

Meeting abstract

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## 1047 Time-resolved three-directional MR velocity mapping of aortic flow in patient follow-up after aortic valve-sparing surgery

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### Introduction

Aortic valve-sparing operations have become a efficacious method for repairing aortic root aneurysm as it leaves native valvular structure in situ thus preserving the anatomy and function of native aortic valve. Cardiac MRI provides an accurate and comprehensive tool for the follow-up after aortic valve-sparing surgery. However, conventional phase-contrast MRI is unable to demonstrate the flow patterns in the aortic root and ascending aorta, which are highly associated with aortic valvular function. Recent studies demonstrated the feasibility of three-directional MR velocity mapping in visualization of aortic flow patterns.

### Purpose

To evaluate the potential of time-resolved three-directional (3D) MR velocity mapping for the follow-up in patients after aortic valve-sparing operation.

### Methods

13 patients were evaluated using time-resolved 3D MR velocity mapping at 6–12 months after aortic valve-sparing operation. For comparison, 10 healthy volunteers and 12 patients with ascending aortic aneurysm were studied with the same method. Follow-up information was obtained at 24 months after valve-sparing operation. The outcome events analyzed were presence of death, need for re-operation, recurrence of > grade 2 aortic regurgitation, and heart failure.

MR velocity mapping was performed using a 2D cine phase-contrast sequence with 3D velocity encoding on a 1.5 Tesla scanner (Avanto, Siemens Medical Solutions). Three Contiguous slices oriented along the axis of the aortic valve image and one along the left ventricular outflow tract image was obtained. TR/TE = 8.0/4.0 msec, flip angle = 15°, FOV = 250 × 340 mm, matrix = 86 × 192, slice thickness = 6 mm, acquisition time = 24 sec per slice, velocity-encoding value 150, 120, 120 cm/s x, y, z directions respectively.

4D flow analysis software (Siemens Medical Solutions) was used to create a dynamic velocity vectors map of aortic flow. The flow vectors maps were assessed by two independent observers. Laminar flow was defined as parallel or near parallel vector lines and was scored on scale of 1 – 4 (1 = poor, 2 = fair, 3 = good, 4 = excellent). Turbulent flow, indicated by circular, semi-circular or demisemi-circular vector lines, was scored on a scale of 0 – 3 (0 = none, 1 = mild, 2 = moderate, 3 = severe). The presence or absence of vertical flow in the sinuses of Valsalva after the peak systole was also determined.

### Results

All patients with aortic valve-sparing operation were alive and no patient had heart failure at 24 months follow-up. There were 2 re-operations within 3 months after primary operation due to high aortic insufficiency. Four of 13 patients presented with mild aortic regurgitation and no

patient had > grade 2 aortic regurgitation assessed using echocardiography.

The average score of laminar flow in the ascending aorta for patients with valve-sparing surgery was similar to that for volunteers ( $3.38 \pm 0.74$  versus  $3.8 \pm 0.4$ ,  $p = 0.14$ ), but was greater than that for patients with aneurysm ( $3.38 \pm 0.74$  versus  $1.25 \pm 0.43$ ,  $p < 0.01$ ). The average score of turbulent flow for patients with aneurysm was greater than that for patients with valve-sparing surgery ( $2.25 \pm 0.72$  versus  $0.23 \pm 0.42$ ,  $p < 0.01$ ). No turbulent flow was visualized in any volunteer. The presence of systolic vertical flow in the Valsalva sinuses for patients with valve-sparing surgery was similar to that for volunteers (8/13 versus 8/10,  $p = 0.26$ ), but was greater than that for patients with aneurysm (8/13 versus 4/12,  $p < 0.05$ ).

### Conclusion

Spiral laminar flow in the ascending aorta and vertical flow in the Valsalva sinuses can be restored in patients after aortic valve-sparing surgery. Evaluation of aortic flow patterns using time-resolved 3D MR velocity mapping may be a useful indicator for outcome of patients with aortic valve-sparing surgery.

Time-resolved three-directional MR velocity mapping demonstrated spiral laminar flow in the ascending aorta and vertical flow in the sinuses of Valsalva can be restored in patients after aortic valve-sparing surgery.

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