Usefulness of magnetic resonance imaging to compare the influence of stentless versus stented valves on left ventricular remodelling and coronary reserve in patients with severe aortic stenosis.

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Introduction: The benefit brought by stentless versus stented valves in patients with aortic stenosis remains controversial. 57 patients with an isolated severe aortic stenosis were randomized to receive either a stented (n=34) or a stentless (n=23) bioprosthesis. We compared the effect of stentless (Freestyle®) and stented (Mosaic®) similarly manufactured porcine valves on left ventricular mass (LVM) regression and remodelling, left ventricular ejection fraction (LVEF), coronary blood flow velocity and coronary reserve assessed by cardiovascular magnetic resonance (MR) in patients with severe aortic stenosis six months after surgery.

Methods: All patients were studied with a 1.5 T imager. A fast gradient echo segmented k-space sequence with radio frequency phase spoiling or a 2D steady-state free precession imaging (2D-FIESTA) was performed in multiple short-axis views, to study the left ventricular mass, the left ventricular ejection fraction, and the left ventricular volumes. Regional end-systolic wall stress was calculated from a set of five contiguous short-axis planes and averaged in the anterior, lateral, inferior and septal sectors. The end-systolic wall stress was calculated using the Grossman formula. To acquire coronary blood flow velocities and reserve, sequences of phase contrast MR imaging (velocity mapping) were realized at rest and after injection of 0.14 mg/kg/min of adenosine. Short-axis slices perpendicular to the LAD were therefore obtained to accurately measure flow velocity using a fastcard sequence in phase contrast mode. Flow velocity was encoded in the slice select direction (double oblicity) and acquired as sequential pairs with phase difference reconstruction during the same RR interval. Radiofrequency excitation pulses were applied uniformly throughout the acquisition to maintain spin in a steady state and allow the data acquisition to start immediately after electrocardiographic R-wave detection**.** The temporal resolution for 1 cardiac phase was 49 ms. Twenty-four heart beats were necessary to acquire all image phases in a single breath-hold. Images were acquired with 4 views per segment, a slice thickness of 8 mm, receiver bandwidth of 32 kHz, flip angle of 20°, an acquisition matrix of 256 x 128, a partial echo acquisition, and a 1.00 excitation. Field-of-view, repetition time, and echotime were 23 x 24.2 cm (pixel resolution 0.9 x 0.9 mm), 10.4 ms, and 4.7 ms, respectively. The flow was encoded in the slice direction with a velocity encoding of 100 cm/s. The acquisition time was between 16 and 26 seconds. (Figure 1)

Results: At 6 months, we observed a significant reduction in indexed LVM ($p<0.001$) from 132±33 to 100±23 g/m² in the stented group and 125±27 to 93±9 g/m² in the stentless group without any statistical difference between groups (Figure 2). It was associated with a significant reduction in the left ventricular end-diastolic volume in the stented group. LVEF improvement was better in stentless group ($p=0.03$) (67±12 to 72±9% in stented group versus 70±13 to 78±7% in stentless group). The independent predictive factors of LVEF improvement were the stentless valve and preoperative LVEF.

Coronary reserve was low and increased similarly at 6 months in the two groups (from 1.59 ± 0.53 to 1.75 ± 1.07 in the stentless group and from 1.58 ± 0.53 to 2.05 ± 1.17 in the stented group) (Figure 1). However the average diastolic peak velocity was lower in the stentless group proportionally to the LVM.

The end-systolic wall stress evaluated at 6 months was similar to normal values in both groups. And the T/R (wall thickness/radius) ratio, which was preoperatively high, decreased at 6 months, but didn't reach normal values.

Conclusion: Our study shows that the use of stentless valves for aortic valve replacement in patients with severe aortic stenosis is associated with a similar degree of LVM regression to a stented valve. But aortic valve replacement with a stentless valve is associated with a significantly greater increase in LVEF. Cardiac MR appears like the method of choice to assess LV remodelling after aortic valve replacement in patients with severe aortic stenosis and to compare different aortic valves using a small study population.

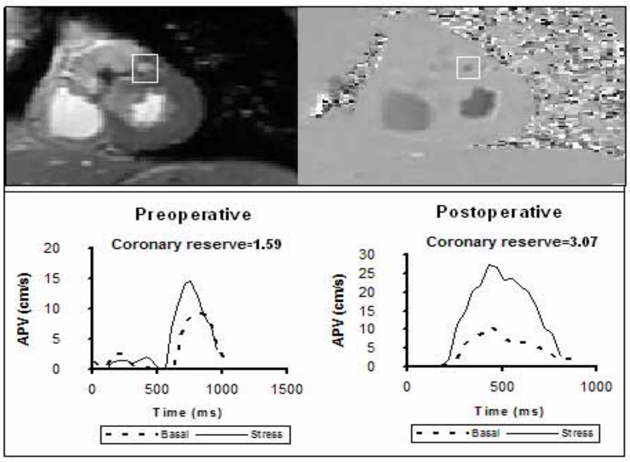

Figure 1: Phase-contrast MRI magnitude (left upper panel) and phase (right upper panel) images of the LAD artery obtained in the diastolic phase are shown. Flow in the LAD artery is shown as darkening signal on the phase image (located in the white square).
The coronary flow velocity curves (lower panel) versus cardiac cycle were obtained in each patient at baseline and during adenosine stress before (left panel) and 6 months (right panel) after aortic valve replacement.

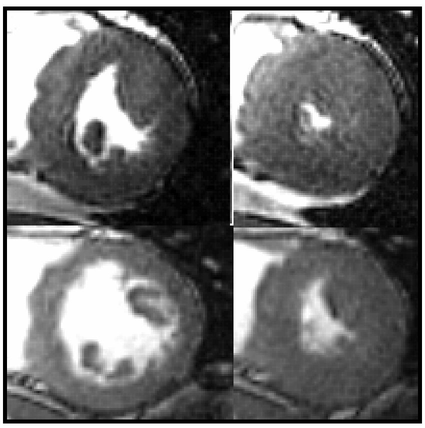

Figure 2: End-diastolic (left panel) and end-systolic (right panel) midventricular short-axis slices of the left ventricule in a patient with severe aortic stenosis obtained before (upper images) and 6 months (lower images) after aortic valve replacement.