

82 RELATIONSHIP BETWEEN CARDIAC STRUCTURE AND FUNCTIONAL CAPACITY IN A FONTAN COHORT

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Introduction Follow up of Fontan patients involves a multimodality approach including imaging to assess cardiac function and cardiopulmonary exercise testing (CPET) to assess functional capacity. Decision making, including use of device therapy in conventional heart failure patients utilises predominantly structural information. We sought to assess whether cardiac structure as measured by conventional cardiac magnetic resonance parameters was related to functional capacity as assessed by CPET in a large Fontan cohort.

Methods 233 Fontan patients under follow up were identified. Of these 76 patients had undergone a CMR and CPET within 12 months. The cohort was divided into 2 groups 1) 47 patients with either a lateral tunnel or total cavo-pulmonary connexion (TCPC group); mean age 19±4 years, 51% male and 2) 29 patients with an atriopulmonary Fontan (AP group); age 29±7 years, 48% male.

Results There were no significance differences in imaging parameters between the 2 groups. The peak VO₂ was significantly higher in the TCPC group (27±9 ml/kg/min) compared to the AP group (22±8 ml/kg/min, p 0.009) (Table 1). In the TCPC group only 19% of patients had a EF<55% whilst in the AP group this was 17%. Predicted VO₂ was reduced in both (TCPC 67±19%, AP 62±18%).

In the TPCP group the end diastolic volume (EDV), end systolic volume (ESV), stroke volume (SV) and ejection fraction (EF) did not correlate with the peak VO₂, nor ventilatory product. Ventricular EF negatively correlated to NYHA class (r=-0.41, p 0.005) as did ventricular mass (r=-0.49, p 0.04). Rest partial pressure exhaled CO₂ (rest PETCO₂)

correlated with the EDV (r=0.30, p 0.04) and SV (r=0.32, p 0.03). In the AP group there was no correlation either between EDV, ESV, SV and EF with VO₂ peak or ventilatory product. Rest PETCO₂ correlated with EDV (r=0.37, p 0.04), whilst rest O₂ pulse correlated with SV (r=0.48, p 0.009) and ventricular mass (r=0.53, p 0.02).

When determined for each functional class in the TCPC group there was no difference in EDV (p 0.75). Ventricular EF was different between NYHA Class: NYHA I (n=29) EF 64±8%, NYHA II (n=12) 55±7%, NYHA III (n=4) 63±7%, NYHA IV (n=1) 51%, P 0.005, but this did not represent a stepwise decline. In the AP group for each functional class there was no difference in EDV (p 0.1) or EF (p 0.6). The peak VO₂ was different between functional classes for the TCPC and AP groups. The TCPC results were NYHA Class I 29±8; NYHA II 23±8; NYHA III 25±5; NYHA IV 11 p 0.03, whilst those for the AP group are NYHA I 25±7; NYHA II 19±7; NYHA III 16±5, (units ml/kg/min, p 0.006).

Discussion This study demonstrates that no conventional cardiac remodelling parameters related to the patients functional capacity. Fontan patients may be disadvantaged when assessed for advanced heart failure strategies as ventricular EF is a poor marker of functional capacity in this cohort and a study assessing response based on exercise parameters may be warranted.

83 USE OF FEATURE TRACKING TO ASSESS SYSTEMIC RIGHT VENTRICLES IN CONGENITAL HEART DISEASE PATIENTS WITH BOTH SINGLE AND DUAL VENTRICULAR CIRCULATIONS

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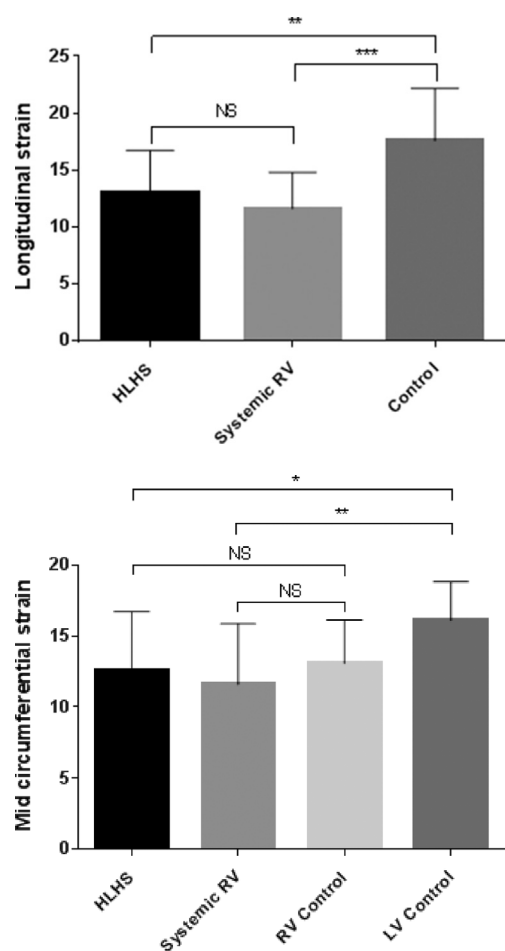
Abstract 82 Table 1 Imaging parameters and exercise parameters for the TCPC Fontan group compared to the AP Fontan Group

