Contribution of the blood flow evaluation by MRI in the ascending thoracic aorta in patients at risk

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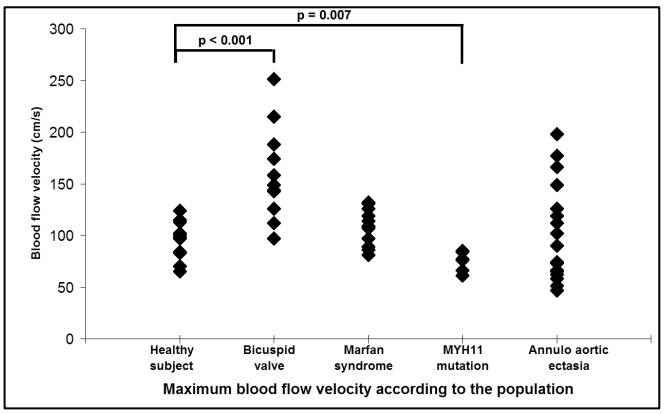
Purpose: Currently the most frequent failures of the aorta are aortic aneurysm and dissection. In order to prevent the process leading to aortic rupture or dissection, a surgical treatment can be proposed. At present, the recommendation for intervention is generally based on aortic diameters, but this parameter is not always pertinent and it would appear appropriate to define new criteria. The evaluation of the functional properties of aortic wall should give a more sensitive indicator of rupture or dissection. In this perspective, 3D velocity imaging acquired with cine-MRI allows the analysis of aortic blood flow, thereby enabling precise hemodynamic characterization and in vivo wall shear stress measurements. Our study has consisted in evaluating the maximum blood flow velocity in healthy subjects and patients with well-classified aortic diseases.

Material and Methods: Eleven healthy adults and 52 patients with aortic disease were recruited for this study (12 patients with bicuspid valve, 13 patients with the Marfan syndrome, 7 patients with MYH11 mutation[1] and 18 patients with annulo-aortic ectasia). Images were acquired with ECG-gated velocity-encoded cine-MRI sequences at the level of the pulmonary trunk with a plane orientated perpendicular to the ascending aorta and with a temporal resolution of 30 msec. At each moment of the cardiac cycle, the acquisition of one magnitude image and 3 phase-contrast images were necessary to enable an automatic reconstruction of the blood flow in 3D[2]. The magnitude images correspond to the velocity encoding in three directions building up an orthogonal system (orientations: through plane, left-right and anterior-posterior). Covering the whole cardiac cycle allowed us to obtain the maximum blood flow velocity.

Results: Patients with bicuspid valve had a blood flow velocity significantly higher than for healthy subjects (160 ± 45 cm/s vs 96 ± 18 cm/s), and patients with MYH11 mutation had a velocity significantly lower than for healthy subjects (75 ± 9 cm/s vs 96 ± 18 cm/s). There were no significant differences between healthy subjects and patients with Marfan syndrome (107 ± 17 cm/s) and patients with annulo-aortic ectasia (101 ± 46 cm/s). There were no other significant differences for clinical characteristics between the groups.

Discussion: The maximum blood flow velocity calculation in patients with bicuspid valve, coupled with precise knowledge of the orientation of the flow jet should lead to a better risk stratification. The low values obtained in patients with MYH11 mutation could be explained by an impairment of the pulse wave reflection. The important variation of values obtained in patients with annulo-aortic ectasia seems to indicate that this parameter is not a pertinent marker for this disease.



References

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