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Journal of Cardiovascular Magnetic Resonance

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Meeting abstract

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1061 The effect of Simpson's method and the Piecewise Smooth Subdivision Surface reconstruction method on right ventricle volume measurement and reconstruction

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from 11th 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):A186 doi:10.1186/1532-429X-10-S1-A186

This abstract is available from: http://jcmr-online.com/content/10/S1/A186

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Background

Magnetic resonance imaging (MRI) using Simpson's method is the gold standard for measuring RV volume. The Piecewise Smooth Subdivision Surface (PSSS) reconstruction method is the only method that has been validated for accuracy in reproducing the 3-D shape of a heart ventricle as well as for measuring ventricular volume. The 3-D shape of the RV in congenital heart disease patients is distorted at the base and apex, regions difficult to visualize from short axis views.

Purpose

We compared RV volume measured by Simpson's method and the PSSS reconstruction method.

Methods

We studied six normal patients and 18 patients whose RVs carry a systemic pressure load, half of whom had transposition of the great arteries (TGA) repaired with an atrial baffle and half with congenitally corrected TGA (ccTGA). Images acquired included a short axis stack, radially related long axis views, and oblique views intended to fully visualize the RV. The RV borders were manually traced and used to reconstruct the RV endocardial surface by the PSSS method, which produces a triangulated mesh. Volume was measured by summing the signed volumes of tetrahedra formed by connecting a point in space with each triangle on the mesh. The Simpson's analysis was performed on the short axis stacks alone, which were traced separately without reference to any other views.

Results

Each study group yielded smaller RV volumes when analyzed with Simpson's method as compared with PSSS reconstruction method. The normal patients showed a 5.8% decrease in RV volume size for ED and an 11.8% decrease in ES ($p < 0.020$). Patients with ccTGA showed a 5.7% loss in volume in ED and a 9.6% loss in ES ($p < 0.026$). Congenital hearts with TGA displayed a 4.3% volume change in ED and 6.4% volume change in ES (p = NS).

Conclusion

When analyzed with Simpson's method, the RV volume was consistently smaller than the PSSS reconstructive method for normal hearts and hearts with ccTGA, but not in TGA. These differences may be attributable to the superior visualization of basal and apical structures from long axis views. Unlike the left ventricle, RV analysis should be performed with additional views due to the more complex shape of this chamber.

Table 1: Average RV volume and EF difference between Simpson's method and PSSS reconstructive method

D_x	EDV 1*	EDV 2*	p1**	ESV 1	ESV 2	p2**	EF 1	EF 2	p3**
Normal	156	147	0.015	76	67	0.020	52	54	NS
ccTGA	265	250	0.018	197	178	0.026	33	34	NS
TGA	231	221	NS	156	146	NS	28	29	NS

* 1 = RV Volume by PSSS Reconstructive Method (mL); 2 = RV Volume by Simpson's method (mL). ** p1 = paired T-Test results between end diastolic volumes (EDV) of Simpson's and the PSSS method; p2 = paired T-Test results between end systolic volumes (ESV) of Simpson's and the PSSS method; p3 = paired T-Test results between EFs of Simpson's and the PSSS method.

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