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A SMELOFF-CUTTER MECHANIC AORTIC VALVE: RETIRED AFTER 35 YEARS OF SERVICE (1974-2009)

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An 82-year-old woman presented to The Methodist Hospital with dyspnea. Medical history was significant for aortic valve replacement with a Smeloff-Cutter aortic valve in 1974. On examination, blood pressure was 110/60, heart rate was 82 regular. The precordial exam demonstrated a displaced apical impulse and 3/6 holodiastolic murmur. Transthoracic echocardiogram showed a dilated left ventricle (LV) end-diastolic diameter of 6.0 cm with reduced systolic function (EF 30%). Spectral and color Doppler assessment indicated normal mechanic aortic valve systolic function with paravalvular regurgitation of moderate severity. Coronary angiography was normal and blood cultures were negative. The patient responded promptly to diuretic therapy and was discharged from the hospital.

Several weeks later she continued to complain of dyspnea at rest (NYHA class IV). As shown in Figure 1, transesophageal echocardiography with 3D color Doppler imaging confirmed normal aortic valve systolic function but indicated severe paravalvular regurgitation. Cardiac MRI was performed to assess LV and aortic valve function (Figure 2). Phase-contrast velocity mapping confirmed a large paravalvular defect with significant diastolic regurgitation (50 ml/beat) in the region of the non-coronary cusp.

The patient elected to have redo aortic valve replacement. At surgery, the unique Smeloff-Cutter struts and ball poppet were inspected and found to be in perfect working order with no visible valve deterioration. A large paravalvular defect was confirmed (Figure 3). The 35-year-old mechanical valve was replaced using a porcine bioprosthesis. At six-month follow up, the patient reported significant improvement of symptoms (NYHA class I), and transthoracic echo demonstrated improved LV end-diastolic dimension (5.3 cm) and systolic function (EF 45%).

The Smeloff-Cutter aortic valve was introduced in 1964. It has a unique design of three titanium struts positioned to create an "open" cage on both the aortic and ventricular aspects of the valve. Unlike the Starr-Edwards valve, in diastole the poppet ball of the Smeloff-Cutter valve passes completely through the

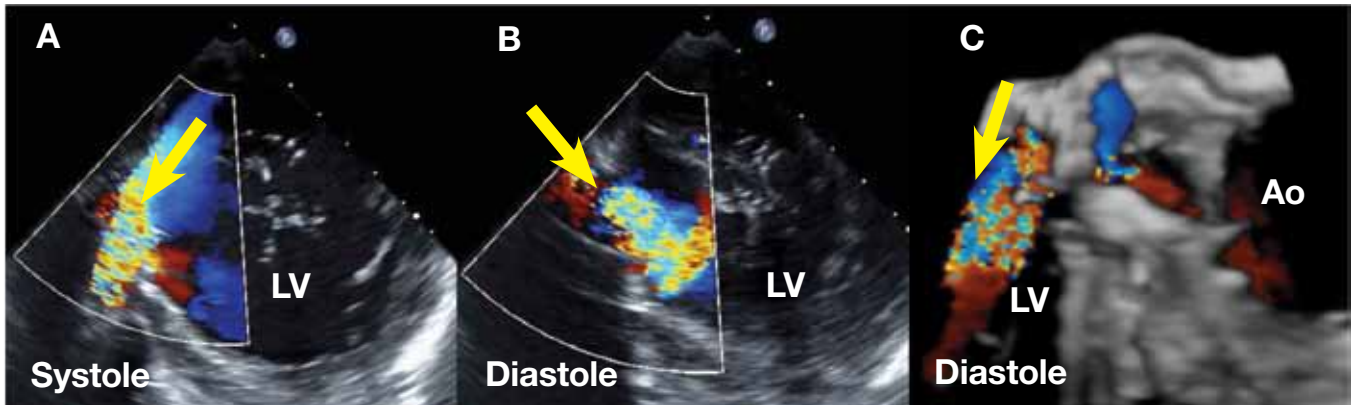

Figure 1. Transesphageal Imaging to assess severity and site of paravalvular regurgitation. 2D color Doppler demonstrates normal systolic flow (A) with significant, almost perpendicular, diastolic regurgitant flow (B). 3D color Doppler demonstrates a large paravalvular defect (C). Yellow arrows indicate flow direction. Left ventricle (LV); Aorta (Ao).

valve orifice and is contained by the ventricular struts. This case demonstrates the utility of multimodality prosthetic valve functional imaging as well as the remarkable longevity of the first generation of ball-cage prosthetic valves. For this patient, her Smeloff-Cutter aortic valve outlasted her paravalvular tissues but eventually had to retire after 35 years of service and approximately 1.5 billion heart beats.

