Evaluation of Mechanical Valve Replacement at Jordan University Hospital

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Abstract

Objective: To investigate the operative mortality and mid-term (up to eight years) results of mechanical valve replacement.

Methods: Retrospective data analysis of 118 consecutive patients who underwent mechanical valve replacement. The early and late morbidity and mortality were analyzed at our institution, from January 2001 to December 2008.

Results: Hospital mortality was 2.5% (3 patients). Complications recorded during the follow up study include: prosthetic valve endocarditis (3.4%), bleeding (3.4%), stroke (3.1%), and reoperation (.8%). No structural valvular dysfunction and no valvular thromboses were reported.

Conclusion: Our data show that valves replacement with mechanical valve may be performed with low morbidity and mortality.

Keywords: Mechanical Heart Valve, Valve Related Complication, Rheumatic Heart Disease.

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Introduction

Since their first implantations in 1977, bileaflet mechanical heart valves have shown a satisfactory homodynamic performance and low complication rates. As a result, the bileaflet prosthesis has become the valve model of choice when valve replacement with a mechanical device is contemplated. [1, 2]

In Western Countries, valvular disease remains a common problem in the elderly, the most common etiology is degenerative, but in our part of the world still the rheumatic is the most common.

Rheumatic heart disease is the most common cause of multivalvular disease in the Developing Countries. Unless aggressive and timely intervention in the form of valve replacement is pursued, the condition progresses rapidly to disability and death.

Rheumatic fever and rheumatic heart disease had been decreasing in incidence in most developed countries, but worldwide it remains a very significant cause of cardiovascular morbidity and mortality. In 1994, it was estimated that 12 million persons suffered from rheumatic fever and rheumatic heart disease worldwide. [3] A large proportion requires valve surgery within 5 to 10

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years and many of them are children**.** [4]

Mechanical prostheses are used worldwide for valvular disease. However, Valvular Replacement with mechanical prosthesis carries the potential risk of thromboembolism and the need for lifelong anticoagulation with the risk of hemorrhage.

The aim of this retrospective study is to analyze the in-hospital mortality and mid-term results of mechanical valve replacement (isolated or concomitant with other surgical procedures).

Methods

We retrospectively reviewed the clinical records, outpatient records and surgical reports of all patients undergoing Mechanical valve replacement (isolated or concomitant with other surgical procedures) at Jordan University Hospital, from January 2001 to December 2008. We considered baseline characteristics including age, gender, cardiac symptoms, New York Heart Association functional class, congestive heart failure, atrial fibrillation, diabetes, renal failure, chronic obstructive pulmonary disease, cerebrovascular accidents, previous cardiac surgery, coexistent coronary artery disease, mitral valve disease, endocarditis, and left ventricular ejection fraction (Table 1). Intraoperative variables included are cardiopulmonary bypass time, aortic cross-clamp time, size and brand of the implanted prosthesis, associated surgical procedures, and surgical priority (Table 2). The operation was defined as urgent when the patient underwent surgery within seven days from the diagnosis, and could not be discharged home before the operation. Operative mortality was defined as death occurring within 30 days of cardiac surgery, or death prior to hospital discharge regardless of cause. Late mortality was defined as mortality after 30 days of cardiac surgery and hospital discharge. The valve related complications were defined according to the recently suggested guidelines for reporting mortality and morbidity after cardiac valve interventions, as hemorrhage, thromboembolism, prosthetic valve endocarditis, device thrombosis, structural valve deterioration and non-structural dysfunction including paravalvular leak. [5] Operative complications and causes of death were recorded and analyzed.

The results of quantitative variables were expressed in means with Standard Deviation (SD).

From January 2001 to December 2008, 118 patients underwent prosthetic valve replacement. In detail, 46 patients received a prosthetic aortic valve, 54 patients had a prosthetic mitral valve inserted and 18 patients had a double valve replacement. The entire population was made up of 63 men (53%) and 55 women (47%); mean age was 45± 14 years. Valve diseases are presented in Table (3).

Concomitant surgery was performed in a total of 18 patients (15%). The most common procedures were coronary artery bypass grafting in 15 patients (13%) and replacement of the ascending aorta in 3 patients for aneurysm of the ascending aorta. Mean valve size was 22± 2 mm for aortic valve replacement, and 28.5± 2 mm for mitral valve replacement.

