

The Nightmare of Obstructive Mechanical Valve Thrombosis: What is the Optimal Care?

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Abstract

Obstructive mechanical valve thrombosis is a rare and serious disease. Despite therapeutic progress, mortality remains high, and the choice between surgery and thrombolytic therapy remains controversial. We report the case of a 46-year-old woman admitted to the emergency department for obstructive mitral mechanical valve thrombosis successfully thrombolized by the recombinant tissue plasminogen activator. Through this case, we would like to discuss the different therapeutic options, and why fibrinolysis was our choice for this particular patient.

Keywords: Mechanical valve thrombosis, obstructive, surgery, thrombolytic therapy

INTRODUCTION

Obstructive mechanical valve thrombosis is a rare situation with an annual incidence of 0.3–1.3/100 patients, but it is the most serious complication of mechanical prostheses. There are two types of clinical presentation, obstructive and nonobstructive thrombosis. Obstructive thrombosis presents with respiratory and hemodynamic instability and requires urgent management, whereas systemic embolism is the major risk of nonobstructive thrombosis. In this case report, we will focus on the controversial therapeutic management of obstructive thrombosis: optimization of anticoagulation, fibrinolysis, or surgery.

CASE REPORT

A 46-year-old female with a history of a severe rheumatic mitral disease who underwent 1 year ago mitral bileaflet mechanical valve prosthesis replacement with tricuspid annuloplasty, after which she was put on acenocoumarol, spironolactone, and atenolol, was admitted to our hospital for respiratory and

hemodynamic distress. Anticoagulation had been stopped 3 days before the admission against medical advice because of an episode of epistaxis. The patient presented to the emergency room for dyspnea at rest, with orthopnea, associated with chest tightness and intermittent palpitations. On presentation, vitals were as follows: oral temperature of 37.8°C, blood pressure of 90/60 mmHg, heart rate of 170 beats/min, and respiratory rate of 30 breaths/min, with an oxygen saturation (SpO₂) of 65% on room air and of 85% under 10 L of oxygen. The patient was alert and oriented. Physical examination revealed signs of acute decompensated heart failure and muffling of the prosthetic heart valve sounds. Electrocardiography showed atrial fibrillation with a ventricular rhythm at 170 bpm. A chest X-ray showed signs of pulmonary edema. Laboratory tests revealed elevated level of NT-proBNP and an The

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international normalised ratio (INR) of 1.5, however renal function and complete blood count were normal. Transthoracic echocardiography (TTE) revealed a mean transprosthetic mitral gradient of 20 mmHg [Figure 1a], a dilated left atrium without visible thrombus and severe pulmonary hypertension. Cinefluoroscopy performed in emergency confirmed the prosthetic valve obstruction [Figure 1c and d].

After putting the patient on noninvasive ventilation and furosemide, she received fibrinolysis using recombinant tissue plasminogen activator (rt-PA) (alteplase): 10 mg bolus +90 mg in 90 min with unfractionated heparin (UFH). Forty minutes after the start of fibrinolysis, there was a hemodynamic and respiratory improvement: blood pressure was 120/80 mmHg, heart rate was 97 bpm, and SpO₂ was 90% on room air with a clear regression of crackles. TTE showed a significant drop in the transmitral mean gradient to 8 mmHg. The TTE performed 48 h after admission showed a normal prosthetic function with a transprosthetic mean gradient at 5 mmHg [Figure 1b]. Transesophageal echocardiography (TEE) performed after patient stabilization showed normal prosthetic motion without an image of prosthetic or atrial thrombus. During the hospital stay, there was a normalization of all hemodynamic and respiratory parameters without any hemorrhagic or embolic events. We kept the patient on UFH until having an INR of 3.5.

DISCUSSION

The treatment of symptomatic obstructive mechanical valve thrombosis is surgery and thrombolytic therapy. Surgical treatment consists of a thrombectomy or a valve replacement preferably by biological valve to prevent recurrences in these patients considered to be at high risk of thromboembolic recurrence. Old publications considered this surgery to be a very high-risk surgery with a reported operative mortality rate in the case of the New York Heart Association (NYHA) class IV of 50%. Thanks to the progress in surgical techniques and anesthesia, there has been an improvement in the prognosis

with mortality rates ranging from 5% to 15% depending on the severity of clinical presentation and NYHA class.^[1] Like surgery, fibrinolysis results improved over time with an increase in hemodynamic efficiency rising from 75% to 90% and a considerable decrease in fatal and major complications: decrease in embolic complications from 13% to <2%, hemorrhagic complications from 6% to <2%, and death from 7% to 3%. This is due to the use of the new generation of thrombolytic agents and small doses – slow infusion protocols. However, the success and complications depend above all on the clinical presentation and the thrombus size if it is visible. After thrombolytic therapy, recurrence is frequent (19%), especially in cases of mitral prostheses.

