

Assessment of 4D flow imaging biomarkers in ascending aortic replacement

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Introduction:

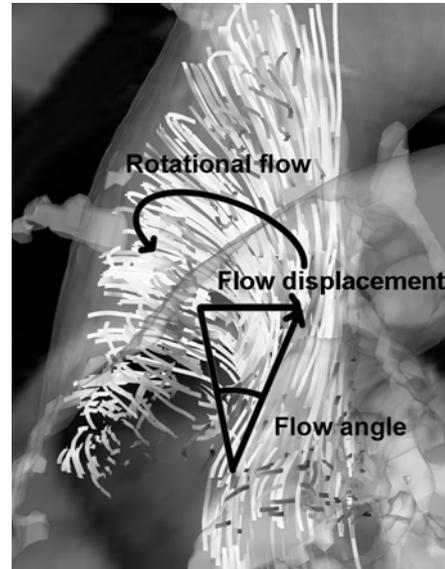
Bicuspid aortic valve disease (BAV) is associated with aortic dilatation and abnormal flow patterns, particularly increased helical flow and changes in the aortic wall shear stress. Aortic valve replacement is common and we sought to assess whether advanced imaging biomarkers can predict the need for additional ascending aortic replacement.

Methods:

We prospectively enrolled 102 patients with BAV (age 8-72) who underwent 4D flow cardiovascular magnetic resonance. This included 59 BAV patients with a right-left coronary cusp fusion (RL-BAV), 33 with a right-non-coronary cusp fusion (RN-BAV) and 10 with other fusion patterns. We then followed this cohort with annual phone calls.

Results:

During a 3 year follow-up period 20/102(19.6%) underwent aortic valve replacement (AVR); 10/59(16.9%) were in the RL-BAV group and 7/33(21%) in the RN-BAV group. Only 4/102(3.9%) underwent AVR with ascending aortic replacement (AVR+AA). Final decision to include ascending aortic decision was made intraoperatively after visual assessment of the ascending aortic wall. Comparing patients in the AVR with the AVR+AA group, at the initial study visit the AVR+AA group had larger ascending aortic diameters/body surface area (22.9 ± 2.0 vs 18.8 ± 3.2 mm; $p=0.014$), higher normalised displacement (0.205 ± 0.027 vs 0.139 ± 0.078 $p=0.01$), absolute rotational flow (55.0 ± 9.2 vs 33.7 ± 17.7 mm²/ms; $p=0.007$) and higher in-plane wall shear stress (0.89 ± 0.13 vs 0.54 ± 0.25 N/m²; $p=0.003$). Flow angle and overall wall shear stress changes did not reach statistical significance.



The patients in the AVR+AA group had mainly stenotic disease. Comparing the AVR+AA and only the stenotic patients in the AVR group the above changes remained significant.

Comparing the stenosis patients ($n=14$) and regurgitant patients ($n=6$) in the AVR group, only flow displacement was significantly lower in the regurgitant group (0.062 ± 0.032 vs 0.174 ± 0.065 vs; $p<0.001$).

Conclusions:

In BAV concomitant ascending aortic replacement is less frequently performed than AVR alone.

Baseline flow abnormalities were comparable in the stenotic and regurgitant AVR group.

While ascending aortic diameters were significantly larger in the AVR+AA group only one patient had a diameter >4.5 cm. The significantly increased haemodynamic flow abnormalities in the AVR+AA group suggest that these may be useful parameters for risk assessment in the future.