

Abnormal Biophysical Properties of the Aorta in Post Surgical Patients with Congenital heart diseases: a Non-Invasive Study

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Introduction

Many congenital heart diseases (CHD) are associated with congenital and/or acquired structural alterations of the aortic wall, but little data are available on the functional status of the aorta. Using non invasive techniques, we sought to assess the aortic biophysical properties, total arterial compliance, hydraulic power and efficiency in post operative children with: [1] tetralogy of Fallot (TET); [2] coarctation of the aorta (COA) and [3] transposition of great arteries (TGA).

Methods

55 children with CHD (TET=24, 15.2y, COA=20, 13.4y, and TGA=11, 14.3y) were compared with 55 matched controls (CTRL, 14.1y). M-mode, and Doppler echocardiographic imaging, and carotid artery applanation tonometry were used to measure aortic flows and dimensions. Pulse-wave velocity (PWV), input (Zi) and characteristic (Zc) impedance, arterial stiffness (Ep) and β -index were calculated. Total arterial compliance (TAC), mean (Wm) and total (Wt) hydraulic power, and efficiency (HE) were calculated from carotid pulse tracings and flows using standard fluid dynamics equations. A Mann-Whitney U test was used to determine differences between groups. A p-value of 0.05 was considered statistically significant.

Results

All CHD subgroups had higher PWV (TET=492, COA=458, TGA=527 vs CTRL=360 cm/s) and TAC (TET=1.71, COA=2.32, TGA=2.34 vs CTRL=1.35 mL/torr/m²) compared to CTRL. COA and TET had higher Zc (COA=234, TET=177 vs CTRL=138 dyne sec/cm⁵). Ep, β -index and Zi were similar. Wm and Wt were higher in TGA compared to TET and CTRL (TGA=1010 vs TET=730 and CTRL=680 mW/m²) and (TGA 1273 vs TET=936 and CTRL=830mW/m²), respectively. HE was higher in TET compared to COA and TGA (TET 86% vs COA 83% and TGA 82%).

Conclusion

Children with post-operative TET, COA and TGA have stiffer aortas, increased work and higher total arterial compliance than CTRL. It is unclear if this is related to intrinsic lesions of the aorta, alterations of the aorta due to surgical repair or other factors. Further studies and follow up are needed to determine if these abnormalities predispose these patients to long-term cardiac dysfunction and cardiovascular risk.