Facing an obstructive mechanical valve thrombosis, should surgery or fibrinolysis be preferred?

A meta-analysis, published in 2014 by CASTILHO, had shown that the incidence of operative mortality was higher than that observed with fibrinolysis: operative mortality was 18.1% versus 6.6% for thrombolytic therapy, and that surgical mortality appeared to increase with the NYHA class. Embolic and hemorrhagic events were more common in thrombolysis: 4.6% versus 12% and 4.6% versus 6.8, respectively. Hemodynamic success rates were comparable between the two methods (81.9% for surgery vs. 80.7% for fibrinolysis). However, this meta-analysis included only observational studies since the literature did not have a randomized study.^[2]

A comparative retrospective study carried out at the University Hospital Center of Bordeaux, France, by Professor Roudaut's team compared the results of the two therapeutic methods, showed a high rate of hemodynamic success with the two options with a slight superiority in favor of surgery (88.9% vs. 70.9%). Embolic and hemorrhagic events were more frequent with fibrinolysis (15% vs. 0.7% and 3.9 vs. 0.7%, respectively), mortality was comparable (11.8% vs. 10.4%), and recurrence was greater with fibrinolysis (18.9% vs. 7.4%).^[3] Another meta-analysis published by Grace *et al.*^[4] had shown that thrombolytic therapy was associated with a higher complication rate compared to surgery and that the mortality rate was higher with surgery compared to thrombolysis (15% for surgery vs. 8% for thrombolysis), but it should be noted that the patients who underwent surgery were more serious than those who underwent thrombolysis.

Karthikeyan *et al.*^[1] had shown through their meta-analysis that urgent surgery was not superior to fibrinolysis to restore valvular function, but it reduced considerably the occurrence of major thromboembolic and hemorrhagic events and the recurrence of valvular thrombosis. Awaiting the results of randomized controlled trials, urgent surgery should probably be preferred to thrombolysis for obstructive left mechanical valve thrombosis [Table 1].

If the choice of thrombolysis is made, which protocol should be used?

Searching for the best agent and fibrinolytic protocol, a lot of studies have been published. The study by Özkan *et al.*,^[5]

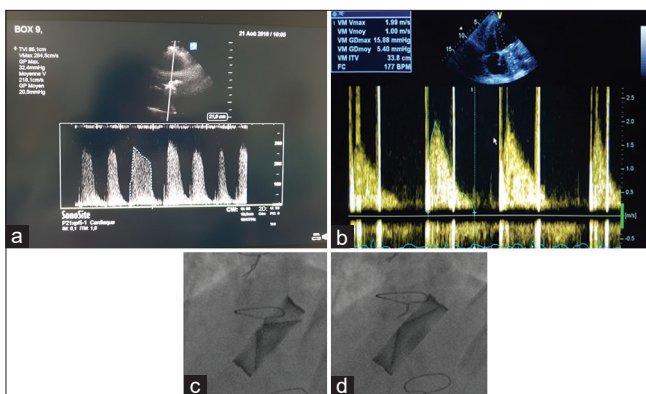


Figure 1: (a) Transthoracic echocardiography performed in the emergency room showing a mean transprosthetic mitral gradient of 20 mmHg; (b) Transthoracic echocardiography showing normalization of transprosthetic mean gradient (5 mmHg) 4 h after starting thrombolytic therapy. Cinefluoroscopy showing almost complete blocking leaflets in closed position. (c) diastolic image, (d) systolic image

Table 1: Summary table of the hemodynamic effectiveness, hemorrhagic, embolic complications and death risk of thrombolysis, and surgery in the treatment of left mechanical valve thrombosis

	Fibrinolysis	Surgery
Hemodynamic success	++	+++
Hemorrhage	++	+
Embolism	+++	+
Death	++	++(+)

which is a monocentric, prospective, nonrandomized study, had compared five protocols: rapid streptokinase infusion (Group I), slow infusion (Group II), a t-PA at full dose (100 mg) (Group III), at half dose of 50 mg with slow infusion over 6 h without a bolus (Group IV), and a low dose of 25 mg in slow infusion over 6 h without bolus (Group V). The comparison between these different protocols had shown that the slow infusion of 25 mg of t-PA over 6 h without bolus was the safest thrombolytic treatment with the lowest complication and mortality rates without loss of efficacy. However, it should be noted that almost 50% of the patients included in the different groups had nonobstructive thrombosis, the thrombi were often small, and the majority of patients were clinically stable. It is important to keep these limitations in mind before applying the findings of this study in practice. Another study carried out by the same author had confirmed the results of the previous study, and it showed that the ultraslow infusion over 25 h of a low dose of t-PA (25 mg) (an infusion of 1 mg/h of rt-PA) without bolus was associated with a low risk of nonfatal complications and mortality except for patients with a class IV NYHA. This protocol could be effective in stable patients.^[6]

