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Feasibility to assess the orifice area of mitral bioprostheses using cardiovascular magnetic resonance

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Introduction

The orifice area of heart valve bioprostheses is important to evaluate their hemodynamic performance. However, its calculation using transthoracic echocardiography (TTE) is frequently complicated due to limited acoustic windows and methodical concerns. Regarding aortic bioprostheses, cardiovascular magnetic resonance (CMR) has recently been established as an alternative tool to assess the orifice area. Yet, in mitral position, annular plane excursion and frequent coincident arrhythmias raise concerns whether CMR can be applied likewise.

Purpose

We initiated a feasibility series testing CMR to quantify the orifice area of mitral bioprostheses.

Methods

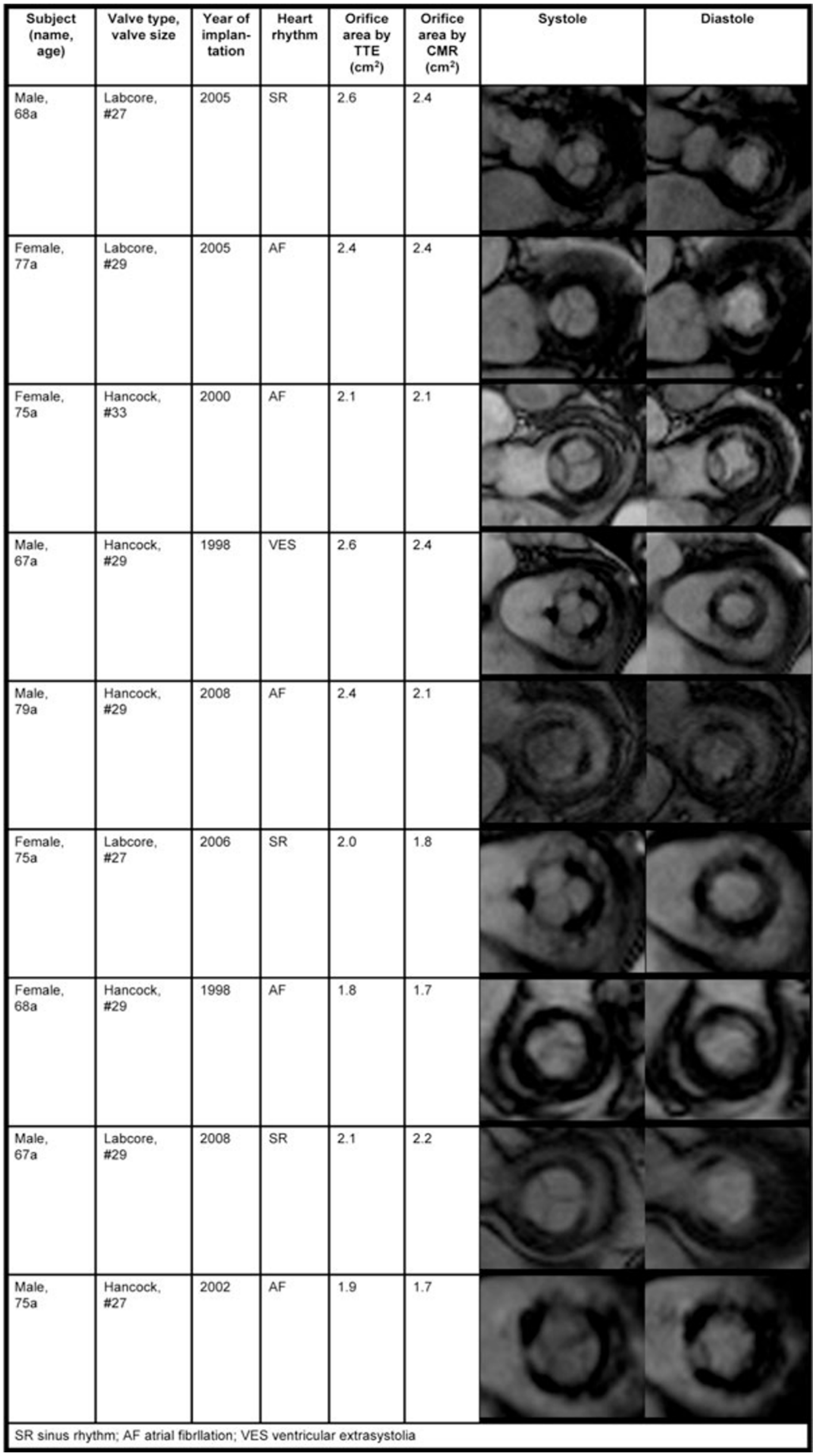
Nine consecutive patients (characteristics: see figure 1) with mitral bioprostheses underwent both TTE and CMR. TTE measured transprosthetic pressure gradients and pressure half time derived orifice area. Continuity equation for orifice area calculation was obsolete due to left sided valve insufficiencies in all subjects. CMR applied electrocardiographic-gated, steady-state free-precession (SSFP) cine sequences with breath holding to image the prosthesis (slice thickness 5 mm, no gap, TE 1.2 ms, TR 2.9 ms, FOV typically 340 mm, matrix 256 × 146 mm, 30 phases per R-R interval). A stack of 7 planes covered the mitral prosthesis perpendicular to the transprosthetic jet. Slice selection for manual orifice planimetry was done using cross-references and visual consideration of the optimal cusp border delineation.

Results

In TTE, mean transprosthetic pressure gradients ranged from 3 to 11 mmHg and pressure half time derived prosthetic orifice areas from 1.8 to 2.6 cm^2. In CMR, diagnostic image quality was achieved in 100% despite atrial fibrillation in 5 and ventricular extrasystolia in 1 subject. Images are depicted in the table. Manual planimetry offered orifice areas from 1.7 to 2.4 cm^2, which agreed well with TTE ($r = 0.90$; mean difference -0.12 ± 0.12 cm^2).

Conclusion

Imaging of mitral bioprostheses using CMR with SSFP sequences is feasible and provides orifice areas with close correlation to echocardiography, even in atrial fibrillation. Larger samples are required to confirm these preliminary results.



Subject (name, age)	Valve type, valve size	Year of implantation	Heart rhythm	Orifice area by TTE (cm^2)	Orifice area by CMR (cm^2)	Systole	Diastole
Male, 68a	Labcore, #27	2005	SR	2.6	2.4		
Female, 77a	Labcore, #29	2005	AF	2.4	2.4		
Female, 75a	Hancock, #33	2000	AF	2.1	2.1		
Male, 67a	Hancock, #29	1998	VES	2.6	2.4		
Male, 79a	Hancock, #29	2008	AF	2.4	2.1		
Female, 75a	Labcore, #27	2006	SR	2.0	1.8		
Female, 68a	Hancock, #29	1998	AF	1.8	1.7		
Male, 67a	Labcore, #29	2008	SR	2.1	2.2		
Male, 75a	Hancock, #27	2002	AF	1.9	1.7		

SR sinus rhythm; AF atrial fibrllation; VES ventricular extrasystolia

Figure 1