Poster presentation

Circumferential strain analysis reveals occult cardiac dysfunction in palliated single ventricle patients

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Introduction

It has been estimated that 40-50% of patients with single ventricular anatomy develop ventricular dysfunction by the time they undergo the Fontan operation. Once overt ventricular dysfunction has been detected there are limited treatment options. Traditional methods of functional assessment by echocardiogram (TTE) or cardiac magnetic resonance imaging (CMR) may not be sensitive enough to detect early evidence of cardiac dysfunction. We previously demonstrated that strain analysis (ε_{cc}) using feature tracking (FT) of steady state free precision (SSFP) cine images was feasible.

Purpose

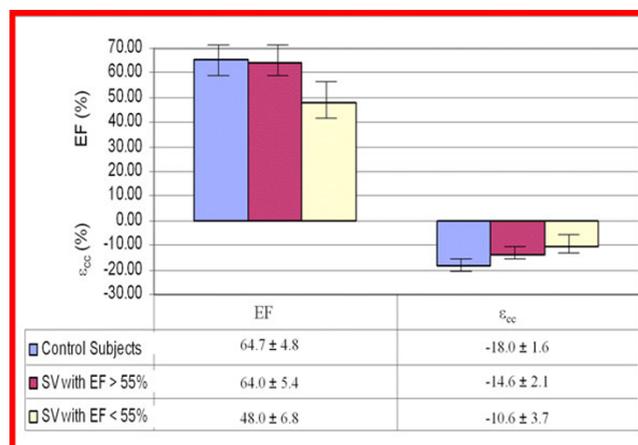We hypothesized that circumferential strain will decline before overt cardiac dysfunction.

Methods

We evaluated cardiac magnetic resonance image (CMR) data from 28 single left ventricle (SLV) patients (tricuspid atresia and double inlet left ventricle) and 20 control subjects (Group A). The SLV patients were dichotomized into two groups, normal EF ($\geq$= 55%) (Group B) and abnormal EF (<55%) (Group C). Standard imaging data included steady-state free precession (SSFP) short-axis cine stack images sequences. Analysis was performed using QMASS® for ventricular function and TomTec® software feature tracking for strain analysis. Ejection fraction (EF) and circumferential strain data was tabulated. Statistical analysis was performed via Student's t-test.

Results

CMR data was reviewed and analyzed from 28 SLV patients (mean age 19.5 ± 11 years) and 20 control subjects (mean age 14.9 ± 8.0 years) (p = NS). All control subjects (Group A) had normal EF (64.7 ± 4.8) and ε_{cc} (-18.0 ± 1.6). Despite having normal EF (64.0 ± 5.4) SLV patients in Group B had lower absolute ε_{cc} (-14.6 ± 2.1) than the

	EF	ε_{cc}
Control Subjects	64.7 ± 4.8	-18.0 ± 1.6
SV with EF > 55%	64.0 ± 5.4	-14.6 ± 2.1
SV with EF < 55%	48.0 ± 6.8	-10.6 ± 3.7

Figure 1
EF and Strain.

control group ($p < 0.0001$). With decline in EF (48.0 ± 6.8), Group C SLV patients had further decline in absolute ε_{cc} (-10.6 ± 3.7) (figure 1).

Conclusion

CMR FT had been shown to be a feasible method for assessing ε_{cc}. FT analysis of ε_{cc} in SLV patients was abnormal despite normal EF and these strain values continued to decline with development of overt cardiac dysfunction. ε_{cc} may provide a more sensitive method of assessing subtle ventricular dysfunction in SLV patients than traditional methods of cardiac functional assessment. Further study on larger groups of SV patients is warranted to determine its efficacy and accuracy especially when comparing multiple types of single ventricle patients.