The widely used thrombolytic in myocardial infarction was tenecteplase (TNK). A study published by Kathirvel *et al.*^[7] compared TNK thrombolysis (0.5 mg/kg in a slow infusion of 24 h) to streptokinase (SK) (intravenous bolus of 250,000 IU during 30 min, followed by intravenous infusion of 100,000 IU/h during 24 h). Thrombolysis was repeated up to 3 times (72 h) in the SK-based protocol and up to 2 times (48 h) in the TNK-based protocol until normalization of the transvalvular gradient. This study did not show any significant difference in the efficacy, hemorrhagic, and embolic complications between the two groups.

In summary, there is no consensus regarding the best fibrinolytic and protocol. A simple therapeutic strategy can be proposed with two types of protocols depending on the patient's clinical presentation:

- A short protocol “rescue protocol” should be preferred in case of hemodynamic instability. It consists of using a fibrinolytic with a short half-life, strong specificity to fibrin, rapid and short infusion time like rt-PA at high doses
- Otherwise, in case of hemodynamic stability, we feel that it is preferable to use a protocol with low doses of

thrombolytic drugs and a prolonged slow infusion; we can even sometimes divide the doses to reduce the risk of thromboembolic and hemorrhagic complications.

The predictors of the success of the thrombolytic treatment are a recent problem of anticoagulation therapy, the absence of stroke history, and the absence of large clot >0.8 cm² at TEE.^[8] These three criteria were present in our patient.

What do the guidelines say?

Concerning the ESC guidelines,^[9] an urgent valve replacement, preferably with a biological prosthesis, is recommended in obstructive mechanical prosthetic valve thrombosis outside the high surgical risk (Class I, Level C). Fibrinolysis should be considered in the case of unavailable surgery or patients with significant comorbidities and high surgical risk or the case of a right heart prosthesis (Class IIa, Level C). In the case of hemodynamic stability with a recent anticoagulation problem, the anticoagulant treatment must be optimized. If failure, consider thrombolysis if the surgical risk is high or unavailability of surgery, otherwise opt for surgery. Surgery should be considered as the first line of treatment if there is no recent anticoagulant therapy problem.

Regarding the American Heart Association/American College of Cardiology (AHA/ACC) guidelines,^[10] urgent initial treatment with low-dose and slow-infusion fibrinolytic regimens, since this type of regimens has higher success rates and lower complication rates than prior high-dose regimens, or emergency surgery in the patient with a left-sided mechanical prosthetic valve thrombosis. The decision for emergency surgery versus fibrinolytic therapy should be based on multiple factors according to AHA/ACC guidelines [Table 2] including the availability of surgical expertise and the clinical experience with both treatments.

For thrombosed right-sided prosthetic heart valves, fibrinolytic therapy is reasonable according to ESC and AHA/ACC guidelines in patients with NYHA functional Class III–IV symptoms or large clot burden (Level of Evidence C).^[9,10]

CONCLUSION

Obstructive mechanical valve thrombosis remains a diagnostic and therapeutic challenge. The optimal treatment remains controversial requiring multidisciplinary management. Despite the absence of recommendations with a high level of evidence, there is a feeling that surgical treatment remains the treatment of choice in patients with a critical clinical presentation, whereas fibrinolytic treatment remains the choice in case of hemodynamic stability and valvular prosthetic thrombosis of the right heart. This case report shows that fibrinolytic treatment can be used as an effective and safe alternative to surgery even in critical clinical situations.

“Patients who have undergone valve replacement are not cured but still have serious heart disease” the patient was consented to the publication of the article.

Table 2: Factors according to the American Heart Association/American College of Cardiology guidelines to make the decision for emergency surgery versus fibrinolytic therapy

Favor surgery	Favor fibrinolysis
Readily available surgical expertise	No surgical expertise available
Low surgical risk	High surgical risk
Contraindication to fibrinolysis	No contraindication to fibrinolysis
Recurrent valve thrombosis	First-time episode of valve thrombosis
NYHA class IV	NYHA class I-III
Large clot (>0.8 cm ²)	Small clot (≤0.8 cm ²)
Left atrial thrombus	No left atrial thrombus
Concomitant CAD in need of revascularization	No or mild CAD
Other valve disease	No other valve disease
Possible pannus	Thrombus visualized
Patient choice	Patient choice

The bold factors were present in our patient (seven factors in favor of fibrinolysis versus two in favor of surgery). CAD: Coronary artery disease; NYHA: New York Heart Association, ACC/AHA: American College of Cardiology/American Heart Association

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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