



The Impact of the COVID-19 Pandemic on Hospitalization Rates due to Prosthetic Valve Thrombosis

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Abstract

Background: Studies have shown a decline in the admission rates of various diseases during the COVID-19 pandemic. Prosthetic valve thrombosis (PVT) is a rare condition followed by surgical or transcatheter valvular interventions. Considering the lack of data on hospitalization rates due to PVT during the pandemic, this study evaluated the implications of the COVID-19 pandemic on PVT admissions and characteristics in a tertiary referral center.

Methods: Data from all the consecutive patients hospitalized due to PVT between February 2020 and February 2021 (the first year of the pandemic) were collected from medical records and compared clinically with the corresponding time before the pandemic (February 2019 through February 2020). Variables of interest included the number of hospitalization, patient and valve characteristics, diagnostic and management strategies, and in-hospital events.

Results: Forty patients (32.5% male, age: 54.0 [46.5-62.0 y]) comprised the study population. We observed a considerable decline in hospitalization rates during the pandemic, from 31 to 9 patients. Admitted patients were 8 years younger, had a higher proportion of the New York Heart Association functional class III or IV symptoms (44.4% vs 22.6%), were more often treated with fibrinolysis (33.3% vs 22.6%) or surgical approaches (33.3% vs 22.6%), and were discharged 6 days sooner.

Conclusion: We described a reduction in PVT hospitalization. Patients presented with a higher proportion of severe dyspnea and had increased treatment with fibrinolysis/surgical approaches. These observations highlight the necessity of the active surveillance of patients with prosthetic valves by caregivers for timely diagnosis and appropriate management during the pandemic.

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Introduction

Prosthetic valve thrombosis (PVT) is a rare, albeit serious, complication of surgical or transcatheter valve replacement. It most frequently affects mechanical and, less often, bioprosthetic valves and is associated with higher mortality and morbidity.¹ Pathologically, valve thrombosis is characterized by thrombus formation on valve-related structures, with the potential ability to result in subsequent thromboembolism. Consequently, failure to diagnose and treat PVT promptly can lead to limb ischemia,² pulmonary thromboembolism, and disabling/fatal cerebrovascular accidents.³

The announcement of the COVID-19 outbreak⁴ adversely affected the health of millions of people. The pandemic has significantly decreased visits to care centers for a wide range of conditions,^{5, 6} including cardiovascular disease.⁷⁻⁹ Studies have suggested the fear of contamination as a culprit for this phenomenon.¹⁰ Cardiovascular comorbidities are particularly significant since they are known risk factors for the severe clinical presentation of COVID-19,¹¹ causing a greater dread and delay for patients with these comorbidities to present to hospitals. Studies have described a decline in admission due to acute coronary syndromes,^{8, 9} while the reported rate of out-of-hospital cardiac arrests has risen.¹² This simultaneity hints at a possible unmet burden of cardiovascular disease during the pandemic, concealed because of the COVID-19 restrictions and fear of contracting the disease at hospitals and clinics.

Given a lack of data on the impact of the COVID-19 pandemic on PVT-induced hospitalization, the present study evaluated hospitalization rates, patient and valve characteristics, management strategies, and in-hospital events among individuals with PVT before and during the pandemic.

Methods

This case series was conducted at Tehran Heart Center, a cardiovascular disease-dedicated hospital affiliated with the Tehran University of Medical Sciences.¹³ All consecutive patients hospitalized due to PVT in the first year of the COVID-19 outbreak (from February 21, 2020, through February 18, 2021) were included in the During-COVID group and were compared with all consecutive patients hospitalized due to PVT (the Pre-COVID group) during the corresponding period before the pandemic (from February 20, 2019, through February 19, 2020). There were no exclusion criteria. Patients either presented to the emergency department or were referred from the outpatient valve or other clinics. The study was approved by the local ethics committee and conformed to the Helsinki Declaration (IR.TUMS.TH.C.REC.1400.044). Due to the retrospective

design and anonymization of the data, the need for informed consent was waived. Data, including hospitalization rates, patient and valve characteristics, management strategies, and in-hospital events, were collected from electronic and paper medical records.

Categorical variables were presented as numbers and frequencies and compared using the χ^2 or Fisher exact test as appropriate. Continuous variables were presented as medians and interquartile ranges and compared using the nonparametric Mann-Whitney *U* Test. IBM SPSS Statistics for Windows, version 21.0, was used for data analysis. Two-sided probability values were reported. Nevertheless, due to the small sample size (ie, lack of power), we relied on the clinical significance of our findings for data interpretation and not the statistical significance.

