CASE REPORT

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Starr-Edwards Mechanical Prosthesis for More Than 53 Years in the Mitral Position: A Case Report

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Abstract

Valvular heart disease affects approximately 2.5% of the global population. Starr-Edwards (SE) prosthetic valves are commonly used in the aortic and mitral positions, with reported durability extending up to 40 years. We report the case of a 77-year-old woman with a SE mechanical prosthesis in the mitral position, which was implanted 53 years ago. Imaging studies revealed the prosthesis to be intact, with no signs of degeneration. This case underscores the remarkable longevity of the SE valve and provides valuable insights into the long-term durability and performance of these valves, suggesting that valvular dysfunction may occur less frequently than previously estimated.

Keywords: Case report, mechanical prosthesis, valve, Starr-Edwards, mitral stenosis, durability

INTRODUCTION

Heart valve disease represents a significant clinical challenge, affecting approximately 2.5% of the global population. For decades, Starr-Edwards (SE) prosthetic valves were widely used in the aortic and mitral positions.[1] Studies have shown that these valves can last up to 40 years, with a notable reduction in hemolysis and valve thrombosis rates in contemporary series, reaching values as low as 0.10% and 0.06% per patient per year, respectively. However, there remains an increased risk of thromboembolic events and valve dysfunction, with a freedom from thromboembolic events ranging from 74% to 87% at 10 years.[2]

More than half a million SE valves were implanted globally between 1960 and 2007, with around 300,000 of them placed in the last 7 years of their production. These valves have proven to be reliable in the long term, offering considerable durability and have reoperation rates comparable to other recent mechanical valves in terms of complications.[3]

In this context, it is being discussed whether valve dysfunction associated with these prostheses is less prevalent than suggested by some experts. There are case reports of patients with SE valves with survival of 48 years, 40 years, and 51 years.[4,5] The case presented involves a patient with an SE valve that has lasted 53 years.

This case is unique due to the extraordinary longevity of the SE valve prosthesis, which has functioned for 53 years without showing expected signs of degeneration. This challenges common conceptions about the lifespan of these valves and suggests that valve dysfunction associated with these prostheses

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may be less prevalent than previously estimated. This report adds significant evidence regarding the durability and long-term performance of SE valves, thereby contributing to a better understanding of patients with these prostheses.

CASE REPORT

A 77-year-old female patient with a history of mitral stenosis was treated in 1971 with the implantation of a SE 6120 2M (silastic) mechanical prosthesis. In 2016, she received a permanent ventricular impulse rate medtronic® pacemaker due to blocked atrial fibrillation. The patient was being managed with warfarin, telmisartan, atorvastatin, levothyroxine, and clonazepam.

Currently, the patient presented with mixed-origin dyspnea and was classified as functional class IV according to the New York Heart Association, with symptoms and signs of global heart failure even at rest. Six months ago, she had community-acquired pneumonia, requiring hospitalization and treatment with a dual antibiotic regimen. Since her discharge, she needed supplemental oxygen at 5-7 L/min to maintain an oxygen saturation above 80%.

Additionally, she experienced episodes of depression and low food intake, leading to malnutrition. On inspection, she appeared cachectic, with signs of dehydration, including dry mucous membranes and positive skin turgor.

Laboratory tests revealed macrocytic anemia, moderate thrombocytopenia, an estimated glomerular filtration rate of 52 mL/min/1.73 m^2, abnormal pancreatic and liver function tests, and prolonged coagulation times [partial thromboplastin time of 62.4 s, prothrombin time of 39.1 s, and international normalized ratio (INR) of 3.55].

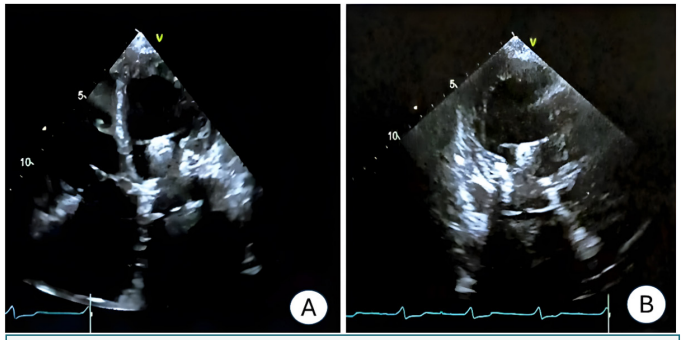


Figure 1: The echocardiogram shows the Starr-Edwards type mechanical mitral prosthesis, which is functioning normally with no pathological leaks. Proper movement of the ball within the cage is observed, as well as the absence of significant gradients or paravalvular regurgitation

To assess her cardiac and pulmonary status, she underwent an echocardiogram (Figures 1-4), an electrocardiogram (Figure 5), and a chest X-ray (Figure 6).

