The Role of multidetector CT scan in the Management of Prosthetic Aortic Valve thrombosis: A Case Report

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Abstract

The diagnosis and management of Prosthetic Aortic Valve thrombosis (PAVT) is challenging. The accurate diagnosis of this entity and its prompt management is vital to improving the prognosis of PAVT patients. Multi detector CT plays a central role in this effort. We present a case of PAVT in which the use of MDCT was useful in guiding management.

Learning Objectives

1. To understand the role of MDCT in the diagnosis of PAVT
2. To evaluate the utility of MDCT in guiding thrombolytic therapy of PAVT patients
3. To assess the viability of low dose, slow infusion of tPA in the treatment of PAVT

History of presentation

A 61-year-old male presented to hospital with dizziness and dyspnea at rest and on exertion of 3 weeks duration. He admitted to running out of his medications about a month prior to presentation to the emergency department. At presentation, the patient was afebrile, New York Heart Association (NYHA) functional class III, with an average pulse of 77, respiratory rate 22 and blood pressure 100/82. An electrocardiograph revealed atrial flutter at a rate of 79 with right bundle branch block. Results of initial biochemical laboratory investigations including High Sensitivity Troponin 1, hemogram, were normal. Significant results of biochemical tests included NT proBNP >3000, and subtherapeutic INR 1.2. Chest x ray showed mild pulmonary vascular congestion.

Medical history

His past medical history was significant for aortic root replacement using Modified Bentall procedure secondary to acute type 1 Aortic Dissection, and concomitant Aortic valve replacement using 23mm Carbomedic bileaflet mechanical valve conduit 3 years ago. He also had a ventricular septal defect repaired at the same time. The rest of his history included heart failure with preserved ejection fraction, coronary artery disease status post coronary artery bypass graft, paroxysmal atrial fibrillation on Coumadin, peripheral artery disease, type II diabetes mellitus and hyperlipidemia.

Differential diagnosis

The differential diagnosis included valvular thrombus, or valve pannus, in the setting of acute decompensated heart failure.

Investigations

A transthoracic echocardiogram (TTE) revealed a moderately to severely reduced left ventricular systolic function with an estimated ejection fraction of 30-35%, moderate transvalvular aortic regurgitation, with increased transprothetic pressure gradients. Prosthetic transvalvular velocities (Vmax 3.55m/s) were increased with peak gradient of 51 mmHg and mean gradient of 32 mmHg [Figure 1]. A transesophageal echocardiogram (TEE) revealed an abnormally functioning mechanical valve with transvalvular peak gradient of 49 mmHg, mean gradient of 29 mmHg, Doppler velocity index of 0.21 and acceleration time of 114msec, consistent with prosthetic aortic valve stenosis [video 1, Figure 2]. Leaflet mobility and sub valvular structures could not be evaluated because of acoustic shadowing on esophageal views. Valve fluoroscopy revealed an immobile disc without any obvious obstructive lesions [video 2]. A Multi detector computed tomography (MDCT) was performed to help in assessing the etiology of valve dysfunction. It revealed a low-density lesion (40HU), consistent with thrombus, measuring 8 x 5 mm interfering with the mobility of the posterior disc of the Prosthetic Aortic Valve [Figure 3].

Management

The heart team evaluated and reviewed the images obtained via MDCT, objectively elected to pursue thrombolytic therapy, tissue plasminogen activator (tPA) infusion was started. The patient received 10 mg IV bolus followed by 90 mg over approximately 2 hours. A repeat aortic valve fluoroscopy demonstrated

restricted valve motion [video 3]. A second round of tPA was administered at the same dosage. A limited echocardiogram showed improved gradient across the aortic valve with peak gradient of 16 mmHg and mean gradient of 10 mmHg and no regurgitation. The heart team decision was made to repeat tPA infusion at a lower dose. The patient received 1 mg/h of tissue plasminogen activator infusion for 25 hours. A repeat TTE revealed more improvement of transaortic velocity/gradient with peak gradient 15 mmHg and mean gradient of 8 mmHg but with a small thrombus still present. Patient symptoms had resolved. A valve fluoroscopy obtained a couple of days later still showed no significant movement of one of the mechanical aortic valve leaflets [Video 4]. The patient received a fourth dose of low dose tPA infusion as the previous described above. Follow up MDCT obtained three days after the fourth tPA infusion, revealed resolution of the thrombus with normal leaflets excursion [Video 5]. There were no hemorrhagic complications. IV heparin used between tPA treatment was resumed after the fourth dose as a bridge to warfarin until achievement of therapeutic INR.