	TCPC Fontan (n=47)	AP Fontan (n=29)	P value
Imaging parameters			
End diastolic volume, ml	143 ± 57	132 ± 58	0.42
End systolic volume, ml	56 ± 28	57 ± 37	0.93
Stroke volume, ml	86 ± 32	75 ± 29	0.12
Ventricular mass, g	88 ± 24	107 ± 49	0.13
Ejection fraction, %	61 ± 8	59 ± 9	0.21
Exercise parameters			
Peak VO ₂ , ml/kg/min	27 ± 9	22 ± 8	0.009
Maximum workload, RER peak	1.1 ± 0.1	1.1 ± 0.1	0.99
Ventilatory product ml/beat*mmHg	324 ± 170	325 ± 147	0.99
VE/VCO ₂ slope	34.5 ± 5.7	36.0 ± 8.3	0.36

Abstract 83 Table 1 Conventional right ventricular imaging parameters for the three study groups

	Hypoplastic left heart syndrome	Systemic right ventricle	Controls	P value (between groups)
RV end diastolic volume index, ml/m ²	107 ± 36	117 ± 30 #	88 ± 21	0.031
RV end systolic volume index, ml/m ²	51 ± 24	60 ± 25 #	33 ± 10	0.003
RV stroke volume index, ml/m ²	56 ± 17	57 ± 15	55 ± 14	0.921
RV ejection fraction, %	54 ± 10 *	50 ± 11 #	62 ± 5	0.001
RV mass index, g/m ²	41 ± 12 *	45 ± 9 #	32 ± 6	0.001

* p < 0.05 between hypoplastic left heart group and controls # p < 0.05 between systemic right ventricle group and controls



Abstract 83 Figure 1 A) Mean longitudinal strain for the RV of patients with a single ventricle (HLHS), a systemic RV in a dual ventricular system (systemic RV) and the RV of healthy controls. B)

Introduction The management of congenital patient's frequently utilises cardiac magnetic resonance imaging to assess changes in patients cardiac function. Ventricular function assessment is challenging in this cohort due to complex ventricular geometry. Feature tracking uses routinely acquired MRI images to assess ventricular strain, a measure of cardiac contractility, which has been found in non-congenital cohorts to be a more sensitive marker of ventricular dysfunction than conventional imaging parameters.

We hypothesised that 1) patients with a systemic ventricle of right ventricular (RV) morphology would have impaired strain parameters compared to controls and 2) patients with a systemic RV in a single ventricle circulation would have more impaired contractility than those with a dual ventricular circulation.

Methods 3 groups were analysed: 1) 16 patients with hypoplastic left heart syndrome (HLHS) resulting in a single ventricle circulation (mean age 20 ± 2 years; 81% male) 2) 16 patients with a systemic RV (sRV) in a dual ventricle circulation (age 32 ± 5 years; 63% male) and 3) 16 healthy controls (mean age 30 ± 4 years; 56% male). Participants underwent CMR at 1.5T for ventricular function assessment, analysis was undertaken using Circle cvi42 (v5.3) to calculate RV mid ventricular circumferential strain and peak longitudinal strain.

Results The two patient groups had increased RV volumes with reduced ejection fraction (EF), elevated RV mass, but similar stroke volumes compared to controls (Table 1).

The peak longitudinal RV strain was significantly reduced between the patient groups (HLHS mean -13 ± 4 ; sRV -12 ± 3) compared to controls (-18 ± 5 , $p < 0.001$). However, there was no difference between the HLHS and sRV groups. Mid circumferential RV strain was not significantly different between both patient groups and also compared to controls (HLHS -13 ± 4 , sRV -12 ± 4 , controls -13 ± 3 , $p = 0.6$). However comparison of mid circumferential RV strain to controls LV strain showed a significant reduction (controls LV mid circumferential strain mean -16 ± 3 , $p = 0.004$) (Figure 1).

The peak longitudinal strain in patients correlated with the RV end diastolic volume index ($r=0.38$, $p 0.03$), RV end systolic volume index ($r=0.52$, $p 0.002$), RV EF ($r=0.535$, $p 0.002$) and RV mass index ($r=0.43$, $p 0.01$). The mid RV circumferential strain only correlated with RV EF ($r=0.40$, $p 0.02$) and no other remodelling parameters.

