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New parameters for the evaluation of mechanic and elastic properties of the aortic root in Marfan Syndrome

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Background: Elastic properties of the thoracic aorta in patients with Marfan Syndrome (MS) have already been evaluated with classic echocardiographic parameters. In the latest years the use of Speckle-Tracking (STE) ecocardiography has been widely extended. Our aim is to describe and provide new parameters of aortic deformation measured by STE in patients with MS.

Methods: 95 unoperated adult patients with MS and 32 healthy controls were prospectively enrolled. We measured classic parameters of the aortic root using 2D echocardiography. We calculated the posterior aortic wall systolic excursion at the sinuses of Valsalva and ascending aorta using M Mode in TDI colour; with ST 2D ecocardiography we measured the aortic strain at the sinuses of Valsalva (SV) and the anterior and posterior aortic wall displacement at the SV. Aortic distensibility was calculated using the formula: $1000 * (Ds - Dd)/Dd * 1/(Ps - Pd)$ in mmHg^{-1} (Ds: systolic and Dd: diastolic diameters, Ps systolic and Pd diastolic blood pressure). Aortic stiffness index was calculated as $Ln((Ps/Pd)/(Ds-Dd)/Dd))$.

Results: As shown in the table bellow, patients with MS had lower aortic strain, aortic anterior and posterior wall displacement and impaired aortic distensibility and stiffness index compared to healthy controls. We found a strong negative linear correlation between aortic root diameter at the SV and aortic root strain (r=−0.56, figure 1).

Conclusions: Our results suggest that aortic deformation and displacement obtained by STE echocardiography is impaired in MS, showing a reduced distensibility and an increased stiffness of the aortic wall, with a strong negative correlation between aortic root dilation and aortic strain. All these parameters may be useful as additional tools for the diagnosis and follow-up of Marfan patients, and could be useful to to improve the echocardiographic evaluation of the aortic root.

Results of statistical analysis

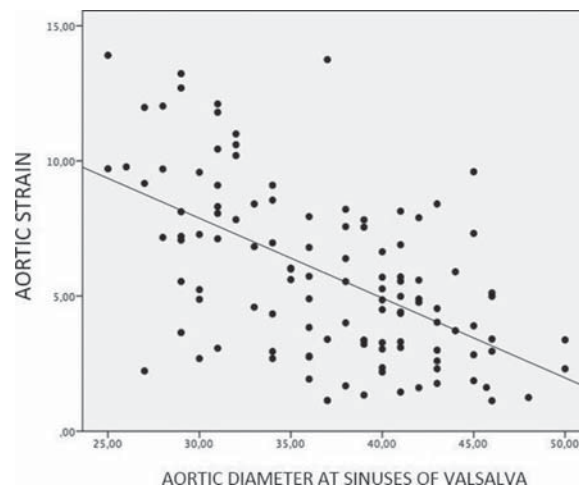|	MS (n=95)	Controls (n=32)	p
Age (years)	32.84±12.35	32.41±7.98	0.85
Aortic root diameter at the sinuses of Valsalva (mm)	38.82±5.35	30.92±3.65	<0.001
Aortic root strain (%)	4.66±2.45	9.19±2.49	<0.001
Anterior aortic wall displacement STE (mm)	10.39±3.64	13.10±2.26	<0.001
Posterior aortic wall displacement STE (mm)	9.02±2.87	11.04±1.82	<0.001
Aortic distensibility	0.98±0.46	1.37±0.72	0.01
Aortic stiffness index	3.74±0.43	3.47±0.51	0.01

MS = Marfan Syndrome; STE = Speckle Tracking Ecocardiography.

Figure 1. Dispersion plot