

**Figure 2.** A: transesophageal echocardiography prior to adjustment of the Cardioband, showing massive tricuspid regurgitation. B: moderate tricuspid regurgitation after adjustment of the Cardioband.

the tricuspid annulus by cinching the wire inside the Cardioband, from 50 to 36 mm on echocardiography. After the annulus had been adjusted, 2 stenoses were observed in the middle segment of the right coronary artery, probably caused by the traction exerted, the long-term significance of which is unknown (figure 1C, D, videos 1 and 2 of the supplementary data). At the end of the procedure, the patient had moderate TR (figure 2, videos 3 and 4 of the supplementary data). She was discharged 2 days later having improved clinically and functionally (New York Heart Association functional class II); at 1-month postdischarge she had no signs of right heart failure.

There is little experience so far with this device, generally coming from the TRI-REPAIR registry,<sup>3</sup> which included 30 patients from 8 European centers and demonstrated the safety of the procedure at 6 months, as well as its efficacy in reducing TR and improving symptoms. In conclusion, the tricuspid Cardioband is a direct percutaneous annuloplasty device that offers an alternative to surgery in patients who are inoperable or high risk. Larger studies with longer follow-up are required to determine its long-term safety and efficacy.

#### Acknowledgements

The authors thank Dr Gonzalo L. Alonso Salinas for his thorough review and comments on the manuscript.

#### CONFLICTS OF INTEREST

Á. Sánchez-Recalde is the associate editor of *Revista Española de Cardiología*; the Journal's established editorial procedure was followed to ensure impartial handling of the manuscript.

#### APPENDIX. SUPPLEMENTARY DATA

Supplementary data associated with this article can be found in the online version available at <https://doi.org/10.1016/j.rec.2019.10.024>

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Available online 20 January 2020

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<https://doi.org/10.1016/j.rec.2019.10.024>  
1885–5857/

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#### Aortic regurgitation in continuous flow left ventricular assist devices for long-term use: a diagnostic and therapeutic challenge



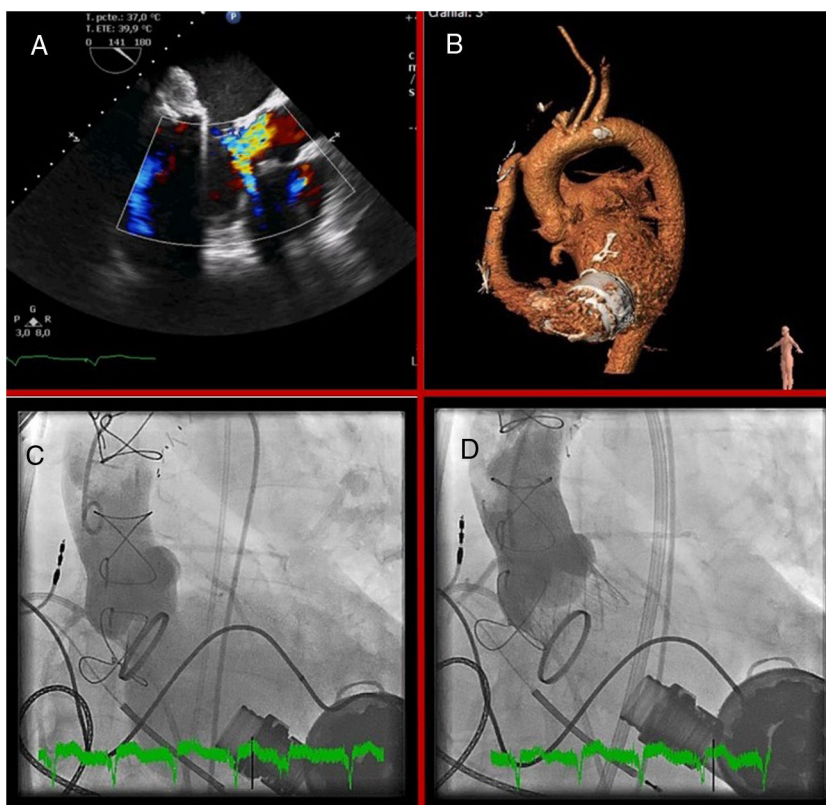
#### La insuficiencia aórtica en las asistencias ventriculares mecánicas de larga duración y flujo continuo: reto diagnóstico y terapéutico