Table (1): Baseline Patient Characteristics.

Age (years) (mean ±SD)	*45.5 ± 14.4*
Female sex, n (%)	*55 (47%)*
Male sex, n (%)	*63 (53%)*
NYHA class, n (%)	
1-11	*29 (25%)*
111-1V	*89 (75%)*
Chest pain, n (%)	*69 (58%)*
Dyspnea, n (%)	*110 (93%)*
Syncope, n (%)	*10 (8.5%)*
Palpitation, n (%)	*45 (38%)*
AF, n (%)	*31 (26%)*
CAD, n (%)	*31 (26%)*
CHF, n (%)	*35 (30%)*
Renal Failure, n (%)	*5 (4%)*
COPD, n (%)	*11 (9%)*
Previous Cardiac surgery	*8 (7%)*
EF%(mean ±SD)	*48±10*
DM, n (%)	*22 (19%)*
HTN, n (%)	*59 (50%)*
CVA, n (%)	*7 (6%)*
Endocarditis, n (%)	*4 (3.4%)*

NYHA: New York Heart Association, CHF: Congestive Heart Failure, HTN: Hypertension, COPD: Chronic Obstructive Pulmonary Disease, AF: Atrial Fibrillation, CAD: Coronary Artery Disease, DM: Diabetes Mellitus, EF: Ejection Fraction, CVA: Cerebrovascular.

Table (2): Operative data.

Surgical Procedure	
AVR	*34 (29%)*
AVR + CABG	*9 (8%)*
AVR + MVR	*17 (14%)*
AVR+MVR+CABG	*1 (0.8%)*
AVR + Aortic aneurysm repair	*3 (2.5%)*
MVR	*49 (42%)*
MVR+CABG	*5 (4%)*
Elective surgery, n (%)	*114 (97%)*
Urgent surgery, n (%)	*4 (3%)*
CPB time (mean ±SD) (min)	*101± 30.1*
Cross clamp time (mean ±SD) (min)	*69.9 ±20.1*
Type of aortic valve, n (%)	
Carbomedics	*32 (50%)*
St. Jude	*19 (30%)*
Medtronic	*13 (20%)*
Type of mitral valve, n (%)	
Carbomedics	*17 (23.5%)*
St. Jude	*51 (71%)*
Medtronic	*4 (5.5%)*
Size of aortic valve, n (%)	
19	*5 (8%)*
21	*29 (45%)*
23	*23 (36%)*
25	*7 (11%)*
Size of mitral valve, n (%)	
27	*30 (42%)*
29	*32 (44%)*
31	*9 (12.5%)*
33	*1 (1.4%)*

AVR: Aortic Valve Replacement, CABG: Coronary Artery Bypass Grafting, MVR: Mitral Valve Replacement, CPB: Cardiopulmonary Bypass.

Results

One hundred eighteen patients underwent Mechanical Valve replacement (isolated or concomitant with other surgical procedures) at our institution between January 2001 and December 2008. The mean age was 45.5±14 (63 men, 55women). Fifteen patients (13%) underwent concomitant CABG, and 18 patients (15%) underwent double valvular procedures. 89 (75%) patients were in NYHA class III or 1V.

The most common presenting symptoms were dyspena on exertion or at rest in 110 patients (93%), chest pain in 69 (58%). Mean ejection fraction was 48±10%. The baseline of the study patients and operative data are shown in (Tables 1 and 2), respectively.

Rheumatic valvular disease was found to be the most common etiology of valvular lesion in 97 patients (71.3%), followed by degenerative in 23 (16.9%) (Table3).

Operative mortality was 2.5% (3 patients). The first patient died intraoperatively due to Intraoperative bleeding and low cardiac output. The second patient death was due to cardiac tamponade two weeks after surgery, the third patient death was due to non cardiac causes; he was on hemodialyses and died from sepsis and respiratory insufficiency two weeks after aortic valve replacement. Late death occurred in 4 cases. The cardiac causes of late death were congestive failure and arrhythmias in a patient with breast cancer two years after aortic valve replacement. Another patient died with prosthetic valve endocarditis after 45 days of double valve replacement. Early postoperative complications are listed in (Table 4). The most common postoperative complication was atrial fibrillation, which affected 30% of the patients.

