Early failure secondary to noncoronary leaflet prolapse in a stentless aortic bioprosthesis

CHERIAN, Sanjay, et al.

Abstract

Structural degeneration is an important long-term disadvantage of biologic prostheses. However, early failure of these prostheses is uncommon and is usually caused by rapid calcification. We report the successful management of a rare case of early failure of a stentless aortic bioprosthesis (within 4 months of implantation). The patient presented with severe noncalcific aortic regurgitation secondary to prolapse of the noncoronary leaflet. In consideration of the acute nature of failure in this new-generation bioprosthesis and its unclear cause, we believe that this report, albeit of a single case, warrants some attention.

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Early Failure Secondary to Noncoronary Leaflet Prolapse in a Stentless Aortic Bioprosthesis

Sanjay Cherian, MD, PhD
Hajo Müller, MD
Afksendiyos Kalangos, MD, PhD
Mustafa Cikirikcioglu, MD, PhD

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From: Divisions of Cardiovascular Surgery (Drs. Cherian, Cikirikcioglu, and Kalangos) and Cardiology (Dr. Müller), University Hospitals and Faculty of Medicine of Geneva, 1211 Geneva, Switzerland

Address for reprints: Mustafa Cikirikcioglu, MD, PhD, Division of Cardiovascular Surgery, University Hospitals of Geneva, Rue Gabrielle Perret-Gentil 4, 1211 Geneva, Switzerland

E-mail: mustafa.cikirikcioglu@hcuge.ch

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Aortic valve replacement using stentless biological prostheses offers the benefits of good hemodynamics, without the requirement of prolonged anticoagulation. Although their major drawback—structural degeneration in the long term—is well documented, bioprostheses rarely fail early, and, when they do, rapid calcification of the valve leaflets is the usual cause.

We report the successful management of a rare case of early failure of a stentless aortic bioprosthesis within 4 months of implantation. The patient presented with severe noncalcific aortic regurgitation secondary to prolapse of the noncoronary leaflet.

Case Report

In March 2009, a 74-year-old man underwent aortic valve replacement with a 23-mm Freedom Solo stentless bovine pericardial tissue valve (SORIN Biomedica Cardio S.r.l.; Saluggia, Italy) for severe aortic stenosis; concomitantly, he underwent coronary artery bypass grafting (saphenous vein graft to obtuse marginal artery). The right coronary artery (RCA) had less than 50% luminal stenosis, so it was not bypassed. Postoperative recovery and echocardiographic results were normal. However, 4 months later, the patient presented with acute chest pain, dyspnea, and ischemic electrocardiographic changes. Angiography showed that rapid progression of coronary artery disease had resulted in significant RCA stenosis, with some luminal irregularity of the left coronary artery ostium. Despite successful balloon angioplasty and stenting of the RCA, he had ischemic symptoms and began to develop acute pulmonary edema. Detailed transesophageal echocardiography (Fig. 1) and aortography (Fig. 2) revealed severe regurgitation of the aortic prosthesis. The unstable hemodynamic situation warranted emergency reoperation.

After the institution of cardiopulmonary bypass by femorofemoral cannulation, the dense pericardial adhesions were released. Aortotomy revealed an intact aortic bioprosthesis, without evidence of endocarditis, leaflet perforation, pannus formation, paravalvular dehiscence, abscess formation, or calcification. However, the noncoronary leaflet of the prosthesis appeared to be elongated and it prolapsed into the left ventricle, thereby preventing proper leaflet coaptation. There was severe inflammation, tissue fragility, and fibrosis on the inner surface of the aorta along the sewing ring suture line, secondary to the healing process of the implanted stentless valve. The aortic prosthesis was well attached to the aortic wall and had not loosened, nor did the aortic wall changes alter the geometric relationships between the posts of the prolapsing cusp. The valve leaflets were excised along with the adjoining aortic sewing ring and sent for bacteriologic and histologic analysis to rule out structural degeneration is an important long-term disadvantage of biologic prostheses. However, early failure of these prostheses is uncommon and is usually caused by rapid calcification. We report the successful management of a rare case of early failure of a stentless aortic bioprosthesis (within 4 months of implantation). The patient presented with severe noncalcific aortic regurgitation secondary to prolapse of the noncoronary leaflet. In consideration of the acute nature of failure in this new-generation bioprosthesis and its unclear cause, we believe that this report, albeit of a single case, warrants some attention. (Tex Heart Inst J 2012;39(5):676-9)
secondary endocarditis, although there were no macroscopic signs of endocarditis. The intense intra-aortic fibrosis had reduced the luminal diameter and permitted the implantation of only a 19-mm Carpentier-Edwards PERIMOUNT Magna bovine aortic prosthesis (Edwards Lifesciences LLC; Irvine, Calif) in a supra-annular position using interrupted mattress sutures. Weaning the patient from cardiopulmonary bypass was difficult, despite inotropic and intra-aortic balloon pump support. Transesophageal echocardiography showed anterolateral akinesia of the left ventricle, for which reason we bypassed the left anterior descending coronary artery (LAD) with a vein graft. Subsequent recovery was uneventful. Postoperative angiography confirmed occlusion of the left main coronary ostium, with patency of the RCA and of both vein grafts (to the left LAD and obtuse marginal branch). Histologic analysis of the excised leaflets revealed numerous macrophages and giant cells with focal fibrin deposition. At the 2-year follow-up examination, echocardiography showed good functioning of the new aortic prosthesis, with well-preserved left ventricular function.