Results

Forty patients (32.5% male, age: 54.0 [46.5-62.0 y]) comprised the study population. We identified 9 PVT patients during the pandemic compared with 31 patients before it. Table 1 compares the characteristics of the During-COVID and Pre-COVID groups. (Only clinically relevant differences are discussed hereafter.) Sex distribution did not differ between the 2 periods, with PVT affecting women almost twice as much as men. The During-COVID group patients were 8 years younger than the Pre-COVID group patients (50.0 [77.0-51.0 y] vs 58.0 [48.5-63.0 y]). The proportion of patients presenting with the New York Heart Association function class (NYHA FC) III/IV increased considerably (44.4% vs 22.6%). There was also an increase in patients with an international normalized ratio (INR) of less than 2.5 (77.8% vs 58.1%). The isolated mitral valve and simultaneous mitral valve and aortic valve involvement decreased (48.4% vs 22.2% and 25.8% vs 11.1%, respectively), while that of isolated aortic valve increased (44.4% vs 22.6%). The use of transesophageal echocardiography (TEE) as the first-line diagnostic imaging technique dropped from 45.2% to 11.1%. In contrast, the proportion of patients who underwent fluoroscopy and subsequent TEE (due to abnormal fluoroscopic findings) rose from 51.6% to 66.7%. In the During-COVID group, treatment with anticoagulants was lower by 21.5%, while fibrinolysis and surgical technique were each higher by 10.7%. Further, the hospital stay was shortened from 14.0 [9.5-17.0 d] to 8.0 [6.0-19.0 d].

Discussion

Figure 1 illustrates the principal findings of the current study. We found a considerable reduction in the number of patients with PVT admitted to our center during the

Table 1. Patient characteristics*

	The Pre-COVID Group (n=31, 77.5%)	The During-COVID Group (n=9, 22.5%)	P
Baseline Characteristics			
Demographics			
Age	58.0 [48.5-63.0]	50.0 [44.0-51.0]	0.024
Male	10 (32.3%)	3 (33.3%)	>0.999
Clinical Presentations			
NYHA FC III / IV	7 (22.6%)	4 (44.4%)	0.227
Unstable hemodynamic	2 (6.5%)	0	>0.999
AF rhythm at admission	9 (29.0%)	2 (22.2%)	>0.999
Paraclinical Evaluations			
LVEF	50.0 [42.5-50.0]	50 [45.0-50.0]	0.323
INR	2.2 [1.5-2.9]	2.1 [1.3-2.4]	0.759
INR Range			
<2.5	18 (58.1%)	7 (77.8%)	0.337
2.5-3.5	7 (22.6%)	2 (22.2%)	
>3.5	6 (19.4%)	0	
VTH Characteristics			
Valve Type			
Mechanical	27 (87.1%)	8 (88.9%)	0.689
Bioprosthetic	4 (12.9%)	1 (11.1%)	
Valve Site			
Isolated MV	15 (48.4%)	2 (22.2%)	0.120
Isolated AV	7 (22.6%)	4 (44.4%)	
MV-AV	8 (25.8%)	1 (11.1%)	
Isolated TV	1 (3.2%)	1 (11.1%)	
Isolated PV	0	1 (11.1%)	
Diagnostic Method			
First-line TTE ‡	1 (3.2%)	1 (11.1%)	0.080
First-line TEE ‡	14 (45.2%)	1 (11.1%)	
Fluoroscopy-TEE	16 (51.6%)	6 (66.7%)	
Fluoroscopy-TTE	0	1 (11.1%)	
Type of Treatment			
Anticoagulant	17 (54.8%)	3 (33.3%)	0.525
Fibrinolytic	7 (22.6%)	3 (33.3%)	
Surgery	7 (22.6%)	3 (33.3%)	
Type of Surgery (n=10)			
Valve replacement	2 (28.6%)	2 (66.7%)	0.500
Surgical thrombectomy	5 (71.4%)	1 (33.3%)	
In-hospital Events			
LOS	14.0 [9.5-17.0]	8.0 [6.0-19.0]	0.211
mortality	2 (6.5%)	0	>0.999
CVA	1 (3.2%)	0	>0.999

*Data are presented as frequencies (percentages) or medians (Q1-Q3).

‡ First-line refers to performing the mentioned diagnostic imaging method as the first step and without preceding fluoroscopy.

NYHA, New York Heart Association; FC, Functional class; AF, Atrial fibrillation; LVEF, Left-ventricular ejection fraction; INR, International normalized ratio; VHT, Valvular heart thrombosis; MV, Mitral valve; AV, Aortic valve; TV, Tricuspid valve; PV, Pulmonary valve; TTE, Transthoracic echocardiography; TEE, Transesophageal echocardiography; LOS, Length of stay; CVA, Cerebrovascular accident

