Poster presentation

Relation between age and aortic wall compliance in the Marfan syndrome: evaluation with Velocity-Encoded MRI

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Introduction
Progressive aortic root dilatation due to reduced compliance often leads to dissection in Marfan syndrome. Aging also has progressive negative effect on compliance.

Purpose
To describe age-related change in compliance, expressed in Pulse Wave Velocity (PWV), Distensibility (Dist) and Stiffness Index (SI), with Phase-Contrast (PC) MRI in Marfan syndrome.

Methods
Twenty-five patients (mean age 36 ± 14 years, range 18-63 years, 13 men) with Marfan syndrome and twenty-five age/gender-matched healthy volunteers were examined. None of the patients had undergone elective aorta replacement. Informed consent and medical ethical approval was obtained.

MRI was performed on 1.5 T Philips Achieva MRI (Philips Medical Systems, Best, The Netherlands). PC-MRI with through-plane velocity encoding (V_{enc} = 150 cm/s) and free-breathing was performed perpendicular to the ascending and descending aorta at the level transecting the pulmonary trunk. Another acquisition (V_{enc} = 100 cm/s) was performed at the abdominal aorta. PWV was deter-mined for the aortic arch (AA), distal aorta (DA) and total aorta using the transit-time method described by Grotenhuis.[1] Brachial-cuff systolic and diastolic blood pressure (BP) were obtained. Distensibility (= luminal area change/(diastolic luminal area × pulse pressure)) and Stiffness Index (= ln [($BP_{Systolic}$/$BP_{Diastolic}$)/(diameter change/diastolic diameter)]) were determined at the ascending aorta in gradient-echo PC-MRI magnitude images. Reduced wall compliance is expressed as increased PWV and SI and decreased Dist. PWV, Dist and SI were compared in Marfan and controls using paired t-tests. Age relation was determined by linear regression.

Results
See tables 1 and 2 and figure 1.

In Marfan, PWV is increased at AA, DA and total aorta. Dist is decreased. SI not statistically significantly different. In Figure 1, age relation of PWVtot is shown.

PWV in AA, DA and total aorta shows significant increase with age: 7 cm/s to 10 cm/s increase in PWV per year; except PWV_{AA} in controls only shows 3 cm/s increase per year. Age relation of Dist and SI was not statistically proven, except only for increasing SI in controls.
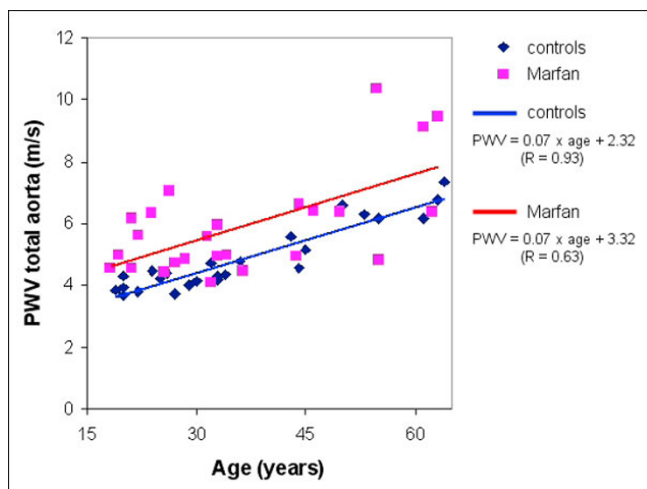
Figure 1

Table 1: Compliance in Marfan versus healthy controls.

	PWV_{AA} m/s	PWV_{DA} m/s	PWV_{tot} m/s	Dist mmHg^{-1}	SI (-)
Marfan	5.6 ± 1.4	6.4 ± 2.4	5.9 ± 1.6	446 ± 262	3.0 ± 0.5
Control	4.8 ± 0.9	5.0 ± 1.5	4.9 ± 1.1	674 ± 426	2.7 ± 0.6
p-value	0.004	0.003	<0.001	0.02	0.07

stiffness index and decreased distensibility. Age-related change in compliance is expressed in increasing PWV.

Acknowledgements

References

1.   Grotenhuis HB, *et al.*: *J Magn Reson Imaging* 2009, **30(3)**:521-6.

Conclusion

Age-related increase in aortic wall compliance can be studied with Phase-Contrast MRI. Patients with Marfan syndrome present with increased Pulse Wave Velocity and

Table 2: Age-related compliance by linear regression A × age + B.

		A ± Standard Error	B ± SE	Pearson R
PWV_{AA}	**Marfan**	0.07 ± 0.01 m·s^{-1}·year^{-1} (p < 0.001)	3.25 ± 0.56 m/s (p < 0.001)	0.69 (p < 0.001)
	Control	0.03 ± 0.01 m·s^{-1}·year^{-1} (p = 0.02)	3.70 ± 0.46 m/s (p < 0.001)	0.47 (p = 0.02)
PWV_{DA}	**Marfan**	0.08 ± 0.03 m·s^{-1}·year^{-1} (p < 0.001)	3.52 ± 1.22 m/s (p = 0.008)	0.47 (p = 0.02)
	Control	0.10 ± 0.01 m·s^{-1}·year^{-1} (p < 0.001)	1.47 ± 0.28 m/s (p < 0.001)	0.94 (p < 0.001)
PWV_{tot}	**Marfan**	0.07 ± 0.02 m·s^{-1}·year^{-1} (p = 0.001)	3.32 ± 0.72 m/s (p < 0.001)	0.63 (p = 0.001)
	Control	0.07 ± 0.01 m·s^{-1}·year^{-1} (p < 0.001)	2.32 ± 0.23 m/s (p < 0.001)	0.93 (p < 0.001)
Dist	**Marfan**	-6.3 ± 3.6 mmHg^{-1}·year^{-1} (p = 0.09)	676 ± 139 mmHg^{-1} (p < 0.001)	0.35 (p = 0.09)
	Control	-11.4 ± 5.7 mmHg^{-1}·year^{-1} (p = 0.06)	1088 ± 240 mmHg^{-1} (p < 0.001)	0.39 (p = 0.06)
SI	**Marfan**	0.011 ± 0.007 year^{-1} (p = 0.13)	2.5 ± 0.3 (p < 0.001)	0.31 (p = 0.13)
	Control	0.019 ± 0.008 year^{-1} (p = 0.03)	2.0 ± 0.3 (p < 0.001)	0.45 (p = 0.03)