ORIGINAL ARTICLE

Obstruction of Mechanical Heart Valve - Diagnosis, Surgical Treatment and Outcome

K K Pau, FRCS, A Yakub, FRCS, A Sallehuddin, FRCS, Y Awang, FRCS, Department of Cardiothoracic Surgery, National Heart Institute, Jalan Tun Razak, 50400 Kuala Lumpur

Summary

From 1982 till 1999, our department performed a total of 2970 heart valve replacements - 92% of which were with mechanical heart valves. During this period, there were 8 patients who came to our department with mechanical heart valve obstruction. All these patients presented with signs of heart failure or compromised haemodynamic. Confirmatory tests included transthoracic or transoesophageal echocardiography and cine fluoroscopy. Seven patients were operated upon urgently. Four of the patients had valve thrombosis. The time interval between the initial implantation and presentation varies from 4 months to 11.3 years. Six of the seven patients who were operated on recovered well from the surgery.

Key Words: Mechanical valve, Obstruction, Redo operation, Thrombosis, Clot, Pannus, Echocardiography, Cinefluoroscopy

Introduction

Artificial heart valves can be divided into two main categories; mechanical or tissue (bioprosthetic) valve. Whenever a prosthetic or foreign surface is in contact with blood, thrombosis and embolism are the major hazards. All patients with mechanical prosthetic heart valves should be treated indefinitely with warfarin. The recommended international normalized ratio (INR) is 2.5 to 3.5. With adequate anticoagulation, the incidence of thromboembolism ranges from 0.5 to 3 per 100 patient year[1]. Most reports find a higher incidence of thromboembolism after mitral valve replacement than aortic valve replacement.

There were 3 major types of mechanical valve implanted in our unit, namely (1) Caged-ball valve e.g. Starr-Edward valve (2) Tilting disc valve e.g. Bjork-Shiley valve and (3) Bileaflet valve e.g. St Judes Medical (SJM) valve, Carbomedic valve, Edward-Mira valve. Caged-ball valve is the oldest heart valve and it has been in clinical use since early 1960. Bileaflet valve is the newest design. It was first designed by St Judes Medical (SJM) and was introduced in 1977. It is the commonest mechanical valve implanted at this time. To date, more than one million SJM mechanical heart valves have been implanted worldwide.

Since 1982, the Department of Cardiothoracic Surgery had done a total of 2970 heart valve replacements. Our records showed that 2728 (92%) of valves implanted were mechanical heart valves while 242 (8%) were tissue (bioprosthetic) valves. Of the mechanical valves implanted, 1185 (43%) were of caged-ball type, 1410 (52%) were bileaflet valves and 141 others (5%). To date, we have managed a total of 8 patients with mechanical valve obstruction.

Materials and Methods

The operating theatre (OT) books of the Department of Cardiothoracic Surgery of Kuala Lumpur General Hospital (1982 - 1992) and National Heart Institute (since 1992) were reviewed and all the patients who had valves implanted were recorded. We noted the various types of heart valves that were implanted.

During the same period, the number of patients with valve obstruction were noted and all the medical records of these patients were traced and analysed. As for the follow-up, the charts of those patients who are still in our follow-up were traced and reviewed. For those patients who were followed up in a peripheral hospital, the nearest hospital was contacted to establish the current status of the patients.

Results

During the study period, we recorded a total of eight (8) patients with mechanical valve obstruction. Seven patients had mitral valve obstruction and one had aortic valve obstruction (in pulmonary position). Seven out of the eight valves involved were bileaflet. The details of the cases are summarised in the table below.

Our patients' ages range from 8 - 50 years. There were 5 Indian and 3 Malay patients. All patients presented with symptoms of heart failure or compromised haemodynamics. The interval between the implantation of the mechanical valve and presentation varied from 4 months to 11 years 3 months (mean=2.5 years). Most of the initial valves were of bileaflet type - St Judes Medical (SJM) (5), Carbomedic (1) and Edward-Mira (1). One patient had tilting disc valve - Bjork Shiley valve done 11 years ago. The size of the mitral valve varied from 25mm to 31mm. The confirmatory tests of valve obstruction included transthoracic echocardiography (TTE), transoesophageal echocardiography (TEE) and cine fluoroscopy. One patient had cardiac catherisation done. Seven patients were operated on urgently upon confirmation of diagnoses. Intraoperatively, 3 patients were noted to have tissue over-growth (see pictures I and II) resulting in the obstruction of the mechanical valve. Four patients had thrombosis of the valves (see picture III). Three patients had inadequate anticoagulation at presentation. One patient had a history of warfarin omission for menorrhagia. During the redo surgery (note: MVR=mitral valve replacement, DVR=double valve replacement), the new valve implanted include two bileaflet valve - St Judes Medical valve, three caged-ball valves - Starr Edward, one tissue valve - Carpentier-Edward and one homograft. Six of the seven patients recovered well from the surgery. Five of the patients were followed up, ranging from 8 months to 5 years 8 months (mean=4.4 year) and all these patients are well.

