Obstruction of Mechanical Heart Valve Prostheses: Clinical Aspects And Surgical Management

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One hundred patients (32 male) aged 5 months to 82 years (median 32 years) underwent 106 surgical procedures for 112 mechanical prosthetic valves obstructed by a thrombus (n = 61) or pannus (n = 7), or both (n = 44), between January 1, 1980 and December 31, 1989. The position of the obstructed prosthesis was aortic in 51 patients (48%), mitral in 49 (46%) and both aortic and mitral in 6 (6%). The types of obstructed prosthetic valves were Björk-Shiley (n = 51), St. Jude (n = 41) and Medtronic-Hall (n = 20). The time interval between valve replacement and obstruction ranged from 6 weeks to 13 years (median 4 years). Of 63% of patients in whom coagulation variables were available at the time of obstruction, 70% were receiving inadequate anticoagulant therapy. In 63% of the procedures the patient was in New York Heart Association functional class IV.

Two patients underwent preoperative thrombolysis with incomplete results. Operative procedures included valve replacement (n = 81), valve declotting and excision of pannus (n = 23) and aortic valve replacement and mitral valve declotting (n = 2).

Valve obstruction is one of the most serious complications of a mechanical prosthetic valve, with an incidence rate ranging from <0.5% to 4.5% per patient year (1-5). The clinical presentation may vary from insidious onset of mild symptoms (6) to abrupt circulatory decompensation often resulting in death (1). Failure to make the diagnosis early and intervene promptly increases the mortality rate associated with this complication. Almost 50% of obstructed valves are diagnosed at autopsy (7). Because the complication is relatively rare, the mechanisms of obstruction and spectrum of presentations are not well understood and the clinical diagnosis is often missed or made too late. Although the mechanism of the obstruction is most often thought to be valve thrombosis, the relative role of chronic pannus formation is less well established (8,9). In addition, the most sensitive method of diagnosis of prosthetic valve obstruction is debatable. It is also controversial whether the patient with an obstructed valve should be managed by valve replacement (10), mechanical declotting (11) or nonsurgical thrombolysis (12).

The early mortality rate was 12.3% (13 patients), and there was no difference between surgery for mitral prostheses (12.2%) versus aortic prostheses (13.7%). The perioperative mortality rate was 17.5% (11 of 63 patients) in patients in functional class IV and 4.7% (2 of 43 patients) in those in functional classes I to III (p < 0.05). For valve replacement, the mortality rate was 12% (10 of 81 patients) and for declotting of the prosthesis 13% (3 of 23 patients).

It is concluded that although obstruction of a mechanical valve prosthesis is usually associated with thrombus, pannus formation is relatively frequent. Clinical presentation varies between minimal or absent symptoms to cardiocirculatory collapse. Symptoms were not related to position or model of prosthesis. Prompt surgical treatment is associated with a relatively low mortality rate. Short-term results after prosthesis declotting and excision of pannus are comparable with those of prosthetic valve replacement.

Methods

Study patients. The medical records of all patients undergoing surgical treatment for an obstructed mechanical valve between January 1, 1980 and December 31, 1989 at the University of Witwatersrand Hospitals in Johannesburg were analyzed. Data were obtained from hospital records. There were 100 patients undergoing 106 procedures for 112 obstructed valves. During the same period, there were 1,114 St. Jude mitral prosthetic valves, 986 St. Jude aortic valves, 1,033 Medtronic-Hall mitral valves and 859 Medtronic-Hall aortic valves inserted. Björk-Shiley valves were not implanted after 1980, and the total number of valve replacements with this prosthesis is not available. Clinical data are summarized in Tables 1 and 2 and Figure 1. There were 41 obstructed St. Jude valves (incidence of obstruction 1.95%) from the Department of Cardiothoracic Surgery, Johannesburg Hospital and Department of Cardiology, Baragwanath Hospital, University of the Witwatersrand School of Medicine, Johannesburg, Republic of South Africa. Manuscript received April 27, 1990; revised manuscript received September 24, 1990, accepted October 4, 1990.

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and 20 obstructed Medtronic-Hall valves (incidence of obstruction 1.06%).

Surgery. Once the diagnosis of prosthetic obstruction was made by clinical examination, fluoroscopy or Doppler echocardiography (Table 3), patients were referred immediately for surgery, with no attempt to measure hemodynamic variables before or during operation. In all patients, cold potassium cardioplegia and moderate hypothermia were used for the operation. The mean aortic cross-clamp time was 53 ± 23 min and there was no significant difference for mitral versus aortic valve replacement or valve replacement versus debridement. Patients were discharged on dipyridamole (300 mg/day) (beginning in 1985) and warfarin at a dose targeted to achieve a prothrombin international normalized ratio (INR) of 2 to 2.5.

