

CASE REPORT

Normal function of a 43-year-old Braunwald Cutter heart valve

Gian Manuel Jiménez-Rodríguez^{1,*}, Sergio Criales-Vera², Mario Adrian Juárez-Peñaloza¹, Luis Alonso González-Tapia¹ and Mariana Chaire-Hernández³

¹Instituto Nacional de Cardiología 'Ignacio Chávez', Hemodinámica, México, ²Instituto Nacional de Cardiología 'Ignacio Chávez', Radiología e Imagen, México, and ³Facultad Mexicana de Medicina, Universidad La Salle, México

*Correspondence address. Instituto Nacional de Cardiología Ignacio Chavez, Hemodinamcia, Mexico. E-mail: gianma21@hotmail.com

Abstract

We present the case of a 72-year-old woman diagnosed with rheumatic fever at the age of 6. In 1972, she was diagnosed with mitral valve insufficiency and mitral valve stenosis, then in 1974, a decision was made to perform mitral valve replacement surgery with a 32-mm Braunwald-Cutter ball cage prosthesis. An echocardiogram performed in 2014 revealed normal biventricular systolic function, mechanical prosthesis in mitral position with maximum speed of 1.9 m/s, maximum gradient of 15 mmHg, mean gradient of 6 mmHg, severe tricuspid valve insufficiency, inferior vena cava measuring 15 mm with more than 50% collapse and pulmonary artery systolic pressure of 40 mmHg. We report the use of the 32-mm Braunwald-Cutter ball cage prosthesis with the longest longevity that remains functional after more than 43 years of implantation.

INTRODUCTION

In 1960, Drs Nina Starr Braunwald and Andrew Morrow developed a mitral valve prosthesis with a flexible Dacron-polyurethane compound. Their design used Teflon strips to link the chordae tendinae. When Dr Braunwald identified the device susceptibility to fibrous connective tissue infiltration, she considered applying Teflon to the metal ball could reduce thrombogenesis [1, 2].

Subsequently, Dr Braunwald worked in Dr Cutter's laboratory developing a silastic ball designed to minimize ball deformation (Figs 1 and 2). A new design included a Dacron tube around the titanium struts previously positioned as free posts without distal attachment. She also coated the inlet ring with a thin layer of polypropylene. It is estimated that around 5000 units were produced and implanted worldwide [3].

Firstable the valve was developed for mitral valve replacement but subsequently was used in both aortic and mitral positions. Successful clinical use started in 1968. One of the valve's main

features was the reduction in thromboembolic complications. However, almost a decade later of clinical use, numerous cases reported attrition of the posts in aortic prostheses that resulted in escape of the silastic ball and subsequent death. In 1979, the valve was withdrawn from market due to an increased rate of pannus formation reported in animal studies [4, 5].

CASE REPORT

A 72-year-old woman diagnosed with rheumatic fever at the age of 6 is presented in this report. She remained asymptomatic until 1962 (17 years old). In 1965, she was referred to our hospital with complaints of shortness of breath on exertion. She was diagnosed with mitral valve insufficiency and mitral valve stenosis though her symptoms improved with medical therapy. In 1972, she had her first uneventful pregnancy, 4 months after that she began with heart failure symptoms, reporting orthopnea and

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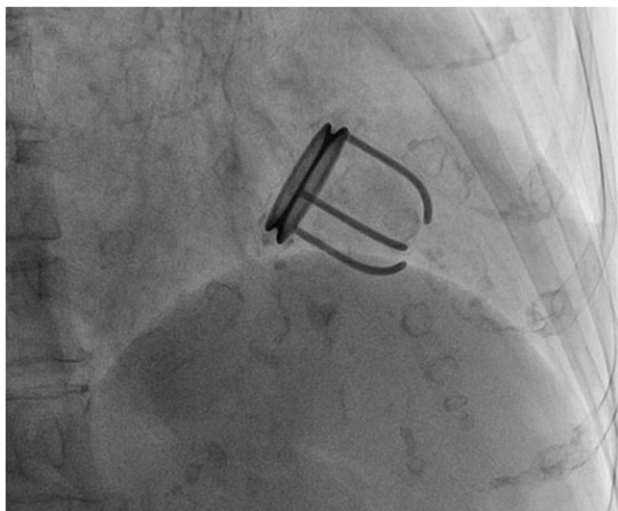


Figure 1: In this fluoroscopic image, is shown the main structure of the Braunwald Cutter prosthetic valve.