**Discussion**

Stentless bioprostheses provide good hemodynamic performance and favorable rates of morbidity and mortality. Although long-term structural degeneration is a major drawback, early complications of the bioprosthesis are very uncommon and usually relate to acute leaflet mineral deposition or failures in surgical technique. This case report describes a rare, but potentially fatal, early failure of the Freedom Solo stentless bioprosthetic valve in the aortic position.

The Freedom Solo is a new-generation stentless bovine pericardial bioprosthesis designed for supra-annular implantation using a single suture line. Proper implantation of this prosthesis permits good alignment of the valve orifice with the patient’s annulus, resulting in low postoperative gradients and decreased cross-clamping time.

The unique design of the Solo aortic prosthesis requires accurate determination of size, proper positioning, and precise symmetry during implantation in order to attain optimal valve function. The operative technique used in our patient was in absolute accord with the manufacturer’s instructions and was informed by our study of previous surgical experience with this prosthesis, in order to ensure no technical errors during implantation. Although this stentless valve is pliable and therefore adaptable to asymmetric sinuses, subcoronary implantation of the valve might distort the aortic root, reduce the normal expansion of the sinuses, and progressively lead to increased mechanical stress on the valve leaflets. Furthermore, there might be a “washout” effect on the right and left coronary leaflets—where-
by blood flow through the left and right coronary ostia might decrease tension on those leaflets during diastole. Because the noncoronary leaflet lacks that tension-decreasing washout mechanism, it could be subject to more stress during each diastole.

It is known that glutaraldehyde pretreatment devitalizes cells, thereby leading to leaflet stiffening, calcification, and subsequent valve failure. In contrast, the Solo valve is detoxified with homocysteic acid, which has been shown to prevent these sequelae.5 Furthermore, there was no evidence of bacterial endocarditis, leaflet perforation, pannus, paravalvular dehiscence, atheroma, abscess formation, or calcification in our patient.

The cause of acute prosthetic failure might then be attributed to an unknown primary tissue failure or to a mismatch of pericardial leaflets of varying tensile properties, which could explain the prolapse of only one leaflet. Histologic analysis of the excised leaflets revealed numerous macrophages and giant cells with focal fibrin deposition. However, because these findings were not localized to the prolapsed leaflet, it is difficult to correlate them with the mechanism of prolapse. In addition to the above-mentioned considerations of cause, this acute prosthesis failure could not be attributed to any patient-related factor.

Despite initial echocardiography that revealed good prosthetic function after proper surgical implantation, severe aortic regurgitation developed in our patient within 4 months of implantation. The right coronary disease that appeared to be of little significance at initial intervention required percutaneous coronary intervention during his 2nd hospitalization. This rapid progression of coronary atherosclerosis within a very short time is a well-recognized phenomenon.8

Reoperation within 1 year of primary prosthesis implantation is an independent predictor of perioperative death, owing to the intense inflammatory reaction and fibrosis that occasionally requires additional procedures—such as patch repair of the aortic root, total aortic root replacement, or the use of interposition grafts.9 However, our patient benefited from explantation of the stentless bioprosthesis and received a new, stented bioprosthesis. Dense inflammation and fibrosis of the inner aorta along the previous suture line led to loss of inner aortic diameter, permitting only a 19-mm stented bioprosthesis. Similarly, the luminal irregularity of the left coronary ostium was a result of the intense inflammatory and fibrotic reaction of the adjacent aorta; this, along with the implantation of a stented bioprosthesis on a fibrosed aortic annulus, led to left coronary ostial occlusion, which was successfully managed by emergency bypass grafting.

To the best of our knowledge, this case recounts the earliest failure of a stentless aortic Freedom Solo prosth-
sis. It underscores the fact that stentless aortic bioprosthetic valves can present not only with late degeneration, but with early complications. In consideration of the acute nature of failure in this new-generation bioprosthesis and its unclear cause, we believe that this report, albeit of a single case, warrants some attention.

References