Discussion

Prosthetic valve thrombosis (PVT) is one of the major causes of primary valve failure with an incidence of 0.5%–8% in mechanical valves in the aortic position (1). The clinical presentation of prosthetic aortic valve thrombosis (PAVT) is variable, with symptoms including dyspnea, decreased exercise capacity, palpitation, chest pain, vertigo, cerebrovascular accident. On physical examination, stenotic or regurgitant murmurs may be revealed. Hemodynamic stability may depend on the number of leaflets involved with better hemodynamic conditions seeing if a single leaflet is involved as opposed to two leaflets (2). In patients with prosthetic valve presenting with symptoms and signs suggestive of valve dysfunction, echocardiography examination should be urgently performed especially if there is suspicion for PVT.

Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) are the standard techniques for the evaluation of prosthetic valve function (3). Cinefluoroscopic is however, considered the gold standard as TTE and TEE do not always allow for quantitative evaluation of leaflet motion. Cinefluoroscopic has the advantages of being low cost, fast and easily repeatable so it can be used for evaluation of valve motion during thrombolytic treatment (4). It is however not useful in assessing the etiology of prosthetic valve failure (4). Multi detector computed tomography (MDCT) diagnostic yield is in the identification of the etiology of prosthetic valve failure (5). Determining the cause of valvular dysfunction is important to guide therapy as surgery is the only option for pannus, PVT may require non-surgical approaches.

The optimal management of PAVT is controversial in part due to the lack of clinical trials. Treatment options include surgery, thrombolytic therapy, and anticoagulation therapy, the latest being inferior to the first two (6). In a systematic review and meta-analysis of observational studies, urgent surgery was found not superior to thrombolytic therapy at restoring valve function, but substantially reduced the occurrence of thrombo-embolic events, major bleeding, and recurrent PVT (7). The authors recommended that in experienced centers, urgent surgery be preferred over thrombolytic therapy for treating left-sided PVT, pending the results of randomized controlled trials (8).

In a multicenter observational prospective study of thrombolytic therapy involving 158 patients with PVT, the authors recommended a low-dose and slow/ultraslow infusion of t-PA as a viable treatment in patients with obstructive PVT. The patients in the study received slow (6 hours) and/or ultraslow (25 hours) infusion of low-dose tissue plasminogen activator (t-PA) (25 mg) mostly in repeated sessions (7). This study found that a low-dose and slow/ultraslow infusion of t-PA were associated with low complications and mortality and high success rates (7). Furthermore, the TROIA trial also showed that slow infusion of 25 mg t-PA without a bolus appears to be the safest thrombolytic regimen with lower complication and mortality rates for PVT compared with higher doses or rapid infusions (8). Recently, Özkan and his colleague also demonstrated that Ultraslow (25hours) infusion of low-dose (25mg) t-PA without bolus appears to be associated with quite low nonfatal complications and mortality for PVT patients without loss of effectiveness, when compared with higher doses or faster infusions of t-PA (9). This Ultraslow thrombolytic infusion approach could be used with repetition without increasing adverse events including major bleeding and intracranial bleeding. (9,10)

In the era of cardiac multimodality imaging, evaluation and management of prosthetic valve thrombosis should not be done only based on clinical findings, or indirect imaging modalities. Rather, MDCT should be incorporated into the decision-making process, as it's diagnostic yielding in identifying the etiology of PVT is invaluable.

Follow-up

At his one-week follow-up, he was still asymptomatic. He reported medication compliance although his INR had dropped from 2.6 to 1.6. The dose of Warfarin was adjusted with lovenox bridging on outpatient basis.

Conclusion

We present a case of PAVT treated with repeated infusions of tPA using a combination of high dose with rapid infusion and low dose with slow infusion. The treatment was successful and well tolerated. Prompt detection and treatment of PVT is importance to avoid catastrophic outcomes. Multimodality techniques, including MDCT helped to reveal etiology of the Prosthetic aortic valve dysfunction, including thrombosis.