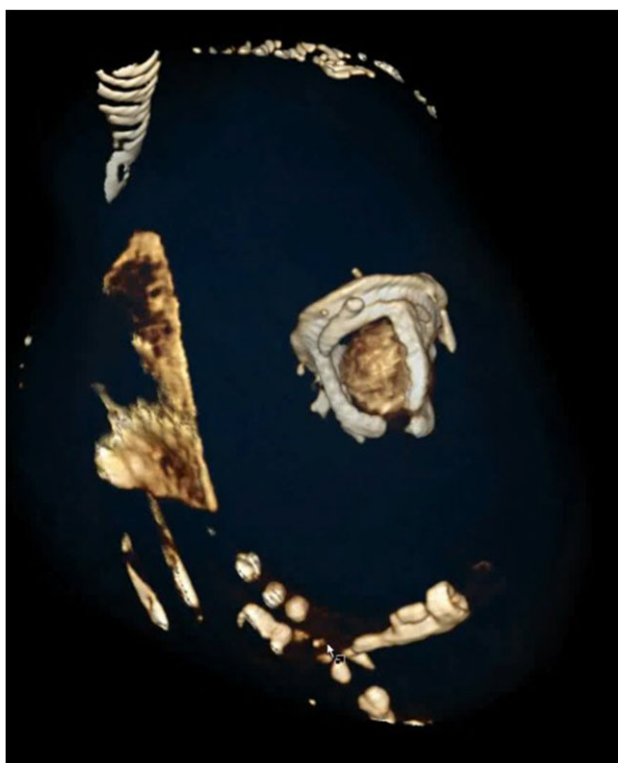


Figure 2: A 3D reconstruction of the prosthesis.

paroxysmal nocturnal dyspnea secondary to double valvular injury. After a cardiac catheterization identified Pulmonary Capillary Pressure of 20 mmHg, V wave of 37 mmHg with maximum gradient of 9 mmHg, a decision was made to perform mitral valve replacement surgery on 17 September 1974 with a 32-mm Braunwald-Cutter ball cage prosthesis. Two years later, the patient had a second pregnancy without complications. Since then, her follow-up was at our hospital treated with oral anticoagulation based on acenocumarol.

In 2011, she reported to the emergency department with dyspnea on moderate exercise. Echocardiographic findings reported

biatrial dilation, normal biventricular systolic function, normally functioning mechanical prostheses, maximum gradient of 14 mmHg, and a mean gradient of 4 mmHg. In addition, she presented a pulmonary artery systolic pressure of 40 mmHg, leading to severe tricuspid regurgitation, and permanent atrial fibrillation, which was treated with medical therapy with good outcome.

Later in 2013, the patient was diagnosed with hairy tubular polyp. She underwent total colectomy, right salpingo-oophorectomy and ileorectal anastomosis with ileostomy for protection. After the procedure, she had an adequate hospital course and was discharged home. In May 2015, a corrective ileostomy was performed.

As part of the preoperative surgical protocol, an echocardiogram performed in 2014 revealed biatrial dilation, no alterations in left ventricular segmental mobility, and normal biventricular systolic function, also, a mechanical prosthesis in mitral position was disclosed with maximum speed of 1.9 m/s, maximum gradient of 15 mmHg, mean gradient of 6 mmHg, severe tricuspid valve insufficiency, inferior vena cava measuring 15 mm with more than 50% collapse and pulmonary artery systolic pressure of 40 mmHg (Fig. 3).

Echocardiographic results from 2016 reveal a normal mechanical prosthesis with maximum speed of 1.8 m/s, maximum gradient of 13 mmHg, mean gradient of 6 mmHg, severe tricuspid valve insufficiency, inferior vena cava measuring 15 mm with more than 50% collapse (Fig. 4). Our patient remains in NYHA Class II, with a normal hepatic function even in the presence of tricuspid regurgitation; without evidence of hemolysis, ball deformation, and cerebral embolism or to any other organ. She is being treated with metoprolol 50 mg twice a day, furosemide 40 mg twice a day, spironolactone 25 mg once a day, cholecalciferol 600 IU once a day, and acenocumarol 12 mg per week as anticoagulant agent.

DISCUSSION

The Braunwald-Cutter prosthesis was removed from market in 1979. In 1977, around 1450 prophylactic valvular replacements were performed in patients with the device in the aortic position [6]. Multiple cases of early (3 months post-implant) pannus formation were reported, as well as cases of ball embolism and death. Therefore, it was recommended that surgical change be performed after 4.5–5 years of implant in prosthesis found in the aortic position [6, 7].