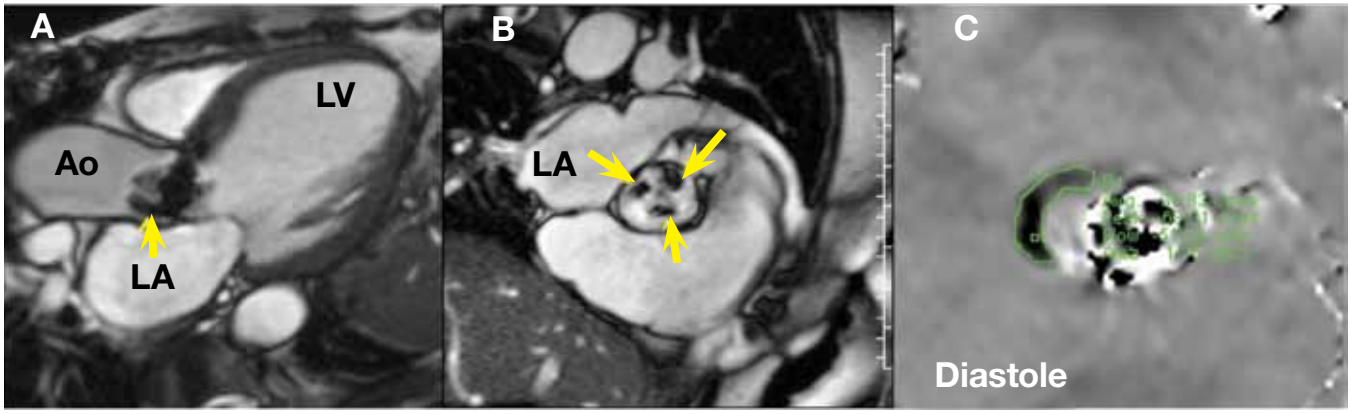

Figure 2. Cardiac Magnetic Resonance Imaging. Long-axis (A) and short-axis (B) views demonstrate the three distinct cage-struts of the Smeloff-Cutter prosthetic valve (yellow arrows). Phase contrast velocity mapping techniques (C) were used to define the crescent-shaped paravalvular flow area (1.36cm^2) and regurgitant volume (50 ml/beat). Left atria (LA); Left ventricle (LV); Aorta (Ao).

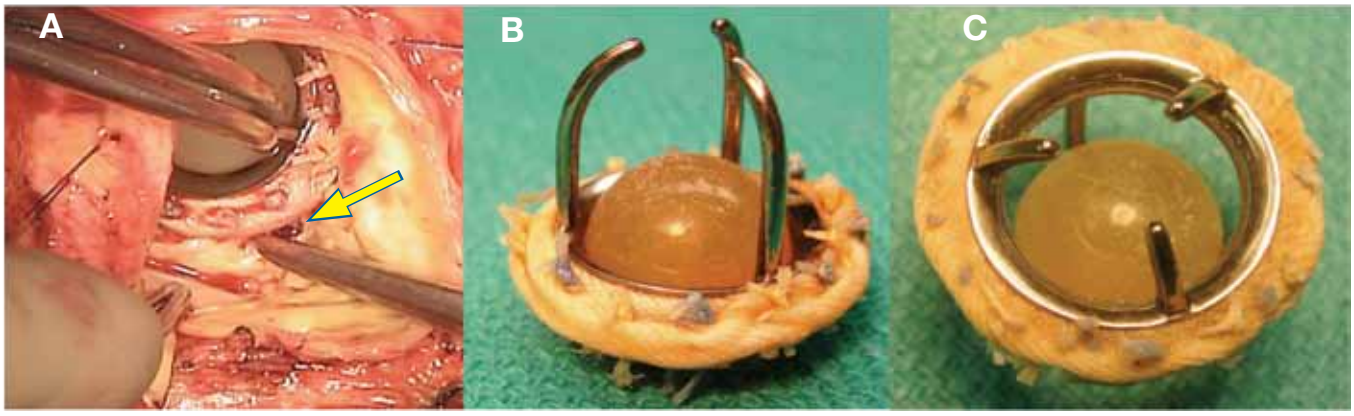

Figure 3. Operative Images demonstrate focal paravalvular pathology. A large paravalular defect is explored using a surgical instrument (A). Direct inspection demonstrates remarkably preserved structural integrity of the three aortic struts (B), the three ventricular struts (C) and the poppet-ball.