Results of cardiopulmonary exercise testing correlate with functional parameters of cardiac MRI in adult Fontan patients - implications for long-term follow-up

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Objectives: To improve long-term outcome of Fontan patients, adequate and continuous follow-up examinations are mandatory. Cardiac MRI (CMR) is a valuable, non-invasive tool to accurately assess cardiac function and quantify Fontan flow. However, CMR is time- and resource-consuming. On the contrary, determination of cardiopulmonary capacity by cardiopulmonary exercise testing (CPET) can easily be performed on a regular basis during follow-up. We therefore analyzed the relationship of CMR measurements with cardiopulmonary capacity in Fontan patients.

Methods: In a retrospective review of our outpatient database covering the last five years, we identified 53 Fontan patients who had both CMR and CPET during regular scheduled visits. At follow-up examination, median age was 18.3 years (range 5.3-48.8) and median follow-up after Fontan operation 11.3 years (range 0.4-22.8). 29 patients were adolescent (>16 years) and adult patients while 24 were children. We compared oxygen uptake capacity (VO2max) determined by CPET with CMR parameters of cardiac function and flow dynamics such as ejection fraction (EF), cardiac index (CI) and venous return (vCl).

Results: In the entire cohort, EF was 53±13%, CI was 3.0±0.7L/min/m², vCl was 2.8±0.6L/min/m² and VO2max was 50.6±14.5% of healthy controls. Except for a higher vCl in children (3.0±0.6 vs. 2.6±0.6L/min/m², p=0.03) parameters did not differ significantly between age groups. We found a modest but significant correlation of EF (r=0.43, p=0.002), CI (r=0.39, p=0.006) and vCl (r=0.40, p=0.005) with VO2max. Interestingly, when analyzing age subgroups, a correlation of CI and vCl with VO2max was not confirmed in children (r=0.31, p=0.17 and r=0.25, p=0.25), while clearly present in adolescent and adult patients (r=0.45, p=0.02 and r=0.56, p=0.004, respectively).

Conclusions: Correlation of cardiopulmonary capacity measured by CPET and CMR cardiac function and hemodynamic parameters is modest but significant. In adolescent and adult Fontan patients there is a good correlation of CPET with CI and vCl. Thus, regular CPET should be routinely performed during follow-up, since it allows to estimate deterioration of cardiac function and hemodynamics and might indicate necessity for further investigation or even intervention. In younger Fontan Patients however, CPET seems to be of limited suitability for this purpose.