In our study, four patients (3.4%) developed stroke immediately post surgery, four patients developed bleeding (3.4%). There was one report of major hemorrhage accident (cerebral hemorrhage necessitating craniotomy) in a context of an INR greater than 5. The remaining 3 patients had a minor bleeding 2 nasal and 1 urinary tract bleeding.

Four patients developed prosthetic valve endocarditis (3.4%). All had double valve replacement with bileaflet mechanical prostheses. Three of whom were successfully treated with antibiotics and one died prior to scheduled reoperation because of congestive heart failure. One patient required reoperation for the implanted valves. The patient had a second aortic valve replacement because of high pressure gradient 40 mmhg, on exploration no pannus in growth. No structural valvular dysfunction was reported and no valvular thromboses were noted.

Table (3): Causes of valve disease.

Cause	*AVR n (%)*	*MVR n (%)*	*Total n (%)*
Rheumatic	*39(61%)*	*58(80.5%)*	*97 (71.3%)*
Degenerative	*14(22%)*	*9(12.5%)*	*23(16.9%)*
Aneurysm ascending aorta	*3(4.6%)*		*3 (2.2%)*
Endocarditis	*6(9.3%)*		*6 (4.4%)*
Brucellosis endocarditis	*2(3.1%)*		*2 (1.5%)*
Ischemic		*5(7%)*	*5 (3.7%)*

AVR = Aortic Valve replacement; MVR = Mitral Valve Replacement.

Table (4): Morbidities.

Morbidity	*N (%)*
Stroke	*4 (3.4%)*
Atrial fibrillation,	*35(30%)*
Re-exploration for bleeding	*4 (3.4%)*
Prosthetic valve endocarditis	*4 (3.4%)*

Discussion

Approximately 210,000 patients, worldwide, undergo valve replacement surgery annually[6]. Roughly, two-thirds of these totals have mechanical valves implanted. Accordingly, there is much ongoing investigation related to improving prosthetic valve construction. Bileaflet cardiac prostheses have shown a low incidence of complications and good homodynamic performance.

The majority of our patients were less than 65 years of age and the cause of valvular disease was rheumatic in most. Hence, the choice remains a mechanical device.

The early (30 days) (2.5%) and late mortality (3.4%) rates of our series were comparable with those reported by other series of mechanical prostheses. [7]

Conventional practice suggests that revascularization should be performed at the time of valve replacement if major coronary artery stenosis is present regardless of the presence or absence of angina. [8] Reports [9] indicate that myocardial revascularization does not increase the operative mortality of valve replacement, and the functional result may be improved by relieving the symptoms of angina and providing improved myocardial protection.

Aortic valve replacement has been shown to be associated with postoperative cerebrovascular accidents in approximately 10% of cases in several studies [10, 11] which may be related to embolic events. [12, 13] This most devastating morbidity has a significant impact on survival and the quality of life, [14] we have routinely employed the technique of inserting a gauze into the left ventricle during excision of the native aortic valve with the aim of capturing embolic debris. In our study, two patients (3.1%) developed stroke immediately post surgery.

The low occurrence of thromboembolic episodes in our patient population with the use of the mechanical valve prosthesis is noteworthy, the low incidence of thromboembolic events is presumably related to factors such as inherent difference in coagulable states, [15] and the importance of meticulous attention to anticoagulant therapy cannot be overemphasized. Also, risk factors for thromboembolism are reduced in younger patients.

The need for lifelong oral anticoagulation therapy in patients with mechanical prosthetic valves is well-recognized. In patients not receiving long-term anticoagulation therapy, the average rate of major thromboembolism is estimated to be 4 to 8 per 100 patient-years. [16] This risk is reduced to 2.2 per 100 patient-years with anti platelet therapy, and further reduced to 1 per 100 patient-years with oral anticoagulation (warfarin). Thus, the utilization of postoperative warfarin therapy reduces the incidence of major embolism by approximately 75% and has become the standard of care for all patients with mechanical prostheses. [16]

The American College of Cardiology/ American Heart Association and the American College of