The echocardiogram revealed a mixed cardiopathy of degenerative atherosclerotic and hypertensive origin. The SE mechanical prosthesis in the mitral position demonstrated proper ball movement in the closure position with a maximum diastolic gradient of 25 mmHg and an average of 5.7 mmHg, without pathological leaks. The tricuspid valve exhibited slight thickening of the leaflets, moderate annular dilation (38 mm), leaflet tethering (11.5 mm), and a tenting area of 1.4 cm^2.

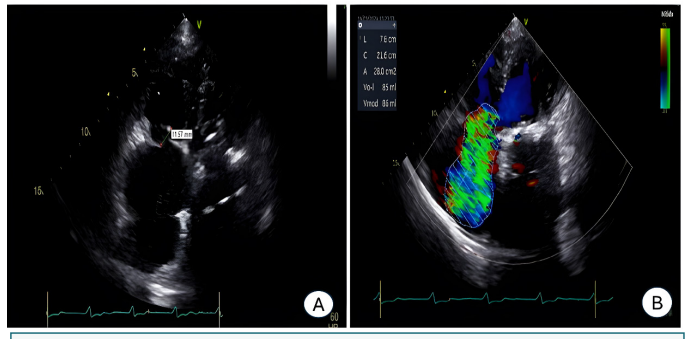


Figure 2: (**A**) Transthoracic echocardiogram in 2D mode, apical four-chamber view, showing the apical systolic displacement of the tricuspid valve (tethering) with a maximum distance from the valvular plane of 11.5 mm. (**B**) In the same apical four-chamber view, in color Doppler mode, the severe secondary (functional) tricuspid regurgitation is visible, extending up to the atrial roof, with a regurgitant volume of 86 mL and a regurgitant area of 28 cm^2

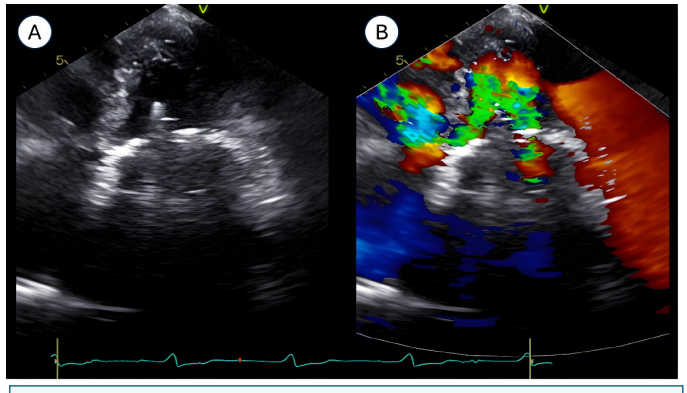


Figure 3: (**A**) Hows an echocardiogram in the apical four-chamber view where the Starr-Edwards mechanical prosthesis is observed, with the ball moving towards the cage during diastole. (**B**) In the same view, a comparative image in color Doppler mode shows the high profile of the prosthesis, allowing diastolic flow to pass along the sides of the ball

