AORTIC ARCH FLOW PROPERTIES IN PATIENTS WITH A SINGLE VENTRICLE AND AORTIC ARCH RECONSTRUCTION

Bonilla-Ramirez, Carlos [1], Charles E. Puelz[2], E. Dean McKenzie[3], Christopher A. Caldarone[3], Justin D. Weigand[2]

[1] Baylor College of Medicine, Department of Surgery, Congenital Heart Surgery
[2] Texas Children's Hospital, Pediatrics, Pediatric Cardiology
[3] Texas Children's Hospital, Surgery, Congenital Heart Surgery

Keywords: Single ventricle

Background: We studied the impact of aortic arch reconstruction on aortic arch flow properties in patients with a single ventricle physiology.

Materials/Methods: We used 4-dimensional flow cardiac magnetic resonance imaging to compare flow properties in single-ventricle patients with and without aortic arch reconstruction. The aortic arch reconstruction group consisted of 4 patients with hypoplastic left heart syndrome who had undergone the Norwood procedure. The control group (no arch reconstruction) consisted of 4 patients with double outlet right ventricle and mitral atresia matched 1:1 to arch reconstruction patients by age, body surface area, and body weight. Recirculating turbulent flow in the aortic arch was qualitatively evaluated (Figure). Flow data, pulse wave velocity (surrogate for vessel stiffness), and wall shear stress were quantitatively derived.

Results: The median age, weight, body surface area, and stroke volume were similar between the arch reconstruction (13.3 years, 50 kg, 1.46 m^2, 56 ml) and control (13.4 years, 53 kg, 1.56 m^2, 62 ml) groups. All patients in the arch reconstruction group had diastolic recirculating turbulent flow, while no patients in the control group had recirculating turbulent flow. The arch reconstruction group had a lower fraction of stroke volume directed to the head and neck vessels (median 41%, IQR 38-42 vs median 54%, IQR 49-59). Aortic pulse wave velocity was higher in patients with a reconstructed arch (median 4.5 m/s, IQR 3.6-5.9) compared to controls (median 2.7 m/s, IQR 2.4-3). Wall shear stress was lower in patients with a reconstructed arch (median 3 Pa, IQR 2.7-3.1) compared to controls (median 3.7 Pa, IQR 3.3-4.1).

Conclusions: Fontan patients with aortic arch reconstruction have disturbed aortic flow patterns, stiffer aortic walls, and demonstrate reduced flow to the head and neck vessels compared to Fontan patient with native aortas. Understanding postoperative flow patterns may help inform design of aortic arch reconstruction.

Images / Graph / Table