Statistical methods. The relations among the severity of symptoms and valve type, valve position, nature of the obstruction (pannus or clots) and mortality were examined by the Pearson chi-square test. We also compared the incidence of death after valve replacement with that after valve declotting using the Pearson chi-square analysis. The nature of the obstruction was assessed by the surgeon at the time of the operation and was categorized as follows: 1) pannus alone, 2) pannus mainly with some thrombus, 3) pannus and thrombus, 4) thrombus mainly with some pannus, and 5) thrombus alone. The t test with Bonferroni correction was used to compare the time interval between valve replacement and obstruction among these five groups. The critical p value was 0.05.
Results

Diagnosis. Data on the level of anticoagulation at the time of diagnosis were available in 67 patients (63%). In 70%, there was evidence of inadequate anticoagulation. The time interval between the onset of symptoms and diagnosis ranged from <1 day to >30 days (Table 2). Most patients presented with dyspnea at rest. In 63% of the procedures, the patient was in New York Heart Association functional class IV. There was no relation between functional class and the type of valve (that is, bileaflet versus single disc) or valve position. The method of diagnosis is summarized in Table 3. Most obstructed valves were detected by either cinefluoroscopy or auscultation without catheterization.

Surgical findings. The nature of obstruction was assessed by the surgeon at the time of operation. Pannus formation was relatively common and was found with little or no thrombus in 10.7% of valves and in combination with thrombus in 11.6%, whereas thrombus was found alone or with little pannus in 77.7%. Elements of pannus formation have been found as early as 6 weeks after valve replacement and obstruction by only pannus has been found as early as 6 months after valve replacement. Bileaflet valves were not less vulnerable to complete obstruction than single disc valves. In 30 of the 41 patients with a St. Jude valve, the thrombus was at the hinge site and impaired the movement of both leaflets.

Surgical procedures and results (Table 4). Operative procedures performed were valve replacement in 81 of 106 valves (23 bioprostheses and 58 mechanical valves), declotting/pannus excision in 23 and aortic valve replacement plus mitral declotting/pannus excision in 2. All patients were operated on urgently once the diagnosis of obstruction was established even if they were in clinically stable condition. In two patients, preoperative thrombolysis was attempted with incomplete results. The operative mortality rate was significantly higher in those who were in functional class IV at the time of operation (p < 0.05). The mortality rate was not different for aortic (13.7%) versus mitral (12.2%) prosthetic valve obstruction.

Table 4. Perioperative Death in 100 Patients With 106 Valve Prostheses

<table>
<thead>
<tr>
<th>Valve Prostheses</th>
<th>No.</th>
<th>%</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>13/106</td>
<td>12.3</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>NYHA I to III</td>
<td>2/43</td>
<td>4.7</td>
<td></td>
</tr>
<tr>
<td>NYHA IV</td>
<td>11/63</td>
<td>17.5</td>
<td></td>
</tr>
<tr>
<td>Valve replacement</td>
<td>10/81</td>
<td>12.3</td>
<td>NS</td>
</tr>
<tr>
<td>Valve declotting</td>
<td>3/23</td>
<td>13.7</td>
<td></td>
</tr>
<tr>
<td>Aortic obstruction</td>
<td>7/51</td>
<td>13.7</td>
<td>NS</td>
</tr>
<tr>
<td>Mitral obstruction</td>
<td>6/49</td>
<td>12.2</td>
<td>NS</td>
</tr>
<tr>
<td>Aortic + mitral obstruction</td>
<td>0/6</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

NYHA = New York Heart Association functional class.

Discussion

The most important findings of this study are 1) surgical results are excellent when patients are not in a state of hemodynamic decompensation; 2) it is incorrect to assume that all obstructed valves present with hemodynamic instability (symptoms may be subacute, chronic or absent); 3) there is no connection between type (bileaflet versus single disc) and location of prosthesis and the clinical presentation; and 4) the early surgical mortality rate for prosthesis declotting and excision of pannus (which are not infrequently found) is comparable with that of valve prosthesis replacement.

Surgical mortality. Our surgical mortality rate is within the range of that (0% to 44%) reported in previous studies (3-6,11,13,14). Copans et al. (15) from our institution reported an 8% mortality rate. However, these overall mortality values may not reflect the results obtained in patients according to their clinical condition. Among patients who presented in functional class I to III, our operative mortality rate of 4.7% did not differ significantly from that reported for valve replacement performed on previously unoperated patients (16). Thus, surgical treatment of prosthetic valve obstruction does not necessarily carry a high risk compared with elective valve surgery provided the patient’s condition is not unstable. Therefore, early diagnosis is extremely important in such patients.