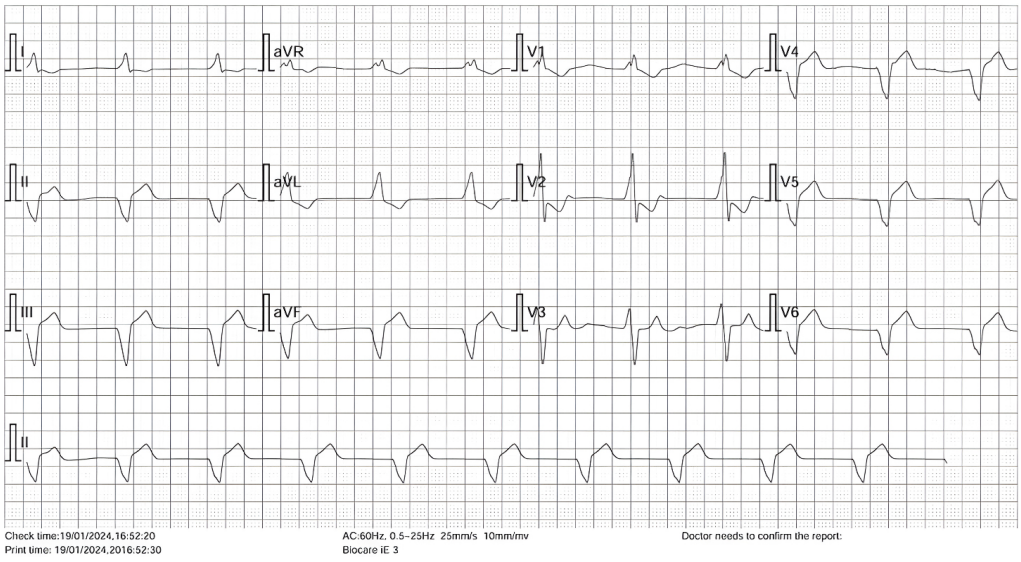


Figure 4: **(A)** Displays the transvalvular gradient across the Starr-Edwards mechanical prosthesis, with a maximum diastolic gradient of 25 mmHg, a mean of 5.7 mmHg, and a valve area of 2.8 cm^2. **(B)** Shows the retrograde gradient of the tricuspid regurgitation assessed using continuous Doppler, revealing a maximum systolic regurgitant velocity of 4.0 m/s and a maximum systolic regurgitant gradient of 64 mmHg. These findings estimate a pulmonary artery systolic pressure of 79 mmHg

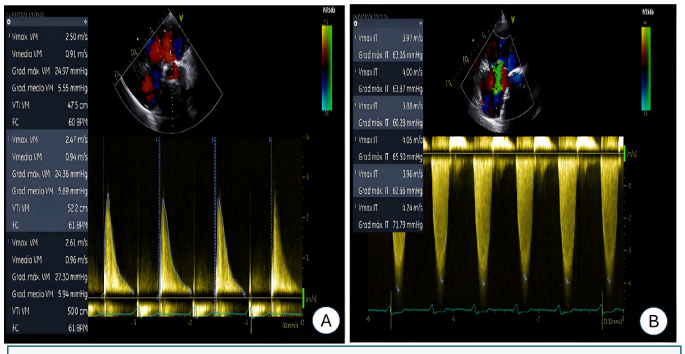


Figure 5: The electrocardiogram shows atrial fibrillation, with a permanent pacemaker capture and 100% ventricular pacing at a heart rate of 60 bpm. It also shows a left bundle branch block and right ventricular hypertrophy. In the right precordial leads, there are increased voltage R waves (R/S index in V2: 1.62) and asymmetrical inverted T waves with negative ST-segment depression, secondary to systolic overload caused by pulmonary arterial hypertension

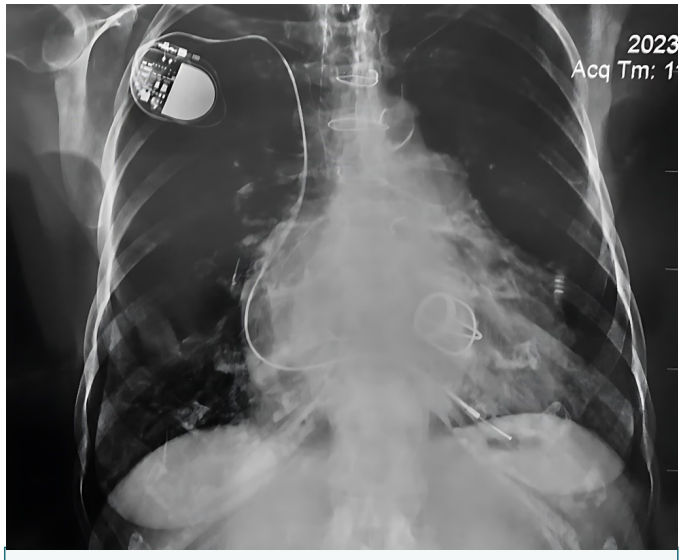


Figure 6: The posteroanterior chest X-ray shows the pacemaker electrode in the right ventricle, directed towards the apex, and connected to the right subclavian generator. The Starr-Edwards mechanical prosthesis is also visible in the mitral position, showing the Teflon ring and polypropylene fabric, continuing with the cobalt-chromium cage; the ball is not visible due to its silicone (silastic) composition. The image highlights moderate to severe cardiomegaly with a cardiothoracic index of 0.6, significant enlargement of both atria, and a prominent pulmonary arch due to pulmonary arterial hypertension

There was severe regurgitation extending to the atrial roof, with a vena contracta of 7.8 mm, regurgitant volume of 85 mL, regurgitant area of 28 cm^2, and maximum systolic regurgitant velocity of 4.0 m/s. Mild functional pulmonary insufficiency was also noted.

Biventricular systolic function was normal, with a left ventricular ejection fraction of 59% as per the automated biplane method, a shortening fraction of 43%, a Tei index of 0.36, and global longitudinal strain of -20%. Severe, irreversible restrictive biventricular diastolic dysfunction was present, with a left atrial volume index (LAVi) of 160 mL/m^2, isovolumetric relaxation time of 69 ms, deceleration time of 147 ms, e' wave velocity of 3 cm/s, flow propagation velocity of pulse

(Vp) of 37 cm/s, and VPd greater than VPs. Segmental wall motion abnormalities were observed in the left ventricle, with dyskinesia and reduced systolic thickening in the basal third of the posterior septum, while the distal two-thirds showed mild hypokinesia. Moderate to severe hypokinesia was also seen in the lateral wall and inferolateral region (both in basal thirds), without areas of fibrosis.

