Early Structural Valve Deterioration of the Mitroflow Aortic Bioprosthesis

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There has been a trend toward more frequent use of bioprosthetic valves, especially in the young generations, over the last decade. Moreover, according to the Society of Thoracic Surgeons database, use of bioprosthetic valve increased from 44% in 1996 to 78% in 2006 in North America. The Freedom from warfarin use and restrictions on diet and activities make bioprosthetic valves more attractive and popular, and multiple reports have shown that choosing a bioprosthetic valve does not decrease survival despite the increased rate of reoperation.

The Mitroflow aortic prosthesis (Sorin Group Inc) is one of the most frequently used bioprostheses, with >100,000 implanted worldwide. The bovine pericardium is mounted externally around the stent, which maximizes the flow relative to the stent size. The valve is placed in the supra-annular position compared with the intra-annular position in some of the other bioprostheses. These characteristics allow superior valve hemodynamics in the Mitroflow aortic valve, especially in those with a small aortic annulus (19 and 21 mm); therefore, the Mitroflow aortic valve is considered an ideal valve for patients with a small aortic root.

The Achilles heel of the bioprosthetic valve is structural valve deterioration (SVD). Cusp tears and thickening, calcification, pannus formation, and thrombus lead to deterioration of the valve, which is the leading reason for reoperation in bioprosthetic valves. The rate of SVD differs among ages; valves implanted in younger patients degenerate faster. For patients >65 years of age, the 10-year freedom from SVD in new pericardial valves is typically >90%.

In this issue of Circulation, Sénage et al strike a note of warning against the use of the Mitroflow aortic valve. Some of the previous reports have shown 99% 5-year freedom from SVD in Mitroflow valve, but in this report, the 5-year freedom from SVD was 91.6% and, when a 19-mm Mitroflow was used, 79.8%. The follow-up time was short (3.8±2.0 years), but the first SVD was observed only 14 months after implantation. The cumulative probability of SVD increased significantly from 0.8% at 2 years to 8.4% at 5 years. Most of the early SVD (92%) was caused by calcified prosthetic stenosis rather than a tear of the leaflet or regurgitation. A small-diameter prosthesis (19 and 21 mm) was used in 64.2% of the patients and was a significant risk factor for SVD in both univariate and multivariate analyses. This is a big concern because Mitroflow has been considered the ideal valve in patients with a small root, as mentioned earlier.

This is not the first report that questioned the durability of the Mitroflow aortic valve. Alvarez et al reported their series of 491 patients >70 years of age who received a Mitroflow aortic bioprosthesis. Freedom from SVD was 95% at 5 years but dropped sharply to 55.8% in 10 years. The median time from operation to SVD was 48 months. Joshi et al reported a 3.6% incidence of early SVD within 6 years, requiring reoperation in patients <60 years of age who had a Mitroflow aortic valve implanted. These numbers are high compared with the historical numbers for other pericardial valves. One study showed a higher incidence of SVD in the Mitroflow group compared with the group receiving a Carpentier-Edwards Perimount valve (Edwards Life Science, Irvine, CA) at 10 years (44% vs 13%). Interestingly, age, which typically is one of the most important factors for SVD, did not have any significance in this report. The high incidence of early SVD of Mitroflow was seen in both young and elderly patients.

In the report by Sénage et al, one third of patients who experienced SVD presented with what the authors describe as “accelerated SVD.” This was defined by an increase in mean valvular gradient >25 mmHg/y. Recently, Saleeb et al have reported this accelerated degeneration of the Mitroflow valve in a young patient population (<30 years of age). Freedom from valve failure was 53% at 2 years and 18% at 3 years in this series. Life-threatening SVD was detected at a median of 6 months after a normal or mild gradient on a previous echocardiogram. Pathological examination showed that intrinsic calcification causing valve fixation was the main reason for this accelerated degeneration. The Sénage et al report gives us more insight into this phenomenon; accelerated SVD was seen more often in patients with a small aortic prosthesis (76.9%) and in patients with a prosthesis gradient >30 mmHg. This subgroup had 46.2% valve-related death rate after the occurrence of accelerated SVD. SVD had the strongest correlation of mortality, with an increased risk of death of 7.7. This highlights the importance of frequent monitoring with echocardiograms in patients who have a small prosthesis and gradient >30 mmHg across the bioprosthesis. Given these data, echocardiogram surveillance should be performed at ≤6 months for early detection.

Another important finding in this article was the underreported incidence of SVD. In many articles, SVD is reported as the rate of reoperation and explantation of the old prosthesis. This underestimates the incidence of SVD because many patients may develop SVD but few may receive surgical treatment. In this series, an
echocardiogram was used to follow up these patients, and an increased gradient and valve insufficiency were used as the criteria for SVD. Only 10.3% of patients with SVD underwent reoperative aortic valve replacement; 11.4% died newly and another 11.4% died while on the wait list. There is a question of why 51.4% were not referred to surgery, but this shows the underreported incidence of SVD if reoperation alone is used as the criterion.

The externally mounted pericardial valve poses problems for valve-in-valve transcatheter solutions. Because the internal diameter of Mitroflow valve is only 15.4 mm for the 19-mm valve and 17.3 mm for the 21-mm valve, no transcatheter valve currently is recommended because of the likelihood of a postprocedural gradient.15 There is also a concern about coronary obstruction when valve-in-valve replacement is performed because of the externally placed valve leaflet pushing into the ostium.16 For these reasons, reoperation for small Mitroflow SVD likely has to be done through a traditional surgical approach. This report does not provide the presence of symptoms at the time of diagnosis of SVD; however, given the poor outcome of these patients, reoperative aortic valve surgery or a transcatheter procedure for high-risk non–small-annulus patients should be offered when the diagnosis of SVD is made, even if the patient is asymptomatic. This early SVD could be attributed to the absence of antimineralization treatment in older-generation Mitroflow aortic valves. Flameng at al17 compared the incidence of SVD in valves with and without antimineralization therapy. There was an increased incidence of SVD (70.1% versus 90.9% 10-year freedom from SVD) in valves without antimineralization therapy.

The Mitroflow A12 was introduced in 1992. This model was modified from the original Mitroflow A11 by reversing the external cloth so that the ribbed side was external. This valve was used widely in Europe and Canada and was subsequently approved in the United States in 2007. The Mitroflow LX is a variation of the A12 and had minor revisions such as the use of an automatic sewing machine, reduction of sewing ring seams to 1 seam, and prefixation by glutaraldehyde rather than post-fixation.18 Both Mitroflow A11/12 and Mitroflow LX do not undergo antimineralization treatment. The most recent modification, Mitroflow with phospholipid reduction therapy, added this step. This chemical process uses long-chain alcohol solution to remove phospholipids from the tissue. This new valve was approved for CE marking in 2011 in Europe, and it was approved by the US Food Drug and Administration in April 2014.19

Although antimineralization treatment is still a hypothetical explanation for the accelerated degeneration seen in the Mitroflow valve, this report warns about a potential epidemic of SVD in patients who had Mitroflow A12 and LX implanted. It is unclear whether the Mitroflow with phospholipid reduction therapy will be able to prevent this type of SVD, but this is a separate issue. Monitoring patients who received older-generation Mitroflow with frequent echocardiography is mandatory to prevent undesired complications, especially in high-risk patients. Aggressive treatment is needed even in asymptomatic patients once the gradient becomes severe.

Disclosures

None.

References


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