***Case report***

**Aortic Endocarditis on Bicuspid Valve Complicated by Valvular Perforation and Severe Aortic Regurgitation Due to Methicillin-Resistant Staphylococcus aureus: A Case Report**

**Abstract**

Infective endocarditis (IE) on a bicuspid aortic valve (BAV) is a severe condition associated with high morbidity and mortality rates despite diagnostic and therapeutic advances. We report the case of a 25-year-old patient admitted with prolonged fever, exertional dyspnea, and marked asthenia, who was diagnosed with complicated aortic endocarditis. Echocardiography revealed a type 0 bicuspid valve with perforation of the anterior cusp, leading to severe aortic regurgitation. Serial blood cultures identified methicillin-resistant Staphylococcus aureus (MRSA). Intravenous vancomycin therapy was urgently initiated, followed by aortic valve replacement with a mechanical prosthesis. The postoperative course was favorable, with complete resolution of the infectious syndrome and proper prosthetic function. This case highlights the importance of early diagnosis and prompt medical-surgical management in the face of severe complications of IE on BAV.

**Keywords:** Infective endocarditis, bicuspid aortic valve, methicillin-resistant Staphylococcus aureus, aortic regurgitation, valve surgery.

**Introduction**

Bicuspid aortic valve (BAV) represents the most frequent congenital heart defect, occurring in approximately 0.5% to 2% of the general population (1). This anomaly arises from the fusion of two of the three aortic valve leaflets during embryonic development, resulting in a bicuspid instead of the normal tricuspid configuration. While many individuals with BAV remain asymptomatic for long periods, the condition is linked to numerous complications, such as aortic stenosis, valve regurgitation, dilation or aneurysm of the ascending aorta, and an elevated risk of infective endocarditis (IE) (2). The atypical valve structure facilitates turbulent blood flow and endothelial damage, which in turn promotes bacterial adhesion and colonization.

Infective endocarditis involving a BAV is particularly concerning due to the valve’s structural fragility and heightened vulnerability to aggressive bacterial infections. Among the pathogens responsible, methicillin-resistant Staphylococcus aureus (MRSA) is especially dangerous because of its high virulence, rapid disease progression, and resistance to standard antibiotic treatment. MRSA endocarditis often leads to serious outcomes such as significant valve destruction, systemic emboli, and acute heart failure, frequently requiring urgent surgical intervention (3).

Timely diagnosis and a coordinated, multidisciplinary strategy are critical in managing such complex cases and minimizing morbidity and mortality. Here, we present a case of MRSA-related infective endocarditis in a young patient with an undiagnosed BAV, characterized by sudden clinical deterioration and requiring immediate medical and surgical care.

**Case Presentation**

A 25-year-old male with no significant medical history was admitted for persistent fever associated with severe asthenia, exertional dyspnea, and multiple episodes of malaise. On clinical examination, his blood pressure was 110/40 mmHg with a decrease in diastolic pressure, heart rate was 110 bpm, SpO2 was 96% on room air, and body temperature was 39°C. A loud diastolic murmur was heard over the aortic area, and ECG showed sinus tachycardia. Laboratory tests revealed an elevated CRP of 130 mg/L, leukocytosis of 15,000/mm³, and positive blood cultures for methicillin-resistant Staphylococcus aureus (MRSA). Transthoracic and transesophageal echocardiography demonstrated a type 0 bicuspid aortic valve with a circular perforation of the anterior cusp (Figure 1), resulting in severe aortic regurgitation (Figures 2-3), along with left ventricular dilation and hyperkinesia indicative of significant volume overload, with preserved LVEF. Other valves were unremarkable, with no evidence of abscess formation. No infectious entry point was identified, and HIV and hepatitis serologies were negative. Renal and hepatic function was normal.

Intravenous vancomycin was immediately initiated upon admission, with close echocardiographic monitoring. Given the severity of valvular lesions and the high risk of hemodynamic decompensation, surgical intervention was performed within a week of admission. The patient underwent aortic valve replacement with a mechanical prosthesis, and intraoperative analysis confirmed severe valvular destruction secondary to infection. Culture of the excised valve identified MRSA susceptible to daptomycin. Postoperatively, the patient's condition improved, with complete resolution of the infectious syndrome within 10 days. The patient was maintained on daptomycin at 10 mg/kg/day. Follow-up echocardiography showed good prosthetic function without complications. The patient was discharged after six weeks of antibiotic therapy, with negative blood cultures.

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**Figure 1:** Aortic valve perforation **Figure 2:** Severe aortic regurgitation at 120° view



**Figure 3:** Severe AR on TTE

**Discussion**

Native valve infective endocarditis (IE) is relatively uncommon, with an incidence of 2 to 10 cases per 100,000 person-years. Infection likely develops on pre-existing endothelial damage to the valve (4) It’s a severe, life-threatening condition characterized by infection of the endocardial surface of the heart, including the heart valves. Despite advances in diagnostic techniques and treatment, the global incidence of IE has been steadily increasing, and IE is ranked among the five most common life-threatening infectious conditions resulting in significant morbidity and mortality.