The right ventricle showed an increased end-diastolic diameter (47 mm x 31 mm x 65 mm), hypertrophy of the free wall (9 mm), and normal wall motion. A pacemaker lead was observed to be directed toward the apex. Right ventricular systolic function was borderline, with a TAPSE of 19 mm, a dP/dt of 315 mmHg/sec, and a lateral tricuspid S' wave velocity of 11 cm/s.

The left atrium was severely dilated, with a LAVi of 160 mL/m^2. It measured 67 mm in M-mode in the parasternal long-axis view, and 82x62 mm in longitudinal and horizontal diameters. No thrombi were observed inside. The right atrium showed moderate dilation (65x50 mm in longitudinal and horizontal diameters in the 2D4C view). The inferior vena cava was dilated, exhibiting an expiratory diameter of 34 mm and an inspiratory diameter of 30 mm, with 12% inspiratory collapse.

There was a high likelihood of pulmonary arterial hypertension (PAH), with positive criteria for severe group 2 PAH. Right atrial pressure was 15 mmHg, mean pulmonary artery pressure was 43 mmHg, pulmonary artery diastolic pressure was 18 mmHg, and pulmonary artery systolic pressure was 79 mmHg.

Treatment

The established treatment included warfarin 2.5 mg tablets every 24 hours; maintaining an INR of 3.5, telmisartan 20 mg daily, spironolactone 25 mg orally, furosemide 20 mg orally, and levothyroxine 50 mg, all administered every 24 hours.

Prognosis

The prognosis is poor for both function and life expectancy due to multiple comorbidities, including depression, severe malnutrition (cachexia), congestive hepatopathy secondary to cardiac cirrhosis, and community-acquired pneumonia. Close and multidisciplinary follow-up was initiated to improve the patient's quality of life.

Written informed consent was obtained from the patient for the publication of this case and the associated images.

DISCUSSION

Albert Starr documented his longest-living patient with a SE valve in the aortic position in 2015, with a survival of 51.7 years and a functioning mitral valve for 44.4 years. Durability was a priority in the prosthesis design, aiming for an indefinite lifespan. The cage-ball valve, with no hinges, distributed stress evenly. Additionally, the biocompatibility of the materials and manufacturing techniques were optimized. After eight modifications between 1960 and 1965, the SEV 6120 model remained unchanged until 2004.[3]

Cases of patients with SE valves lasting 48, 40, and 51 years have been documented.[1,4,5] However, this case stands out due to the 53-year duration of a SE valve in the mitral position, which represents one of the longest reported durations and surpasses the expectations of many experts. This is a key point in discussing the durability and long-term performance of these prostheses in clinical practice.

Over time, the patient maintained good clinical and functional stability. This is despite the unfavorable long-term prognosis of this type of prosthesis, due to thromboembolic complications and resistance to flow, which make these prostheses less physiological. This case illustrates the effective function of the SE prosthesis, which was revolutionary in cardiac surgery at the time, significantly improving the quality of life and life expectancy of many patients with valvular disease.

However, the case limitations included the difficulty in correlating the clinical condition with the prosthesis' functionality and hemodynamics, mainly due to the patient's severe general deterioration from chronic malnutrition, community-acquired pneumonia in the last 6 months, and abnormal liver function tests associated with cardiac cirrhosis secondary to right heart failure.

Although SE mechanical prostheses are no longer implanted, we will continue to encounter patients with them due to their proven durability in case reports. However, there is no evidence from larger case series, associating survival with prosthesis durability. Patients with SE mechanical prostheses require close follow-up. Maintaining optimal coagulation profiles is necessary to reduce thromboembolic and hemorrhagic risks. Additionally, hemodynamic profiles, cardiac function, and pulmonary pressures should be evaluated through serial echocardiography. It is crucial to detect and treat comorbidities that deteriorate patients' clinical conditions and increase mortality.

Ethics

Informed Consent: Written informed consent was obtained from the patient for the publication of this case and the associated images.

Footnotes

Authorship Contributions

Surgical and Medical Practices: R.C.M.C., L.M.A.F.G., E.A.M., Concept: R.C.M.C., Design: L.M.A.F.G., Data Collection or

Processing: L.M.A.F.G., E.A.M., Analysis or Interpretation: R.C.M.C., Literature Search: L.M.A.F.G., E.A.M., Writing: R.C.M.C., L.M.A.F.G., E.A.M.

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