Discussion RV longitudinal strain was reduced in patients with a systemic RV irrespective of whether the ventricular configuration was single or dual. No difference was seen between the single circulation systemic RV compared to the dual circulation systemic RV, suggesting that RV remodelling is mostly in response to the systemic position rather than the ventricular configuration. Longitudinal studies will be required to assess the utility of the longitudinal strain in the prediction of outcomes in the follow up of these patients.

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AN ASSESSMENT OF THE PERFORMANCE OF THREE BIOLOGICAL TRICUSPID VALVE REPLACEMENTS IN PATIENTS WITH CONGENITAL HEART DISEASE

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Objective To assess the performance of three Biological Tricuspid Valve replacements (St Jude Epic, Perimount and Hancock) in congenital heart disease patients. Currently, there is little comparative data on the long term performance of these biological tricuspid valve replacements.

Methods We audited the performance of the valve replacements in all the patients with Congenital Heart Disease ($n=50$) who had Biological Tricuspid Valve replacements in the Queen Elizabeth Hospital, Birmingham, from 2000 to present. For each patient, we collected echocardiogram data at baseline (the first data available after their surgery) and at their most recent review. Valve performance was assessed according to criteria set out by the American Society of Echocardiology (ASE) in terms of valve stenosis and regurgitation. We also looked at patient-reported symptoms before surgery and at most recent review.

Valve was Stenosed if one or more of the following was met: Mean gradient 6 mmHg; Peak velocity >1.7 m/s; Pressure half time >230 ms.

Valve was Regurgitant if the following was met: Tricuspid regurgitation $>$ Mild regurgitation on report.

Patient Declined symptomatically if one or more of the following was met: NYHA class unchanged or worsened; new arrhythmia post-op; decrease in measured peak VO_2 . All mortalities that occurred during follow-up were recorded. These patients were not included in the analysis.

Results Only two Hancock valves had been used since 2000, which was too few to be able to draw any reliable conclusions. Table 1 presents background data for the other two valves; Table 2 presents the comparison of their performance. Proportionately fewer Perimount valves became stenosed or regurgitant than the St Jude Epic valves. St Jude Epic valves were associated with improved peak VO_2 , however average NYHA class reduction (improvement) was greater in those with the Perimount. This may reflect the case mix in this small number of patients.

Abstract 84 Table 1

	Perimount Valve	St Jude Epic Valve
No. of operations performed	16	27
No. of survivors	13	24
Average follow-up (years)	3.49	3.00
Total patient-years of follow-up	41.9	68.9

Abstract 84 Table 2

	Perimount Valve	St Jude Epic Valve
Percentage 'stenosed' at baseline	0.0	8.7
Percentage 'stenosed' at follow-up	11.1	22.2
Percentage difference	11.1	13.5
Percentage 'regurgitant' at baseline	9.1	0.0
Percentage 'regurgitant' at follow-up	23.1	21.7
Percentage difference	14.0	21.7
Percentage 'declined symptomatically'	46.2	37.5
Average NYHA class change	-1.31	-0.91
Average VO_2 max change	-8.6	5.43

Discussion and conclusion Tricuspid valve replacement is rarely performed and the choice of which valve to use is not assisted by any published data. This audit suggests that the Perimount valve in the tricuspid position has a marginally better echo profile than the St Jude Epic valve over a three year follow up. The cohort is too small to make recommendations on which valve to use, but has highlighted a relatively high early attrition rate in terms of bioprosthetic valve function in the tricuspid position.

Therefore we propose that valve surveillance is carried out annually for these valves and that valve dysfunction merits further investigation. We propose to perform CT evaluation of dysfunctional bioprosthetic valves for evidence of thrombus and this will be prospectively audited.

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POST OPERATIVE COMPLICATIONS IN ADULT CONGENITAL HEART DISEASE

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Introduction Increasing numbers of adults with congenital heart disease (ACHD) are undergoing redo or primary surgical procedures. There is little available data relating to post-operative mortality and morbidity in this group.

Methods We examined 99 consecutive ACHD patients who underwent cardiac surgery in our institution over twelve months from April 2015. Data collected included age, body mass index (BMI), type of procedure, whether the procedure was a primary procedure or a redo, length of stay and the occurrence of any complications. Complications were classified as requiring intervention or self-limiting. Whether complications had permanent long term sequelae or not was assessed.

Results Patients were aged between 16 and 69 years. 41 patients underwent a primary procedure, and there were 58 redo operations. 19 different primary procedures were