Clinical detection and diagnosis. Our policy for detecting prosthetic malfunction is reflected in Table 3. Clinical evaluation, including careful auscultation, is the first step in the routine assessment of patients with a mechanical valve. If there is any evidence of valve malfunction, further investigation is mandatory. We used cinefluoroscopy as the procedure of choice for the rapid and accurate detection of reduced disc/leaflet motion. This is a simple method that allows rapid assessment of valve function even in patients who are restless or in unstable condition (17). Whenever necessary, the findings can be confirmed by Doppler echocardiography or cardiac catheterization. Cardiac catheterization was necessary in only three of our patients, and the routine use of this procedure only delays prompt intervention. This approach to patients with a prosthetic valve has enabled us to detect a significant percent of patients with insidious prosthetic valve obstruction.

An interesting and important finding was that not all patients with valve obstruction present in critical hemodynamic compromise. The long duration of symptoms in this (Table 2) and previous (3,6,18,19) studies indicates that many patients continue with valve obstruction too long before a diagnosis is made. Thus, any new or worsening symptoms in a patient with a prosthetic valve should prompt a thorough investigation to exclude valve obstruction. As previously noted (6), some patients with significant prosthetic valve obstruction may be completely asymptomatic.

It has been previously suggested (15) that the indication for surgery is more urgent for mitral prosthetic valve ob-
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March 1, 1991:646-50

Obstruction of mechanical heart valve prostheses is not significantly different than for aortic or combined aortic and mitral prosthetic valve obstruction. One hopes that a bileaflet valve design such as the St. Jude prosthetic valve would reduce the degree of hemodynamic compromise provided that the leaflets obstruct sequentially and not simultaneously. However, we did not find any difference in the severity of symptoms between patients having a bileaflet or single disc valve. Moreover, in 30 of 41 patients with an obstructed St. Jude valve, the movement of both leaflets was impaired.

Mechanism of valve obstruction. The pathology of prosthesis obstruction is more complex than is widely believed. Although thrombus has been considered to be the sole cause of obstruction (20,21), pannus formation plays an important role in the mechanism of obstruction (11,19) and may even be its sole cause (8,9). There was pannus in 46% of our patients, whereas thrombus was the sole cause of obstruction in 54%. Therefore, the term "valve thrombosis" is not synonymous with "valve obstruction," and the latter is preferable until the surgical findings are known. One might think that when obstruction is related to pannus formation, the time interval from valve replacement to obstruction should be longer. However, this has not been the case. Cleveland et al. (8) described pannus formation only 1 month after valve replacement. In our study, elements of pannus formation were found as early as 6 weeks after valve replacement and obstruction by only pannus has been found as early as 6 months after valve replacement. Conversely, valve obstruction by thrombus alone was found in our series as late as 12 years after valve replacement. The difference in the time interval from valve replacement to obstruction is not significantly different for obstruction by thrombus versus obstruction by pannus. The interaction of valve thrombus and pannus has not been fully elucidated and requires further study.

Some investigators (20–22) have found a direct relation between valve thrombosis and the adequacy of anticoagulation. In other reports (6,8,11), valve obstruction had occurred with adequate anticoagulation. Although data about the status of anticoagulation were available in only 63% of our patients, 70% of these had evidence of inadequate anticoagulation. However, it is difficult to be certain that the coagulation variables at the time of diagnosis of obstruction accurately reflect the patient's long-term anticoagulation status (2). Thus, we believe that repeated measurement of anticoagulation status over time is necessary to draw any conclusions about valve obstruction and level of anticoagulation, and these data were not available in any of the studies just mentioned.

Optimal surgical method. The optimal surgical approach to the patient with an obstructed prosthesis is debatable. Declotting and debridement of pannus were first described by Björk and Henze (23) and this approach was adopted by others (5,11,21,22). This method is relatively simple and shorter in relation to valve replacement and has been found to be associated with a lower mortality rate (5,22). Although some investigators (3,10) have shown that the rate of rethrombosis after this procedure might be higher than after valve replacement, the difference in recurrent thrombosis between valve replacement versus mechanical debridement in those studies was not statistically significant. In our study, the cross-clamp times and early mortality rate for these two methods were similar. Thus, we believe that the decision to replace or debride the valve should be left to the surgeon, depending on anatomic and technical factors at the time of surgery. When debridement is technically feasible, it should be the preferred technique. However, the long-term results of the two methods should be carefully assessed before it can be stated with certainty that debridement is superior.

Thrombolysis was attempted in two of our patients with incomplete results. Because of this and reports of embolic rates of 15% to 25% (12,24,25), we believe that thrombolysis is not the treatment of choice for patients who can undergo surgery. Furthermore, in view of the frequency of pannus formation that we and others have noted, thrombolysis will not be effective in a significant number of patients in whom pannus formation is involved.

Conclusions. Obstruction of a mechanical valve prostheses is most often caused by thrombus with or without pannus and infrequently by pannus only. Clinical presentation varies from minimal or absent symptoms to cardiocirculatory collapse. Symptoms were not related to valve position or model of prosthesis. Prompt surgical treatment is associated with a relatively low mortality rate. Short-term results after prosthesis declotting and excision of pannus are comparable with those of valve prosthesis replacement.

References