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Informed consent and authorization were obtained prior to preparation of this manuscript. This would be made available to editor on request.

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Legends for videos

Video 1: Transesophageal echocardiogram (TEE) revealing an abnormally functioning mechanical valve.

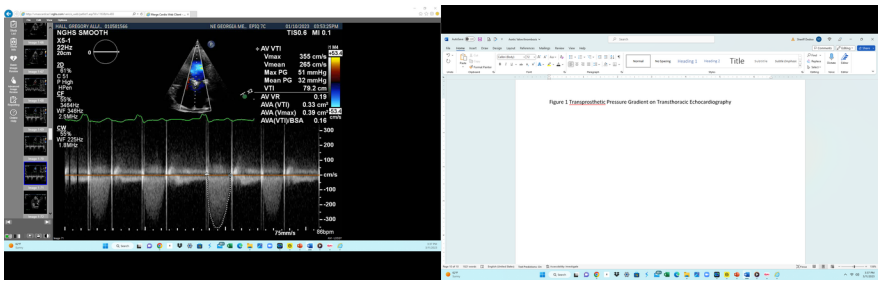
Video 2: Valve fluoroscopy showing an immobile disc without obvious obstructive lesions

Video 3: Repeat aortic valve fluoroscopy demonstrating restricted valve motion.

Video 4: Valve fluoroscopy showing no significant improvement in motion of the immobile mechanical aortic valve leaflet.

Video 5: MDCT revealing resolution of the thrombus with normal leaflets excursion.

Figure 1 Transprosthetic Pressure Gradient on Transthoracic Echocardiography



Transthoracic echocardiography showing increased transprosthetic pressure gradient (PG) (maximum PG 51mmHg; mean PG 32mmHg). VTI – Velocity time integral

Figure 2 Transesophageal Echocardiography showing increased transprosthetic velocity of 3.51m/s with mean gradient 29mmHg

