

Cardiac index is not related to Ventricular Ejection Fraction in different types of Total Cavo Pulmonary Connection

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Introduction : Cardiac Magnetic Resonance (CMR) is nowadays the "gold standard" diagnostic technique for patients underwent Total Cavo Pulmonary Connection (TCPC) completion. Little is known about MRI findings after different types of Fontan palliations.

Methods: We retrospectively reviewed CMR performed between 2008 and 2017 in patients underwent TCPC completion with Extracardiac conduit or Classic Fontan in a single center. All the studies comprehended ventricular function assessment and a complete set of cardiac flow allowing calculation of cardiac index and effective cardiac index (measured from the sum of SVC and IVC net flow). Atrio ventricle valve regurgitation was calculated by a combined analysis of volumes and cardiac flows. Medical, surgical and clinical data were collected from hospital records.

Results: One hundred thirteen (113) patients were included. Mean age at MRI was 19.7 ± 6.7 years, mean age at TCPC was 5.7 ± 4.5 years. Extracardiac tunnel was the most common type of palliation (105 pts; 93%), whilst Classic Fontan was performed in 8 pts (7%). Main CMR findings between the two subgroups are summarized in Table 1.

Comparing the two subgroups of different type of palliation there were no differences in term of EF ($p = 0.75$), and of presence of at least moderate AV valve regurgitation ($p=0.9$). No differences ($p = 0.62$) were found in term of MACE (death, heart transplant, and listing for heart transplant due to failing). Despite the comparable findings a significant difference was found in term both of cardiac index and effective cardiac index ($p < 0.001$ and $P = 0.02$ respectively) between the Extracardiac conduit and the Classic Fontan subgroups.

Conclusions: Despite comparable value of ventricle function, AV valve regurgitation and percentage of systemic to pulmonary collaterals, cardiac indexes measured by CMR are higher in patients with Extracardiac Tunnel Fontan compared to the ones underwent Classic Fontan. This finding suggests a better efficiency of the Fontan system in this subgroup, and confirms that cardiac output in Fontan patients is not only related to ventricle function but is dependent on the combination of many different factors.

Table 1

	Classic Fontan N = 8	Extra- cardiac N = 105	p
Male sex; n (%)	4 (50%)	62 (59%)	0.61
Age at MRI; (yrs)	29.8 ± 7.9	$18,9 \pm 6$	<0.001
Age at TCPC; (yrs)	4.9 ± 2.4	5.8 ± 4.7	0.581
Time MRI from Fontan; (yrs)	25.5 ± 5.7	13.5 ± 5.8	<0.001
Saturation at rest (%)	93 ± 5	95 ± 3	0.186
Heterotaxy; n (%)	0 (0%)	15 (14%)	0.25
Main ventricle type:			
-Left; n (%)	6 (75%)	62 (59%)	0.374
-Right; n (%)	2 (25%)	27 (26%)	0.964
-Biventricular; n (%)	0 (0%)	16 (15%)	0.228
Indexed EDVV (ml/m ²)	69.3 ± 19.3	98.4 ± 27.1	0.004
EF (%)	51 ± 11	50 ± 9	0.749
EF < 45%; n (%)	3 (38%)	24 (23%)	0.349
CI (l/min/m ²)	2.2 ± 0.6	3.1 ± 0.6	<0.001
Effective CI (l/min/M ²)	2 ± 0.5	2.6 ± 0.6	0.02
RPA/LPA net flow ratio	1.1 ± 0.3	1.7 ± 3.4	0.621
SP collateral flow; (%)	16 ± 12	19 ± 10	0.2
AVVR \geq moderate; n (%)	1 (12.5%)	13 (12%)	0.9
MACE; n (%)	1 (12.5%)	8 (8%)	0.62