In 1974, Karp et al. reported a study following a cohort of 278 patients with as long as 15 months follow-up undergoing aortic valve replacement with the following prostheses: Barunwald-Cutter (BC), Starr-Edwards (SE) and homograft prosthesis (HP). The group found a higher incidence of thromboembolism in patients with BC (10.7%, average 6.8 months follow-up) and SE (9%, average 9.6 months follow-up). It is worth noting that no anticoagulation therapy for patients with the SE was used. In-hospital death for the three prostheses was reported as follows: 7/44 patients for the BC (15.9%); 5/72 patients for the SE (6.9%); 13/307 patients for the HP (4.2%). Meanwhile, the 12-year survival rate was 88% for BC, 83% for SE, 94% for HP [8].

Tandon et al. published a comparative analysis in 1978 for the following prostheses in the mitral position: Ionescu-Shiley pericardial xenograft ($n = 126$), Bjork-Shiley ($n = 42$) and Braunwald-Cutter ($n = 52$). The 7-year mean survival rates were reported as $89 \pm 9.3\%$, $81.9 \pm 12.8\%$ and $41.7 \pm 22.9\%$, respectively. An elective change of prosthesis was suggested because of the high risk of embolism and death, in contrast to values reported in other studies [9].



Figure 3: Right atrial enlargement and severe tricuspid regurgitation

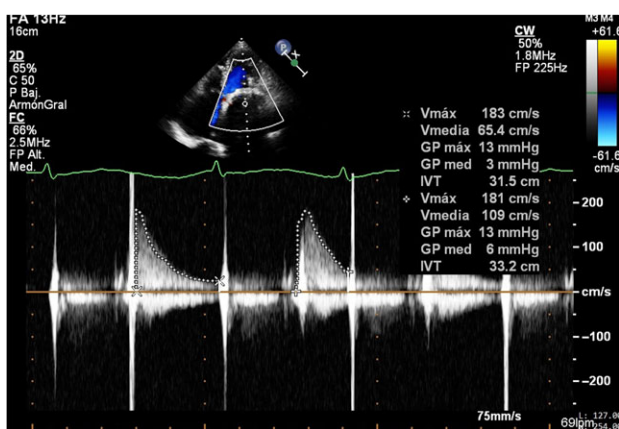


Figure 4: Normal mechanical prosthesis gradients with maximum speed of 1.8 m/s, maximum gradient of 13 mmHg, mean gradient of 6 mmHg.

A 1982 retrospective study with 234 patients that received 239 these prostheses in both mitral ($n = 130$) and aortic ($n = 109$) positions. The patients were followed an average of 44 (range: 1–92) and 52 (range: 2–96) months, respectively. For patients with prophylactic valvular change, early pannus formation was found in 9% (1/11 patients) for valves in the mitral position, and 93% (43/46 patients) for valves in the aortic position. For patients with the prosthesis in the mitral position, ball embolism was not reported, and a 71% survival rate was observed at 5 years. Reduction of the ball occurred in 4% of patients and 4 of them experienced ball embolism (all in aortic position). The incidence of endocarditis was reported in 5 and 4% in the mitral and aortic positions, respectively. For patients with multiple prostheses, endocarditis was reported as 4%. Monitoring of patients with prosthesis in the mitral position was satisfactory and no elective change was recommended [7].

A second report by Abdulali et al. in 1984 produced similar results in 80 patients with mean follow-up of 84.6 months (range: 72–120). Ball damage was reported as 29% (5/17 patients). No cases of ball embolism were reported [10]. Yakirevich reported early ball embolism after 8 years when the Braunwald-Cutter valve is found in the mitral position [11]. In the case of the Smeloff-Cutter prosthesis, the longest duration reported was 43.3 years. After that, ball deformation and pannus development was observed, which prevented adequate ball mobility. These were signs that the valve must be replaced [12]. There is

a case reported of the Starr-Edwards valve lasting 37 years that required prosthetic change due to endocarditis [13]. Another Italian report in 2008 described a patient in NYHA Class II with a functioning Starr-Edwards prosthesis after 39 years of implantation [14].

Here, we report the use of the 32-mm Braunwald-Cutter with the longest longevity that remains functional after 43 years of implantation. Upon literature review, we found a Braunwald-Cutter lasting 33 years in a patient who presented valvular dysfunction and paravalvular leak that had to undergo valve replacement. It has been suggested that the reason for the increased duration of prostheses in the mitral position in comparison to the aortic position is due to the decreased blood flow through the prosthesis in the mitral position, which promotes endothelialization of struts and minimizes ball deformation [15].

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CONFLICT OF INTEREST STATEMENT

None declared.

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ETHICAL APPROVAL

Aside from informed consent, ethical approval was not required for this case report.

CONSENT

Written informed consent was obtained directly from the patient for publication of this case report and any accompanying images.

GUARANTOR

S.C.V is the guarantor of this article.

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