Impact of Pulsatile Pulmonary Blood Flow on Cardiopulmonary Exercise Performance long after the Fontan procedure

Objective: To evaluate the results of exercise capacity test in patients following atriopulmonary connections (Fontan–Kreutzer), atroventricular connections (Fontan-Björk) and total cavopulmonary connection (TCPC).

Methods: A total of 229 patients who performed exercise capacity test at least one time after the Fontan procedure between 1979 and 2007 were included. Patients after Fontan-Björk procedure were divided into two groups according to the pulmonary blood flow (PBF) pattern: patients with pulsatile PBF and those without. Peak oxygen uptake (VO2) was measured and age- and sex-related reference values (percent-predicted peak VO2) were calculated.

Results: The types of the Fontan procedure included Fontan-Kreutzer in 50 patients, Fontan-Björk in 38 patients (11 with pulsatile PBF and 27 without pulsatile PBF), and TCPC in 141 patients. Median age at the Fontan procedure was 4.5 (IQR: 2.1-8.2) years (Fontan-Kreutzer: 7.8 (5.1-13.1), Fontan-Björk: 5.9 (2.2-7.9), and TCPC: 2.9 (1.9-6.5) years). Median follow-up was 20.0 (16.0-24.4) years. A total of 978 cardiopulmonary exercise tests were performed at median follow up of 17.7 (11.3-23.4) years postoperatively. Yearly distributions in percent peak VO2 in individual patients are shown in Figure. Percent-predicted peak VO2 was higher in patients with pulsatile PBF after Fontan-Björk (76.1 (64.0-83.9) %) compared to patients without pulsatile PBF after Fontan-Björk (59.0 (46.1-69.5) %, p<0.001), to patients after Fontan-Kreutzer (62.2 (51.5-71.3) %, p<0.001) and to patients after TCPC (66.0 (56.0-79.3) %, p=0.026). Percent-predicted peak VO2 was negatively correlated with the follow-up period in patients with pulsatile PBF after Fontan-Björk procedure, (R=0.410, p<0.01), and in patients after TCPC (R=0.228, p<0.01), but was not correlated with the follow-up period in patients without pulsatile PBF after Fontan-Björk (R=0.046, p=0.569) and in patients after Fontan-Kreutzer (R=0.115, p=0.084).

Conclusions: In long-term survivors after various types of Fontan procedure, patients with pulsatile pulmonary blood flow after the Fontan-Björk procedure demonstrated a better exercise performance, compared to those after TCPC, those after Fontan-Kreutzer procedure, and those after the Fontan-Björk procedure with non-pulsatile pulmonary blood flow. The results implicate the importance of pulsatile pulmonary flow to maintain the Fontan circulation.

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Percent-predicted peak VO2

Years after the Fontan procedure

- Fontan-Björk (P)
- Fontan-Björk (N)
- Fontan-Kreutzer
- TCPC