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**Surgical treatment of left-sided mechanical valve thrombosis: Twelve
years' experience**

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Abstract

Background: Mechanical valve thrombosis (MVT) is a severe complication of heart valve replacement. In this study we presented our surgical experience for left-sided MVTs.

Methods: From October 2010 through January 2022, 1418 operations of mechanical valve replacement in 1252 patients. 59 patients were operated for left-sided MVT. Preoperative, operative and postoperative data were collected.

Results: In this study 48 (81%) of patients were women, the mean age was 46.7 ± 13.2 years. Mitral valve was thrombosed in 51 patients (86%) and aortic valve in 8 patients (14%). The most frequent clinical presentation was dyspnea III-IV (58%). The time interval between first valve replacement and MVT was 58.6 ± 38.4 months. INR was less than 2 in 37 patients (63%) patients. All patients underwent a surgical procedure; thrombectomy in 21 patients (36%), valve replacement in 38 patients (64%). Early mortality was (12%).

Conclusion: MVT is a serious complication of valve replacement. Early diagnosis and early surgery gives excellent outcomes. The best means of prevention is effective anticoagulation.

Keywords: Mechanical Valve; Thrombosis; Cardiac Surgery; Thrombectomy; Valve Replacement

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Introduction

Mechanical valves have long term durability, but some complications may occur. MVT is caused by a thrombus attached to a mechanical valve interfering with its function. Endmunds defined MTV as a complication attributable to any type of thrombus, without evidence of infection, attached around a mechanical valve, deranging hemodynamics, or interfering with valvular function [1]. The incidence of

thrombosis ranges from 0.5% to 6% in the aortic and mitral positions [2,3]. The annual rate of prosthetic valve thrombosis with mechanical valve ranges from 0.1% to 5.7% [4]. Diagnosis can be made with variable clinical presentations related with the degree of valvular obstruction. Physical examination is frequently insufficient, and diagnosis of valve thrombosis is established by fluoroscopy, transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) [5,6].

The optimal management of MVT is controversial between fibrinolytic treatment (FT) and urgent surgery. In experienced centers, urgent surgery should probably be preferred over FT for treating left-sided MVT [7]. The aim of this study was to describe our surgical experience of left-sided MVTs.

Material and Methods

From October 2010 through January 2022, a total of 1418 operations of mechanical valve replacement were performed in 1252 patients. We operate, in this period, 59 patients for MVT. We included only left-sided valve. Clinical and surgical data from the patients were collected. Fifty-nine patients presented with MVT, 11 (19%) men and 48 (81%) women. Mean age at the time of MVT diagnosis was 46.7 ± 13.2 years (19-67). Thirty-four (58%) patients have dyspnea class III or IV (NYHA). The initial replacement involved the mitral valve in 42 (71%) cases, whereas aortic valve in 7 (12%) cases and double-valve in 10 (17%) cases. The first valve replacement was a redo intervention in 14 (24%) patients; four of them (7%) were a redo for MTV. Twelve (20%) patients presented a thromboembolic complication. Three (5%) patients were pregnant; one of them at full term baby. Diagnosis was based on transthoracic echocardiography (TTE). We used transesophageal echocardiography (TEE) to confirm diagnosis in 18 (30%) and fluoroscopy in 15 (25%) patients. At the time of diagnosis of MVT, international normalized ratio INR was < 2 in 37 (63%) patients. All patients were treated surgically. A redo vertical median sternotomy was utilized for all. Surgical intervention was performed using a standard cardiopulmonary bypass (CPB) technique under normothermia. We used femoral CPB in three (5%) patients for hemodynamic shock at time of anesthesia. Anterograde crystalloid cardioplegia was used for myocardial protection (Table 1).

Table I: Preoperative data.

	N° of patients (%)
Gender	
Female	48(81)
Male	11(19)
Thromboembolic event	12(20)
Previous operation	
Mitral	42(71)
Aortic	07(12)
Both	10(17)
First intervention = Redo	14(24)
Dyspnea	
NYHA 0 – II	25(42)
NYHA III - IV	34(58)
INR < 2	37(63)