Patients with bicuspid aortic valves have a significantly increased risk of developing native valve infective endocarditis. This congenital anomaly, affecting approximately 1% to 2% of the population, is associated with altered blood flow and endothelial lesions that predispose to bacterial adhesion and IE (5). Several studies have shown that BAV patients have a higher incidence of IE compared to those with tricuspid aortic valves, primarily due to blood flow turbulence causing microtrauma to the valvular endothelium (6).

Methicillin-resistant Staphylococcus aureus (MRSA) is a particularly concerning strain due to its resistance to beta-lactam antibiotics, attributed to the acquisition of the mecA gene, which encodes a low-affinity penicillin-binding protein (PBP) (7). This resistance limits the effectiveness of commonly used antibiotics, leaving few therapeutic options such as vancomycin, daptomycin, ceftaroline, and dalbavancin for severe infections (8)

“Host factors also play a crucial role in MRSA’s ability to colonize endothelial surfaces. Subendothelial matrix proteins, endothelial cell receptors, and platelets interact with MRSA cell wall adhesins, such as fibronectin-binding proteins, promoting bacterial attachment to these surfaces and enhancing biofilm formation. This interaction between MRSA and host components is pivotal in the development of IE”. (9).

“Clinical manifestations of IE range from acute to chronic forms, with complications including heart failure, embolic events, and neurological deficits. Diagnosis is based on the modified Duke criteria, incorporating modern cardiovascular interventions and advanced imaging techniques such as PET/CT to improve the detection of biofilm-associated infections. Management of MRSA-associated IE requires prolonged antimicrobial therapy, often with vancomycin or daptomycin, and frequently necessitates surgical intervention to remove infected prosthetic material or repair damaged cardiac valves” (9).

Regarding MRSA-induced infective endocarditis, its prevalence ranges from 19% to 34%, depending on the study (10). “First-Line Therapy: Vancomycin is the drug of choice for MRSA NVE”([1](https://www.mdpi.com/2079-6382/13/12/1132#B1-antibiotics-13-01132)1,1[2](https://www.mdpi.com/2079-6382/13/12/1132#B2-antibiotics-13-01132)). “According to the 2023 European Society of Cardiology (ESC) guidelines, both right-sided and left-sided NVE caused by MRSA in adults should be treated with intravenous vancomycin, aiming for an area under the curve (AUC) of 400–600 mg·h/L over a 6-week period. If vancomycin is contraindicated or if the MRSA isolate has a minimum inhibitory concentration (MIC) > 1 mg/L, daptomycin is recommended as an alternative. In most cases, intravenous therapy is advised for the entire treatment duration.

Second-Line Agents: In patients intolerant to vancomycin, daptomycin combined with ceftaroline, cloxacillin, or fosfomycin (availabel orally in some regions) is suggested” (1[2](https://www.mdpi.com/2079-6382/13/12/1132#B2-antibiotics-13-01132)). Combination therapy not only enhances bacterial clearance but also reduces the risk of resistance development. High-dose daptomycin (10 mg/kg) for a 6-week duration is favored to mitigate the risk of resistance. While combination therapy is preferred, rifampin and gentamicin are generally avoided due to their potential for hepatotoxicity and nephrotoxicity and limited evidence for improved survival in this population.

 “In addition, novel therapeutic strategies to combat biofilms are emerging. These include antimicrobial peptides” (13)(14), quorum sensing inhibitors (15), bacteriophage therapy (16), and nanoparticle-based drug delivery systems (17), all of which show promise in disrupting biofilm integrity and enhancing antibiotic efficacy. These innovative approaches target biofilm structure and bacterial communication pathways, opening new avenues for treatment. However, further clinical trials are needed to validate the efficacy and safety of these therapies in real-world settings.

“It is estimated that nearly 50% of all IE cases require heart valve surgery, driven by critical issues such as extensive valvular damage, large vegetation, or failure of antibiotic therapy to control the infection” (18)(19). The primary goals of surgery include repairing or replacing damaged valves, excising infected tissue, and removing prosthetic materials that are sources of biofilm. The timing of the surgery is crucial, with early intervention often significantly improving outcomes, particularly in cases complicated by heart failure, embolic risk, or uncontrolled infection. Without prompt surgical management, the risk of recurrent infection and mortality increases, underscoring the essential role of surgery in the comprehensive treatment of IE.

**Conclusion**

Infective endocarditis on a bicuspid valve, particularly when caused by MRSA, is a diagnostic and therapeutic emergency. It’s a complex and evolving clinical problem, with biofilm-mediated resistance posing persistent challenges in both diagnosis and treatment. While current therapeutic regimens are essential, they often require supplementation with surgical intervention, and emerging targeted strategies may offer important additional tools to address the limitations imposed by biofilms. This case illustrates the critical importance of early diagnosis, appropriate antibiotic therapy, and timely surgical intervention to improve patient prognosis. Close collaboration between infectious disease specialists, cardiologists, and surgeons is essential to optimize the management of these complex cases and reduce the risk of complications.

**Ethical Approval:**

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

Consent

As per international standards or university standards, patient(s) written consent has been collected and preserved by the author(s).

1. Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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