm 7\%$  higher than the second one. Stress CI first increased by  $33 \pm 19\%$  and then by  $41 \pm 20\%$  ( $\Delta 8\%$ ), there was no difference in stress CI between both tests.

**Conclusion:** HR and BP were higher at the first test compared to the second one. This may be explained by a learning process of the volunteers, but has to be studied further. However, the changes of LV-EDV and CI were very similar. The stress test may give new insights into hemodynamics of different underlying congenital heart defects.