Results

In almost twelve years, we collected data about fifty-nine patients which operated for left-sided MVT. The mean age at MVT diagnosis was 46.7 ± 13.2 (19-67) years. The median period between the initial valve replacement and MVT was 58.6 ± 38.4 months (0 - 176 months). The mean time from diagnosis of MVT to surgical treatment was 2 ± 5 days (0-12 days). There were 11 (19%) early thrombosis (< 30 days after the valve replacement) thrombosis and 48 (81%) late thrombosis. Thrombosis occurred in the mitral position in 51 patients (86%), and in the aortic position in 8 (14%). Among previous double-valve replacement (10); MVTs were in a mitral prosthesis in 9, an aortic prosthesis in 1. The most common symptom was dyspnea in 37 (63%) patients, cardiogenic shock in 5 (8%) patients, thromboembolism events (stroke or organ ischemia) between initial valve replacement and the MVT in 12 (20%) patients. In two patients (3%) MVT was a fortuitous echocardiographic finding. MVT occurred during pregnancy in 3 (5%) patients. One patient had MVT at full baby term and underwent valve replacement and cesarean procedure at the same time. Eighteen patients (30%) underwent an emergency surgery. We established diagnosis of MVT by transthoracic echocardiography (TTE) in all patients. We

used transesophageal echocardiography (TEE) to confirm diagnosis in 18 patients (30%) and fluoroscopy in 15 (24%) patients. The INR at the time of thrombosis was less than 2 in 37 (63%) patients. MVT occurred during a change in the anticoagulant treatment for another surgical treatment or dental care in 14 (24%) patients. All patients were started on intravenous heparin (Table 2).

Table II: Diagnosis of MVT.	
	Value
The mean age (years)	46.7±13.2
Time between previous operation and MVT (months)	58.6±38.4
Time from diagnosis of MVT and surgery (days)	2±5
Early MTV (<30 days)	11(19%)
Late MVT (>30 days)	48(81%)
Localization of thrombosis	
Mitral valve	51(86%)
Aortic valve	8(14%)
Symptoms	
Dyspnea	37(63%)
Thromboembolic events	12(20%)
Cardiogenic shock	5(8%)
Pregnancy	3(5%)
Fortuitous	2(3%)

All patients underwent surgery under redomedian vertical sternotomy, central CPB in 56 (95%) patients and femoral CPB in 3 (5%) patients for cardiogenic shock at time of anesthesia. The etiologic factor was thrombus formation in 36 (4 aortic + 32 mitral) (61%) patients, pannus formation in 5 (3aortic + 2 mitral) (8 %) patients, and thrombus and pannus formation in 18 (01 aortic + 17 mitral) (31%) patients. Macroscopically, it was a fresh thrombus in 12/54 patients, old in 22/54, and had both characteristics in 20/54 (51%) patients. All patients with aortic MVT underwent valve replacement. Among mitral MVTs, 30 had mitral valve replacement and 21 had only thrombectomy. The crossclamping time averaged 57.3±28.8 min (range, 13-143 min), and the cardiopulmonary bypass time was 104.6±35.7 min (range, 33-172 min). Overall,

there were 7 deaths (12%), 3 operative deaths (5%) due to cardiopulmonary weaning failure and 4 patients (7%) died within 30 days. Hospital complications were bleeding in 5 patients (8%), pulmonary insufficiency in 3 patients (5%), and neurological event in 2 patients (3%). Oral anticoagulation after surgical treatment consisted of Sintrom alone in 38 (64%) patients and a combination of Sintrom and Aspegic in 21 (36%) patients. The mean hospital stay was 14.7±11.8 (range, 10-63) days (Table 3).

Table III: Operative data.	
	Value
Cross clamping time (min)	57.3±28.8
CBP time (min)	104.6±35.7
Nature of thrombosis	
Thrombus	36(61%)
Pannus	5(8%)
Thrombus+Pannus	18(31%)
Aspect of thrombus (54)	
Fresh	12/54
Old	22/54
Both	20/54
Surgery procedure	
Valve Replacement	38(64%)
Thrombectomy	21(36%)
Complications	
Deaths	7(12%)
Bleeding	5(8%)
Pulmonary Insufficiency	3(5%)
Neurological Event	2(3%)