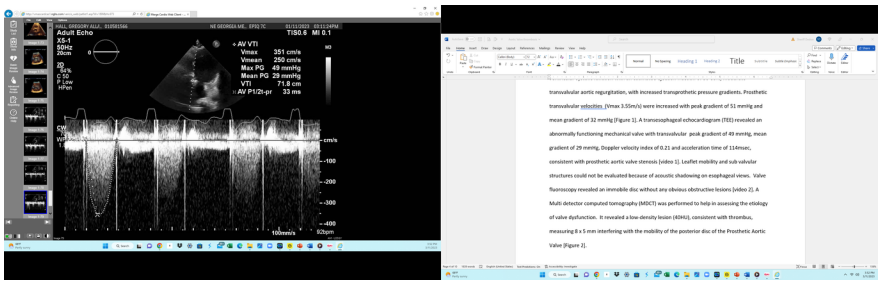
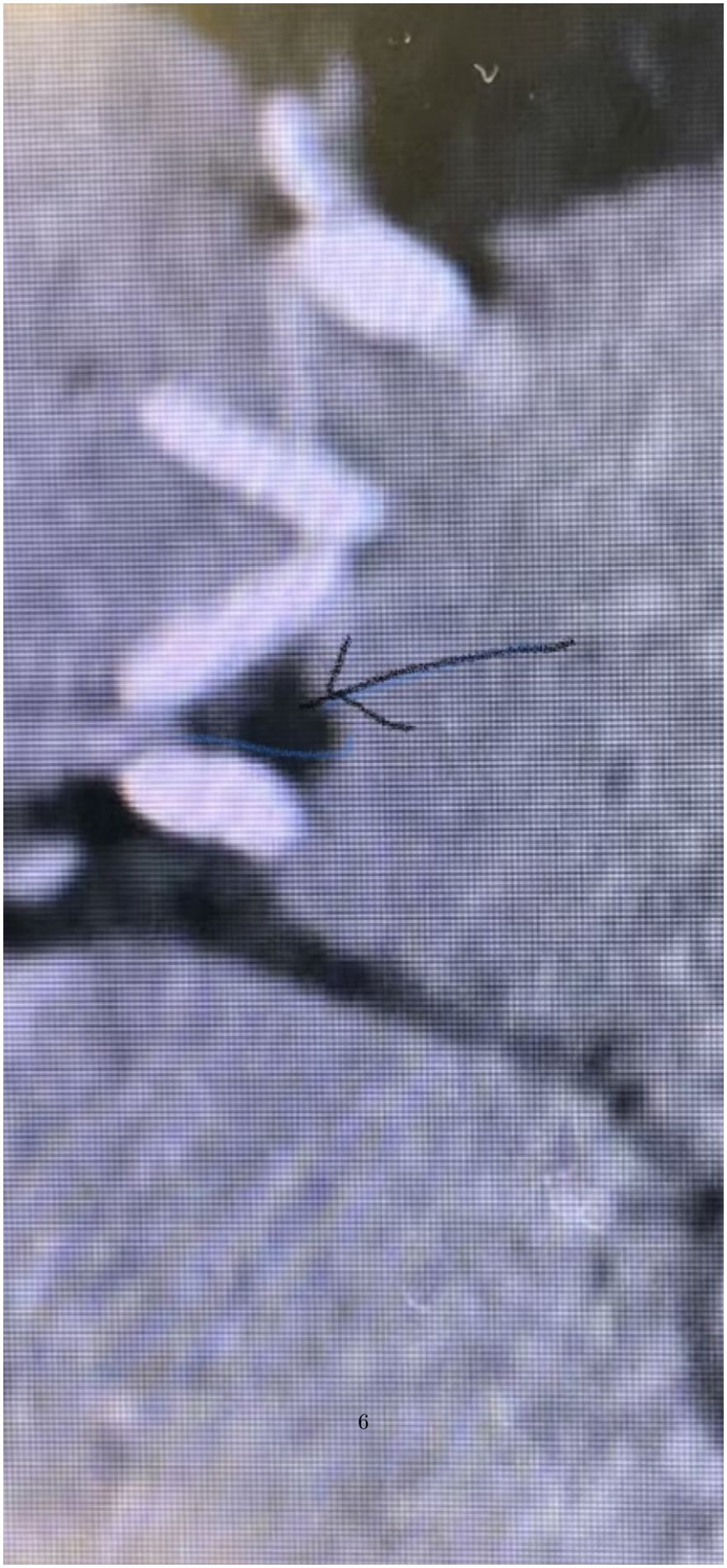


Figure 3 MDCT showing Bileaflet mechanical aortic valve, with thrombus interfering with function of the posterior leaflet (shown with arrow)



Ethics approval and consent to participate.

Not applicable.

Consent for publication

Written informed consent was obtained from the patient for publication of this case

report, and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interest to disclose.

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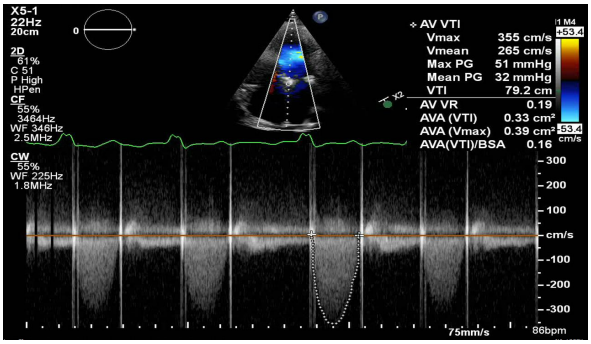

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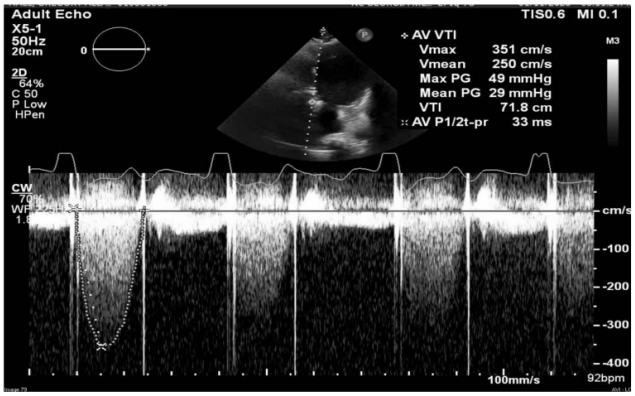

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