There was one unfortunate patient with valve obstruction that was not operated upon. The patient was a 50 years old Punjabi lady who had a rather complicated history. She had chronic rheumatic heart disease with mitral valve stenosis and had percutaneous mitral commisurotomy (PTMC) done in another hospital. Unfortunately, she developed severe mitral regurgitation soon after the PTMC and had mitral valve replacement done in the same hospital (SJM size 27mm). After the first surgery, she developed bacterial endocarditis (*S. viridans* in blood culture) and was treated successfully. She did well for about 2 months, until she presented again with signs of heart failure over 2 days. She deteriorated rapidly and the diagnosis of mechanical valve obstruction was made. She had a redo operation done in the same hospital. Intra-operatively, pannus overgrowth was noted on the mechanical valve causing the valve obstruction. The mitral valve was replaced with a new valve (SJM size 25mm). Four months later, the patient presented again with a 2-day history of shortness of breath. Both TTE and TEE were done which showed an immobile mechanical valve leaflet with severe tricuspid regurgitation. After consulting with the surgeon in-charge, the cardiologist referred the case to our hospital. Unfortunately, the patient

Case No	Age	Sex	Race	Main Presenting Symptoms	Interval from Previous Implant	Previous Implant	Confirmatory test(s)	Management	Intra-Operative Findings	Surgical Outcome	Follow Up	Current Status
1	37	F	Mal	Orthopnoea PND	11yr 3mth	Bjork-Shiley A17, M25	TTE, TEE, Cinefluoro	Redo DVR SJMA19, M25	Pannus	Alive	4 yr 8 mth	Well
2	43	F	Mal	Progressiv dyspnoea	4 yr 5 mth	Carbomedic M29	TTE,TEE Cinefluoro	Redo MVR Starr-Ed 3M	Pannus	Alive	Disch to D. Hosp	Not contactable
3	38	F	Ind	Orthopnoea SOB	8 mth	St Jude Med A21, M29	TTE, TEE Cinefluoro	Redo MVR Starr-Ed 3M	Acute thrombosis	Alive	5 yr 8 mth	Well
4	8	M	Ind	SOB on exertion	9 mth	St Jude Med A19 (in Pul)	TTE, Card. Cath	Redo Homograft A#21	Intimal proliferation	Alive	5 years 6 mth	Well
5	50	F	Punj	Cardiogenic shock	4 mth	St Jude Med M25	TTE, TEE	Conservative	-	Died	-	-
6	25	F	Mal	SOB	7 mth	St Jude Med M29	TTE, TEE Cinefluoro	Redo MVR St Jude Med M27	Acute thrombosis	Alive	5 yr 7 mth	Well
7	32	M	Ind	Vomiting, SOB, Arrested in A/E	10 mth	St Jude Med M31	TTE, TEE,	Redo MVR Carp-Ed #29	Acute thrombosis	Died	-	-
8	30	F	Ind	Lethargy, giddiness	1 yr 4 mth	Edward-Mira M31	TTE	Redo MVR Starr-Ed 3M	Thrombosis, some organised	Alive	8 mth	Well

deteriorated rapidly during the transfer and when she was admitted to our hospital, she was in circulatory collapse (BP=50/30, pale & clammy, no urine output and severely acidotic with PH=7.1, BE=-20). Despite immediate resuscitation and multiple inotropic support, the patient deteriorated further. The surgery was not done as the patient was in irreversible shock and was not suitable for another complicated surgery. The patient passed away the day after admission.