Discussion

In our experience, rheumatic patients requiring surgical treatment of valvular diseases are still frequent [8]. Mitral valve repair is not always feasible in the young rheumatic population and valve replacement with a mechanical valve is preferred than a bioprosthesis, which is likely to degenerate over time and require reintervention [9]. MVT is a serious complication. The incidence of left-sided MVT ranges from 0.5% to 6% [2]. The annual rate of MVT ranges from 0.1% to 5.7% [4]. In left-sided MTVs, surgery is recommended for obstructive valve

thrombosis and is preferred than fibrinolysis treatment [10]. Urgent surgery should probably be preferred over fibrinolysis treatment for treating left-sided MVT [7]. Predominance of female gender was reported also in some series [11-13]. In this study we showed that clinical presentations of MVT were various. The formation of a thrombus on the prosthetic structures reduces the effective orifice area and increases the trans-valvular gradient, producing a variety of symptoms, from asymptomatic patient whose diagnosis of MVT was fortuitous to cardiogenic shock, but the most common symptom is dyspnea NYHA classes III and IV. The time between previous valve replacement and MVT was 58.6 ± 38.4 months. In most cases, MVT occurred insidiously and clinical manifestations were various [12,13]. The majority of our patients had an INR less than therapeutic range at time of diagnosis. An inadequate anticoagulation is an important factor of MVT [14]. In these patients MVT occurred during a change in the anticoagulant treatment for another surgical treatment or dental care or pregnancy. In our study, we used TTE in all patients. To confirm diagnosis we used TEE in 18 (30%) and fluoroscopy in 15 (25%) patients. Usually, TTE is sufficient to establish the diagnosis of MVT [5,15]. TEE had superior diagnostic value than TTE and fluoroscopy can also be used when TTE's evaluation is difficult [11,16]. After the introduction of TEE, surgery is preferred, perhaps because TEE has demonstrated incomplete hemodynamic success with fibrinolysis (greater sensitivity of TEE for residual thrombus detection) together with a risk of embolic complications [17]. All early MVTs (<30 days after first replacement) were in mitral valve and all aortic MVTs were late (>30days). Pathological studies and observational registries indicate that the risk of valve thrombosis and thromboembolic events is highest in the first 3 months after surgical implantation of valve. Among parameters that influence this risk of early thrombosis is the position of the prosthesis valve, mitral valve more than aortic valve [18,19].

Pathologically the etiology of the mechanical valve obstruction was thrombus, pannus or both. The fibrotic pannus is defined as an exaggerated biological reaction to the implanted valve, which leads to reduced leaflet motion and manifests clinically with mechanical valve dysfunction. As it is fibrotic in nature, pannus is generally unaffected by anticoagulation. However, a thrombus layer can form either as a consequence of the pannus or in conjunction with it [20,21]. Usually, the MVT is a subacute or chronic process, rather than an acute phenomenon. Some studies suggest that fresh thrombi are less common and that the main pathological entity is characterized by organized thrombus with multiple clot layers [22,23]. In our experience, we opt for surgical treatment for all patients with obstructive left-sided MVT. Treatment of left-sided MVT is influenced by clinical status, thrombus size and presence of obstruction. Mobile or large thrombi are usually treated surgically. Critically ill patients (NYHA functional class IV), obstructive MVT and large non-obstructive MVT are indications for surgery. Obstructive MVT with a small thrombus and stable clinical condition (NYHA classes' I-III) can be treated by either surgery or fibrinolysis. Non-obstructive MVT with a small thrombus can be treated by fibrinolytic therapy [24]. Pannus is more present with aortic MVT (4/8) than mitral valve (19/51). We preferred the valve replacement in all patients with aortic MVTs. In mitral MVTs, when pannus was present, we replaced the mechanical valve after resection of the fibrotic pannus. We opted for thrombectomy, only in cases with a fresh thrombus. When this thrombus is old or fresh and old, the valve replacement is required. Mechanical valve thrombectomy with restoration of leaflet motion is a safe, rapid, and simple procedure in a limited number of patients [13].

Early mortality (less than 30 days) occurred in 07 (12%) patients. This mortality may be partly related to a high incidence of NYHA functional classes III/IV (58%) and cardiogenic shock (8%) at clinical presentation [25]. In

anticoagulation oral treatment, aspirin is added to sintrom to optimize the level of anticoagulation [13]. This study suggests that early diagnosis and a surgical treatment without delay are essential for a patient with obstructive left-sided MVT. Surgery is a safe and effective treatment for these patients.

Conclusion

Every mechanical prosthesis valve is assumed to develop thrombosis one day or another. MVT is a severe complication. Obstructive left-side MVT is caused by pannus or thrombus or both. Clinical presentations are various but the most common symptom is dyspnea. An early diagnosis and early surgery are important for prognosis. The role of TEE is fundamental, not only for diagnosis but also to indicate surgery. Surgical thrombectomy in fresh thrombus only without pannus, is a save procedure, rapid and simple. The prevention of MVT is an optimal anticoagulation treatment and patient's education.

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