Journal of Cardiovascular Magnetic Resonance

Poster presentation

Open Access

Four dimensional analysis of aortic magnetic resonance images in connective tissue disorders: Novel indices of local and regional vessel properties

Ryan Johnson*, Senthil Premraj, Sonali Patel, Andreas Wahle, Milan Sonka and Thomas Scholz

Address: University of Iowa, Iowa City, IA, USA
* Corresponding author

from 13th Annual SCMR Scientific Sessions
Phoenix, AZ, USA. 21-24 January 2010

Published: 21 January 2010

Journal of Cardiovascular Magnetic Resonance 2010, **12**(Suppl 1):P240 doi:10.1186/1532-429X-12-S1-P240

This abstract is available from: http://jcmr-online.com/content/12/S1/P240

Introduction

Magnetic resonance (MR) imaging is a primary modality for following patients with connective tissue diseases, yet the amount image data precludes comprehensive analysis.

Purpose

The goal of this study was to develop an automated 4D analysis method and demonstrate novel data presentation and parameters with prognostic potential.

Methods

MR scans of the thoracic aorta were acquired over 3 years on controls (Ctrl; n = 32) and patients with connective tissue disease (Pt; n = 37). Images were obtained at 1.5 T using a True FISP sequence. Imaging planes included left ventricular outflow tract and aortic arch views. 4D data from the two views were merged and a graph theory-based segmentation algorithm was applied to quantitate cross sectional area (CSA) and novel parameters for the entire length of aorta throughout the cardiac cycle.

Results

Ctrl were younger than Pt (Median age (years +/- SEM): Ctrl = 29.8 ± 4.9; Pt = 37 ± 18) although body surface area (BSA) was similar (Median BSA (m2 +/- SEM): Ctrl = 1.8 ± 1.2; Pt = 2.0 ± 0.3). Connective tissue disorders included Marfan (n = 9), thoracic aortic aneurysm (n = 12), bicuspid aortic valve (n = 5), Ehlers Danlos (n = 3), and family history of aortic dissection (n = 5). Robust automated analysis from the 4D image dataset showed good reproducibility by repeated measures ANOVA ($p < 0.05$) in Ctrl, which allowed construction of a nomogram for the 5^{th} to 95^{th} percentile of CSA along the entire aorta (Figure 1). In Pt, automated calculated aortic root dimensions at several levels correlated closely with echo measurements (R = 0.74 - 0.87). Mean CSA in the proximal and distal thirds

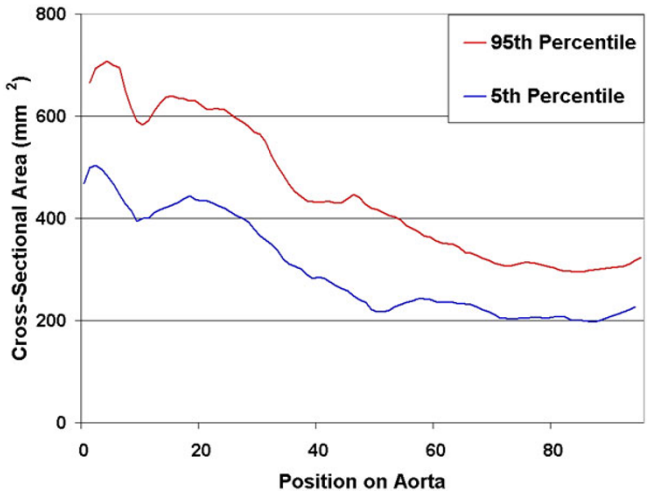

Figure 1
Aortic cross sectional area nomogram.

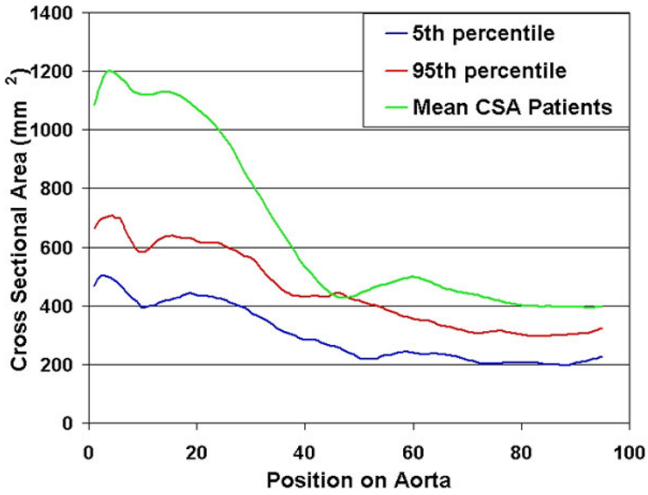

Figure 2
Cross sectional area as a function of position on aorta: Pt vs. Ctrl.

of the Pt thoracic aorta was significantly greater than Ctrl ($p < 0.001$) (Figure 2). Novel parameters calculated from the 4D data included centroid displacement (aortic movement during the cardiac cycle), eccentricity (asymmetry of the vessel) and regional CSA (effective vessel volume). Eccentricity was significantly different between Pt and Ctrl at the aortic root, and transverse arch ($p < 0.05$).

Conclusion

The automated analysis method allowed for rapid and reliable quantitative 4D assessment of the entire aorta. This technique should prove useful not only for routine patient management but also for investigative evaluation of novel parameters that may predict aortic disease progression.