

Poster presentation

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Cardiac mri strain analysis demonstrates systemic right ventricular dysfunction late after atrial switch procedure despite normal ejection fraction

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Introduction

The atrial switch operation (ASO), performed routinely until the early 1990's for d-Transposition of the Great Arteries (d-TGA), resulted in a systemic right ventricle (SRV). Anecdotal qualitative data has suggested that the RV is doomed to progressive dysfunction and eventual systolic failure when placed in the systemic circulation over the long term. Quantitative analysis of SRV function after ASO has only recently been available via cardiac MRI (CMR) assessment of SRV Ejection Fraction (EF), an index that has proven to be somewhat insensitive to subtle cardiac dysfunction in other cardiac conditions. We hypothesized that CMR-based myocardial strain (ϵ) assessment would prove a more sensitive indicator of cardiac dysfunction than SRV EF in ASO subjects.

Purpose

Determine the changes in myocardial strain in a cross section of ASO patients.

Methods

Data was reviewed from d-TGA ASO subjects and normal young-adult control subjects, all of whom underwent CMR at our center for clinical or research indications. Data included demographics and systemic ventricular EF via standard techniques. Systemic ventricular circumferential strain (ϵ_{cc}) was measured with feature tracking software (Diogenes[®], TomTEC Inc, Munich, Germany). The ASO subjects also had radial (ϵ_{rr}), and longitudinal (ϵ_{ll})

SRV strains measured, and these subjects were further stratified into global functional classes by SRV EF as normal (>55%) or depressed (< 55%). Statistical comparisons were performed between SRV EF and ϵ , as well as age/time since surgery, via student's t-tests.

Results

Data from 33 ASO subjects and 14 controls was analyzed. Mean SRV ϵ_{cc} magnitude for all post ASO subjects was lower than systemic ventricular ϵ_{cc} magnitude in controls, regardless of EF status, and was lower still for ASO subjects with abnormal SRV EF (see Table 1 for further details). However, there was no significant correlation between time since ASO and SRV EF or SRV ϵ_{cc} magnitude ($r^2 = 0.02$ and 0.14) (Figure 1 a-b). In addition, neither ϵ_{ll} nor ϵ_{rr} strain indexes were significantly different between ASO classes.

Conclusion

In ASO patients with normal EF, SRV ϵ_{cc} magnitude is decreased compared with systemic ventricular ϵ_{cc} in controls. SRV ϵ_{cc} magnitude is further depressed in ASO patients with abnormal SRV EF. However, SRV systolic function, as measured by both EF and ϵ , was not associated with time since ASO. This data suggests that as a more sensitive indicator of SRV function, SRV ϵ_{cc} surveillance should be included routinely as a parameter of SRV functional assessment.

Table 1: Comparison of CMR findings between control and ASO groups

Groups Parameters	Controls (n = 14)	ASO normal SRV EF (n=13)	ASO low SRV EF (n = 20)
Age (years)	17.3 ± 8.4	22.1 ± 6.1	23.6 ± 6.3
Heart rate (bbm)	73 ± 14	66 ± 13	70 ± 12
Age at ASO (mo)	-	17 ± 15	22 ± 16
EF (%)	63.8 ± 3.0	60.7 ± 6.1	47.2 ± 7.4*
E _{cc}	-18.3 ± 1.6	-10.9 ± 2.2*	-9.1 ± 2.7*
E _{rr}	-	9.0 ± 3.9	9.9 ± 4.8
E _{ll}	-	-10.6 ± 2.0	-8.5 ± 4.0

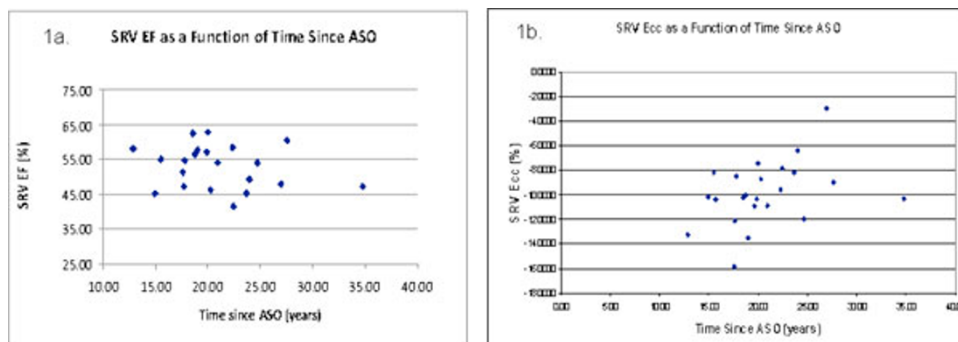


Figure 1
(a) There is no significant correlation between time since arterial switch operation (ASO) and systemic right ventricular (SRV) ejection fraction (EF). $r^2 = 0.02$. **(b)** nor is there a significant correlation between time since ASO and SRV circumferential strain (E_{cc}) ($r^2 = 0.14$).

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