Mid-term results of the valve-on-valve technique for bioprosthetic failure

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Abstract

Objective: Redo operations for bioprosthesis malfunction can sometimes be technically very demanding and cardiac structures may be damaged. Excising only the leaflets of the damaged bioprosthesis and leaving the old ring in situ on which the ‘new’ mechanical valve is sutured can, in very selected cases, represent a solution. Methods: Twenty-two patients were operated on, with the valve-on-valve technique, from September 1991 through December 1992. There were three operative deaths. Results: The surviving 19 patients were followed-up from 83 to 98 months (mean 90.5 months). There were two late deaths. The patients were examined clinically and with transthoracic and transesophageal echocardiograms. All patients were in good condition and the echocardiographic examinations showed no clinically important gradients across the prostheses. Conclusions: The valve-on-valve technique, in certain difficult situations, can give successful mid-term results. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Bioprostheses have a better performance in terms of thromboembolism than do mechanical valves. However, they suffer from a high incidence of deterioration, which has been demonstrated to be an age-related phenomenon. Reoperations are therefore necessary and sometimes surgeons are faced with very difficult technical problems.

In 1993 we reported our results with the valve-on-valve technique [1]. Harsh criticism ensued, and even our echocardiographic results were doubted [2].

These critics forced us to reflect for a period and we applied this new technique even more rarely than before in redo operations. We also followed up these patients very closely to detect early signs of valve failure and promptly reoperate.

In this paper we report the mid-term results in that group of patients adding, for completeness, only four patients to close the reported period of time by December 1992.

2. Materials and methods

From September 1991 through December 1992, 22 patients were reoperated on for bioprosthetic malfunction, using the valve-on-valve technique.

This technique, as previously described [1], was not a ‘planned’ technique but was indeed a consequence of technically very demanding situations.

There were 11 men and 11 women with ages ranging from 29 to 73 years. The time between first and redo operations ranged from 50 to 168 months (mean 120.3 ± 27.3 months).

In these 22 patients, 26 malfunctioning bioprostheses were partially removed and 28 mechanical valves were implanted (two on native diseased valves).

The surgical technique has been described and was performed by the same surgeon (N.S.) using the same technique throughout the period of study [1]. Briefly, femoral vessels are cannulated for extracorporeal circulation (ECC) and the ECC is started. For a few seconds the ECC and the ventilation are stopped, allowing a brief period of patient exsanguination; then the sternum is quickly reopened with a Sarns saw. The ECC and the ventilation are promptly resumed. The decompressed heart is easily freed from adhesions. We always open the left pleura and hitch up the right side of the pericardium with sutures to facilitate the expo-
sure of the mitral bioprosthesis. The left atrium and/or the aorta is opened, the bioprosthesis which is deeply buried in the myocardium and/or in the ascending aorta is left in place, removing only the leaflets with a no. 11 knife and scissors. Next, 2-0 pledgets Tevdek sutures are placed on the bioprosthetic ring and then in the mechanical valve ring, which is therefore seated on the old ring. The atriotomy and/or the aortotomy is closed. The heart is deaerated and the aorta is opened.

Patients surviving the operative period were followed up for a minimum of 83 months and a maximum of 98 months (mean 90.5 ± 4.9 months). The cumulative follow-up was 128.2 patient-years and no patients were lost to follow-up.

The definitions of events, their classification, and the analysis of the data follow the recently suggested guidelines for reporting morbidity and mortality after cardiac valve prosthesis operation [3]. Operative mortality is defined as death in the operating room, in the hospital, or within 30 days of the procedure and are all classified as valve-related. Late mortality is affirmed as death beyond 30 days after surgery.

The value are expressed as mean ± SD. The patients survival was determined by Kaplan–Meier actuarial analysis and expressed as percentage who were event free ± SE. Hospital deaths were included in the survival curves.

The Student’s t-test was used to screen variables in the univariate analysis: a value of \( P \) less than 0.05 was considered statistically significant.

To evaluate the gradients across the prostheses, echocardiography was performed in all patients. Patients were studied by using Hewlett Packard echo machine with 2.5 MHz duplex probe. Continuous doppler was employed to measure the maximal prosthetic velocity; then the maximal and mean gradient of prosthetic valves and the mean gradient of mitral prostheses were calculated as a mean of three cardiac cycles in patients in sinus rhythm and of five cardiac cycles in patients in atrial fibrillation. In 11 patients transeosophageal echocardiography was performed with multiplanar probe.

3. Results

There were three operative deaths (13.6%), all patients were in IV NYHA functional class and two were in cardiac cachexia and were operated on urgently.

Nineteen patients were discharged from the hospital in fairly good condition.

There were two late deaths. One patient, who underwent his third operation and had a 25 mm mitral Carbomedics and a 23 mm aortic Carbomedics, died suddenly at home 3 months after surgery. At his last outpatient control, 2 weeks earlier (ECG, chest X-ray, and transthoracic echocardiogram), the clinical situation appeared good. His death is obviously classified as valve-related. The other death was due to valve thrombosis 1 year after surgery and is discussed in the valve-related complications. The survival curve of patients is depicted in Fig. 1.