We had one surgical mortality. The patient was a 32 years old Indian man who had mitral valve replacement (SJM size 31mm) done 10 months previously. He presented with acute shortness of breath (SOB) and vomiting for a day and arrested upon admission to casualty. Immediate cardiopulmonary resuscitation was instituted and the patient was noted to be in frank acute pulmonary oedema. After the initial resuscitation, the haemodynamic status improved. An echocardiogram (TTE) confirmed that his valve was not functioning properly. He arrived in OT within an hour with a very high dose of inotropic support. Intra-operatively, acute valve thrombosis was noted. Redo MVR was done with tissue valve (Carpentier Edward size 29mm). However, after completion of the valve replacement surgery, we failed to wean him from the cardiopulmonary bypass and the patient expired in theatre. History from father showed that the patient was having a poor compliance with warfarin and on his last follow-up, his INR was only 1.2.

Discussion

In many patients with chronic rheumatic heart disease, the heart valve is often so severely diseased that the best option is to change the valve. In a young patient, mechanical valve is often the better choice as it is much more durable than the tissue (bioprosthetic) valve.

Valve replacement surgery improves the quality of life and it also saves many lives. However, these mechanical valves are not without potential problems as they are made of prosthetic material.

One of the main complications of mechanical valve failure is valve obstruction, which can either be due to thrombosis of the valve or tissue overgrowth with pannus formation. Although we have implanted more than 2700 mechanical heart valves, we have not seen many cases of valve obstruction in our institution. The reported incidence of valve obstruction is 0.5% to 4.5%[2]. Most of our patients presented with progressive dyspnoea and orthopnoea, which is a common presentation of valve obstruction. All our patients presented with unstable haemodynamics and in New York Heart Association (NYHA) functional class 4. The interval between the implantation of the mechanical valve and presentation varies from 4 months to 11 years 3 months (mean=2.5 years).

Chronic rheumatic heart disease does not seem to have racial preponderance. However, though the Indian community makes up only 10% of the Malaysian population, half of our patients with valve obstruction are of Indian origin. This may be pure coincidence, although from our observation, Indian patients tend to need a much higher dose of warfarin, possibly due to interaction with their natural diet. Therefore, it is possible that omission of warfarin may have a bigger impact on the anticoagulation status.

Initial diagnosis was mainly based on history and clinical findings. All our patients had 2D transthoracic echocardiogram (TTE) done although a transoesophageal echo (TEE) usually gives a better window. Cinefluoroscopy was used in three patients to confirm the diagnosis. Although 7 out of 8 patients had bileaflet valve obstruction, studies had shown that obstruction could occur in any type of mechanical valve. It is possible that many patients were never diagnosed and studies had shown that about 50% of the valve obstruction were diagnosed at autopsy[3]. Most of the mechanical valve obstruction was reported to occur within the first 4 years[2], although it can occur as early as 48 hours postoperatively[4]. In our series, 5 out of 8 patients had valve obstruction occurring within the first year.

The reported overall mortality of valve obstruction was about 40%[5]. In one report, 77.7% of the valve obstruction were due to thrombosis and about equal number due to pannus (10.7%) and both pannus and thrombus (11.6%)[4]. Adequacy of anticoagulation to achieve the therapeutic INR is very important. Most of the patient had valve thrombosis because of discontinued or intermittent anticoagulation therapy[8]. As mentioned earlier, three of our patients had inadequate anticoagulation at presentation. Treatment for the prosthetic valve obstruction includes (1) Valve replacement, (2) Removal of clot (declotting) and/or pannus excision and (3) Thrombolysis. The reported operative mortality for patient with mechanical valve obstruction varies from 1 - 55% with an average of 8 - 15%[2,6]. Patients who presented with NYHA functional class of I-III has a lower mortality of 4.7% whereas those patient who presented with functional class IV, the operative mortality was 17.5%[2]. Declotting and/or pannus excision has an operative mortality comparable to valve replacement, although the long-term result is unknown. Although thrombolysis has been used in acute thrombotic obstruction, it is not effective for patient with concomitant pannus formation and the reported embolic rate varies from 12 - 18%[5,7]. One recent study reported an excellent restoration of normal prosthetic function, though the embolic phenomena remain high[9].

Patients who had mechanical valve replacements need to be followed up carefully. Although the current heart valves are of low thrombogenicity, the clot can still form on the valve leaflet if the patient is not adequately anticoagulated. These patients need close monitoring of their anticoagulation status for life to prevent the thrombosis of their prosthetic heart valve.

Although our series is small, our experience showed that those patients with valve obstruction which was diagnosed early and underwent the redo valve surgery, the outcome was good (6 out of 6). However, when the patient presented with severely compromised haemodynamic or in irreversible shock or cardiac arrest, then the outcome was very poor.

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