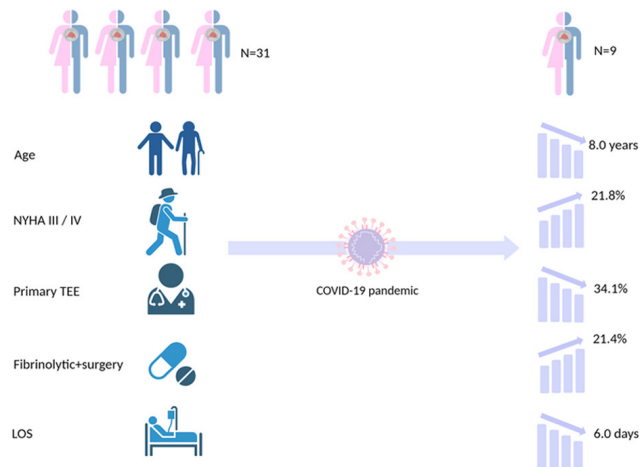


Figure 1. The image depicts the impact of COVID-19 on hospitalization rates due to prosthetic valve thrombosis. NYHA, New York Heart Association; TEE, Transesophageal echocardiography; LOS, Length of stay

COVID-19 pandemic. The During-COVID group patients were 8 years younger, had more frequent presentations with severe dyspnea and treatment with fibrinolytic/surgical therapies, and had shorter hospital stays than the Pre-COVID group patients.

The impact of the COVID-19 pandemic on various cardiovascular conditions has been previously reported.^{7-9, 14, 15} However, information on admissions due to PVT is missing. Chiming with our observation, a recent systematic review reported a 40-50% reduction in acute coronary syndromes and a 12-40% reduction in stroke admissions during the pandemic.¹⁶ Likewise, a large multisite study reported a significant reduction in admission rates due to various cardiovascular conditions, one of which was “other selected acute cardiovascular conditions” including prosthetic valve-related diseases.¹⁷

Multiple explanations can be proposed for the reduced hospitalization, the most worrisome of which is that patients, particularly those with milder symptoms, were more reluctant to seek medical care due to the fear of contracting the disease,¹¹ which is also suggested by others.¹⁰ Nonetheless, it is difficult to evaluate the pure role of viral fear without considering its intricate interaction with COVID-19 restriction rules and media effects, which might have heightened this effect.¹⁸ Moreover, dyspnea as a common symptom of PVT might be mistaken for COVID-19 symptoms by both patients and physicians, thereby causing delays in further evaluations for PVT. Additionally, patients might have presented to COVID-19 dedicated centers due to dyspnea; thus, their PVT diagnosis might have been made elsewhere rather than at our center. Still, we continued to encourage our patients with valvular interventions to come to our center if they had any symptoms.

Patients were considerably younger during the pandemic, possibly reflecting that older people are more frightened to present to the hospital. Some studies have reported

the younger age of admitted patients with acute coronary syndromes, as well,⁸ while others have not.¹⁹ The behavior of medical care avoidance might have more severe implications among older patients, hence the importance of encouraging this group not to ignore their symptoms during the ongoing pandemic.

As also noted with other cardiovascular conditions,^{7, 8, 19, 20, 21} the more frequent presentation with severe symptoms (eg, dyspnea in our study) during the pandemic might imply that patients with milder symptoms were more inclined to stay home and present to hospitals when their symptoms had become critical. The increase in the use of fibrinolytic and surgical treatments, which are preferred for patients with more severe symptoms and higher clot burdens, can support this claim.

During the pandemic, the proportion of patients undergoing first-line TEE dramatically decreased, possibly implying an enhanced tendency toward the use of fluoroscopy over TEE as the initial diagnostic technique. This is in line with the latest guidelines on cardiac imaging during the ongoing pandemic. Due to the high risk of staff contamination, TEE should be avoided as much as possible and be limited to occasions when there are crucially suspicious findings or when it might change the treatment approach.²² The decline in hospitalization length has been a worldwide issue since the start of the pandemic,^{14, 16, 17, 23} representing physicians' and patients' inclination toward an early discharge, as well as hospitals' endeavors to ensure bed availability.

INR changes could indicate that patients went to outpatient prothrombin time clinics or drugstores less frequently and more irregularly, as proposed by other researchers, as well.²⁴ Many people taking anticoagulants are older and have comorbidities; therefore, they may be more afraid of contracting the disease and more likely to abide by the country's “stay home” instructions. These behavioral changes can make patients liable to over-or

under-anticoagulation.²⁵

The observational and single-center nature of the current study precluded the possibility of finding a causal relationship between the pandemic and PVT admissions. Our findings are, accordingly, only hypothesis-generating and should be confirmed by other studies. Most importantly, as a consequence of the low PVT incidence and our single-center design, there was a lack of power to detect statistically significant differences. Consequently, we were able to discuss only clinically-relevant findings. It should be noted that many variables for which we reported a clinical difference had significant or borderline P values. Therefore, larger multicenter studies could further draw statistically significant differences in this regard. Our study is the first to report the effects of the COVID-19 pandemic on PVT admissions so far, which we hope will serve as a trigger for further multicenter research in the field.

Conclusion

Hospitalization due to PVT dropped considerably during the COVID-19 pandemic. Admitted patients were 8 years younger, with a higher proportion of severe dyspnea and treatment with fibrinolysis/surgical approaches. These changes highlight the significance of the active surveillance of patients with prosthetic valves to ensure that they are symptom-free, taking their anticoagulant medications properly, and having scheduled follow-up visits promptly during the pandemic.

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