4. Valve-related complications

4.1. Thromboembolism

One patient (with a no. 27 mitral Carbomedics valve) was back in hospital with ingravescent dyspnoea 1 year after surgery. Her prothrombin time level was 80%, with a INR of 1.20. An urgent echocardiographic examination was carried out and showed valve thrombosis with the tilting disks blocked. Cardiac condition worsened rapidly and the patient was deemed too sick for surgery, therefore thrombolysis (r-TPA) was carried out. Cardiac condition improved and the echo examination showed an improved, but not a completely free, disk movement. Two days later the patient was reoperated on. At surgery, the mechanical valve was partly thrombosed with a pannus on the atrial side (Fig. 2). The patient died of low output syndrome and multiorgan failure 7 days after surgery.

At follow up, on clinical examination, the remaining patients were in fairly good condition. There were the normal clicking sounds of the mechanical prostheses, and no pathological murmurs. The echocardiographic (transthoracic and/or transesophageal) examinations showed normal valve positions, no abnormal disk movements and no clinically important gradients across the prostheses (Fig. 3). The mean early and late postoperative gradients across the mitral valves were 4.8 ± 1.6 and 4.3 ± 1.2 mmHg (not significant). For the aortic valves, the mean early and late postoperative mean gradients were 24.5 ± 9.2 and 22.5 ± 4.6 mmHg (not significant). The mean early and late postoperative peak gradients across the aortic valve were 41 ± 17.1 and 37.5 ± 6.4 mmHg (not significant).

There were no instances of structural deterioration, hemorrhage, endocarditis, paravalvular leaks, and other valve reoperations.

Fig. 1. Curve of patients survival.
5. Comment

Reoperative surgery for failed bioprostheses may sometimes pose extremely difficult technical problems. Probably this is due to the ‘oversizing’ problem that afflicted many surgeons when implanting the bioprostheses. As surgical technique develops, of course, risks associated with bioprostheses explantation are minimized. Nevertheless, few valves are really embedded in the myocardium and/or the ascending aorta and the surgeon is faced with technically demanding situations. In these cases the technique of valve-on-valve may be useful.

Our first report was accepted with harsh criticism, so we followed up these patients very closely to detect early signs of valve failure. Therefore, we were very pleased when we looked at our mid-term results.

One patient died suddenly at home. He had a 25 mm mechanical mitral valve and a 23 mm mechanical aortic valve. We do not think that in a patient with a body surface area of 1.60 m² a 25 mitral valve can give a significant gradient, which can result in sudden death. Furthermore, this patient, at his last outpatient visit 2 weeks earlier, was asymptomatic and the transthoracic echo did not show any important gradient across the mitral and aortic valves. However, early in our experience, fearing the impingement of the disks in the bioprosthetic ring, we had preferred to stay on the ‘safe side’ and had implanted few 25 mitral valves. With increasing experience, we now comfortably fit a mechanical mitral valve only one size smaller than the bioprosthesis. In any case, this death is classified as valve-related, even if, as others, we think that sudden death markedly increases the valve-related death (VRD) [4,5]. Burke and Rooney [4,5] in an autopsy series have shown that 50–90% of VRDs were not related to the prosthesis itself. Sometimes myocardial infarction and arrhythmia are responsible for VRDs.

The other patient returned with a thrombosed valve. However, her prothrombin time level was 80%, and we think that even a ‘normal’ mechanical valve would thrombize with that level of anticoagulation. Probably in that patient, with large left atrium and invertebrate atrial fibrillation, a mild dose of antiaggregation (added of course to the anticoagulation regimen) may have been indicated.

Our mid-term results are encouraging, the new valve appear well positioned and the echocardiographic examination confirms the results.

At present echocardiography assesses the prosthetic function by using the overall information obtained from M and 2D echo, pulsed and continuous Doppler and by color Doppler. M and 2D echo, although useful in assessing the...
timing and motion characteristics of prosthetic mobile elements, are neither sensitive nor specific, whereas continuous Doppler shows a high sensitivity and specificity in the evaluation of the hemodynamic prosthetic performance. It has been demonstrated that in patients with mitral prosthesis, pressure gradients obtained simultaneously by Doppler echocardiography and cardiac catheterization show a one-to-one correlation [6]. Otherwise, because all prosthetic valves are inherently mildly stenotic and because gradients depend on the type and size of the prosthesis and, obviously, on the heart rate, ejection fraction, cardiac output, the ACC/AHA guidelines for the clinical application of echocardiography suggest that a baseline postoperative study is useful for comparison with future evaluations and assessment of changes in ventricular and prosthetic function [7].

From a technical point of view, in mitral position, the St. Jude prostheses are to be preferred, owing to the fact that the leaflets are hinged on the atrial side and do not protrude into of the ventricular side. The use of St. Jude inverted aortic prosthesis, as later proposed by Geha [8], to take advantage of the thinner sewing ring, is not really relevant, because in our technique it is important to match the internal diameter of the mechanical prosthesis to that of the bioprosthesis. The new mechanical valve is sutured ‘sitting on’ the old one and not inside. In aortic position carbomedics valves are to be chosen because of their extremely flat profile. However, when implanting the mechanical device between the prongs of the old bioprosthesis, the size of the new valve must be at least two sizes smaller and a mild gradient can sometimes result. If the failed bioprosthesis is too small, the prongs can be amputated and the new valve seated on the old ring, therefore a larger valve can be used [1].

The mid-term follow-up demonstrated that even if this technique is not to be routinely used in redo operations for failed bioprosthesis, is nevertheless a technique that in certain difficult situations can give successful mid-term results.

Of course, longer follow-up is mandatory to assess the definite value of this technique precisely.

References