Chest Physicians recommended, in their most recent guidelines, recommended that contemporary mechanical valves in the aortic position should be anticoagulated with a target INR of 2.0 to 3.0, and mechanical valves in the mitral position to be anticoagulated with a target INR of 2.5 to 3.5. [17]

The American College of Cardiology/American Heart Association, in their most recent guidelines, recommended that the addition of aspirin (80 to 100 mg/day) to warfarin should be strongly considered for all patients with mechanical valves. [17]

Concerning the localization of bleeding, the most common sites of minor bleeding are the nose and mouth, accounting for over one-third of episodes and the gastrointestinal tract is the most frequent source of major bleeding. [18] In our study, three minor bleeds (75%) occurred in the ENT-tracts and one major bleeds were intracerebral hemorrhage.

We adhered to a low-intensity anti coagulation regimen in which a target International Normalized Ratio (INR) in isolated aortic valve replacement AVR 2 to 2.5, in Double valve 2.5 to 3.0.

Prosthetic valve endocarditis remains a serious complication of heart valve surgery despite improvements in prophylaxis, diagnosis, and treatment. The traditional approach to the management of this condition has been early surgery. Superior results have been shown with surgical treatment compared with antibiotics alone. However, while early surgery is indicated in patients with homodynamic compromise, there is evidence that in selected cases treatment with antibiotics alone provides equivalent results. [19]

Structural deterioration resulting in mechanical failure of the prosthesis did not occur. The review of the literature of Orsinelli et al. [20] reported six isolated cases of leaflet embolization and one case of leaflet fracture.

There was no instance of paravalvular leak in the present review. We believe that interrupted horizontal mattress sutures with Teflon pledgets are a sine qua non in its prevention.

A controversial point remains in the inclusion of sudden death in the valve-related deaths. The significant risk factors on univariate analysis were known preoperative ventricular arrhythmias and associated coronary artery disease. Although suggestive, univariate analysis does not prove a direct relationship between arrhythmias and sudden death. Here again, none of the valve-related factors have been identified as risk factors. This finding is in agreement with two recent autopsy studies questioning the value of classifying sudden death as valve-related death. Rooney et al. [21] showed in 48 autopsies after sudden deaths with the Medtronic Hall valve (Medtronic, Inc., Minneapolis, Minn) that 90% of deaths were unrelated to the prosthesis, and Burke et al. [22] found, among 37 patients with sudden death, that more than half of the deaths were due to cardiac hypertrophy and atherosclerosis, hypothesizing a relationship with ventricular arrhythmia.

The New York Heart Association functional status of surviving patients significantly improved when compared with the New York Heart Association status before surgery. Whereas 75% of patients were in New York Heart Association class III or IV preoperatively, 81.2% achieved class I or II postoperatively.

The main limitation of the present study resides in its retrospective design.

Conclusion

Our data show that valve replacement with mechanical valve may be performed with low morbidity and mortality.

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تقييم عمليات زراعة الصمام الميكانيكي في مستشفى الجامعة الأردنية

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الملخص

الهدف: معرفة نتائج عمليات استبدال الصمامات الميكانيكية في المدى القصير والمتوسط من حيث المراضات والوفيات.

طريقة البحث: تحليل استرجاعي للمعلومات عن 118 مريضاً أجريت لهم عمليات استبدال الصمام الميكانيكي في مستشفى الجامعة الأردنية في الفترة ما بين كانون الثاني 2001 إلى كانون الأول2008.

النتائج: توفي في المستشفى 3 مرضى بنسبة (2.5%) ، وقد شملت المضاعفات التي تم تسجيلها في فترة المتابعة ما يأتي: التهاب الشَّغاف الصِّمامي (3.4%)، نزيف شديد (3.4%)، السكتة الدماغية (3.1%)، إعادة استبدال الصمام (0.8%) لم يتم تسجيل حالة خلل تركيبي في الصمام أو حالة تجلط صمامي.

الخلاصة: بينت نتائج هذه الدراسة أن عمليات استبدال الصمام الميكانيكي يمكن إجراؤها بنسب وفيات ومراضات منخفضة.

الكلمات الدالة: عمليات استبدال الصمامات الميكانيكية، مضاعفات استبدال الصمامات الميكانيكية، الحمى الروماتيزمية.