Journal of Cardiovascular Magnetic Resonance

BioMed Central

Meeting abstract

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209 MRI cardiac catheter assessment of total and differential pulmonary vascular resistance in the context of single ventricle physiology

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from 11[th] Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 1–3 February 2008

Published: 22 October 2008

Journal of Cardiovascular Magnetic Resonance 2008, **10**(Suppl 1):A70 doi:10.1186/1532-429X-10-S1-A70

This abstract is available from: http://jcmr-online.com/content/10/S1/A70

Introduction

In patients with complex cyanotic heart disease, pulmonary blood flow may be derived from more than one source, making assessment of pulmonary vascular resistance (PVR) difficult by conventional methods. Phase contrast MRI (PC-MRI) combined with invasive cardiac catheterization enables accurate measurement of the PVR. We demonstrate the application of MRI catheter in this patient group.

Hypothesis

MRI Cardiac catheter can assess the PVR in these patients, including those with multiple sources of pulmonary blood flow.

Methods

MRI cardiac catheterisation was performed in a combined XMR suite with a Philips 1.5 T Intera Achieva MR scanner and a single plane cardiac X-Ray unit. All patients underwent MRI cardiac catheter under general anaesthesia and were ventilated to normocarbia. Simultaneous pressure measurements were obtained with PC-MRI according to the vascular anatomy. Differential pulmonary blood flow was measured distal to all sources of blood flow. For those patients with multiple sources of blood flow, PVR was calculated by the equation: $1/PVR_{total} = 1/PVR_{left} + 1/PVR_{right}$. Data is expressed as mean (± standard deviation), means are compared with a 2-tailed t-test.

Results

Twenty MRI cardiac catheters were performed in 18 patients with complex cyanotic disease, median age 3.63 years (0.5 to 41.7). For all patients, the mean PVR was 2.95 WU.m^2 (± 1.41). Differential PVR was measured in 11 patients, the mean PVR_{right} was 6.70 (± 2.01) WU.m^2 and was significantly elevated compared to the mean PVR_{left} of 3.49 (± 1.12) WU.m^2 (p = 0.002). Seven of these patients had multiple sources of pulmonary blood flow (Table 1). Seventeen patients were being investigated for suitability for progression to the next stage of cavo-pulmonary connection, 11 patients were suitable and 6 were unsuitable. The mean PVR or those suitable was 2.35 WU.m^2 (± 0.58) compared to 4.54 WU.m^2 (± 1.57), p = 0.017, for those who were unsuitable for further cavo-pulmonary palliation. The remaining three patients underwent assessment for complications related to the fontan circuit, the mean PVR was 2.14 in this group.

Conclusion

In patients with a single ventricle physiology, the PVR needs to be low in order to proceed with palliation by means of a cavo-pulmonary connection. This can be determined by MRI cardiac catheter. Additionally, this technique offers the advantage of being able to measure the differential pulmonary vascular resistance, even in the context of multiple sources of pulmonary blood flow. We

Table 1: Patients with multiple sources of pulmonary blood flow. MRI Cardiac Catheter allows for the measurement of pulmonary vascular resistance in patients with complex congenital heart disease. Differential pulmonary vascular resistance can be measured when there are multiple sources of pulmonary blood flow.

	Age (years)	Diagnosis	Procedures	Sources of pulmonary blood flow	PVR (WU.m^2)			Outcome
					Right	Left	Total	
1	3.1	Right atrial isomerism Complete atrioventricular septal defect Double outlet right ventricle Recurrent chylothoraces	TCPC	SVC and IVC	4.4	3.6	2.0	Conservative management of chylothoarces
2	3.0	Hypoplastic Left Heart Syndrome Recurrent ascites	TCPC	SVC and IVC	6.8	5.0	2.9	Recreation of atrial fenestration
3	12.5	Double inlet left ventricle Transposition Great Arteries Hypoplastic right ventricle	SCPC	SVC MPA	3.3	4.3	1.9	Proceed to TCPC
4	11.5	Right atrial isomerism Atrioventricular Septal Defect Pulmonary atresia Protein losing enteropathy	TCPC	SVC and IVC	9.3	1.9	1.6	Medical treatment of protein losing enteropathy
5	13.7	Mitral valve dysplasia Hypoplastic left ventricle Double outlet right ventricle	PA Band	MPA Right MBTS	6.9	2.7	1.9	Proceed to SCPC
6	1.47	Pulmonary atresia intact ventricular septum	Pulmonary valvotomy and ductal stent	MPA Arterial duct	6.0	3.3	2.1	Proceed to SCPC
7	41.7	Situs inversus Double inlet left ventricle Atrioventricular septal defect Pulmonary stenosis	Right MBTS Pulmonary valvotomy	MPA Right MBTS	5.5	3.2	2.0	Suitable for SCPC, patient elected for conservative management

Abbreviations: TCPC – Total cavo-pulmonary connection, SVC – superior vena cava, IVC – inferior vena cava, MPA – Main Pulmonary Artery, SCPC – Superior cavo-pulmonary connection, MBTS – Modified Blalock Taussig shunt.

have found a difference in the mean PVR between the right and left lungs, which merits further investigation.