#### To the Editor,

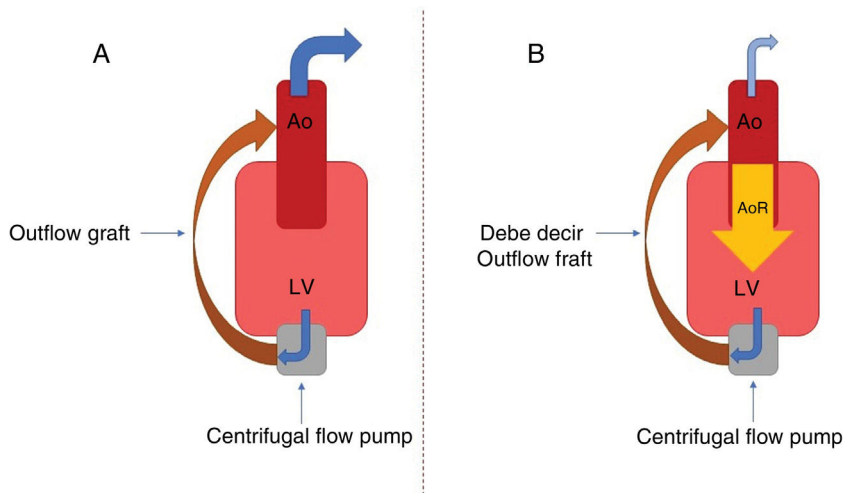
Aortic regurgitation (AR) of at least moderate severity is a frequent complication in patients with a long-term continuous flow left ventricular assist device (LVAD) (affecting 25%-30% of patients in the first year). However, its prevention and manage-

ment are sources of controversy, given the limited evidence available. In addition, its clinical presentation can be atypical and may delay the diagnosis of this potentially life-threatening complication.<sup>1</sup>

We present the case of a 72-year-old man with a mechanical mitral prosthesis after native valve endocarditis in 2003. The patient had an extensive anterior myocardial infarction due to a septic embolism that progressed to severe left ventricular dysfunction. Optimal treatment was implemented and he had good functional status until he progressively deteriorated about 2 years ago, developing dyspnea on minimal exertion and needing several hospitalizations that sometimes required the use of inotropic agents. Workup was begun to evaluate the possible use



**Figure 1.** A: aortic regurgitation on transesophageal echocardiography. B: tomographic reconstruction. C: aortography showing severe regurgitation. D: transcatheter aortic valve implantation.



**Figure 2.** A: normal functioning of the device. B: the inefficient cycle established by AR. Ao, aorta; AoR, aortic regurgitation; LV, left ventricle.

of advanced treatments. In September 2018, a HeartMate 3 long-term LVAD (Abbott; Santa Clara, California, United States) was implanted as destination therapy. Echocardiography showed absence of aortic valve opening and minimal AR.

About 5 months later, the patient was admitted due to deterioration in his overall condition. He had no dyspnea or any other clinical signs or symptoms of heart failure and was afebrile, hemodynamically stable, and without congestive signs. Mild cutaneous erythema at the exit site of the percutaneous LVAD lead was treated with empirical antibiotics. Preantibiotic culture results were negative. Blood tests revealed creatinine

1.66 mg/dL, slight transaminase elevation with total bilirubin 4.1 mg/dL, a normal complete blood count, and an INR of 4.8. Although hemolysis data were not obtained, blood cultures and serological tests for hepatotropic viruses were negative and abdominal ultrasound findings were unremarkable. After 48 hours, the patient exhibited a decreased and fluctuating level of consciousness and was tachypneic with signs of poor distal perfusion, even with 95% arterial blood oxygen saturation and without focal neurological deficits. Cranial computed tomography was unremarkable. Blood tests revealed compensated metabolic acidosis, with lactate 3.5 mmol/L, and further

deterioration in liver function tests. The relevant device parameters were 3200 rpm and flow 5 L/min but the mixed venous oxygen saturation was 47%, indicating insufficient cardiac output despite adequate flow.

Despite cardiogenic shock, transthoracic echocardiography revealed normal right ventricular function and severe AR, which was confirmed on transesophageal echocardiography (figure 1A); there were no signs of endocarditis. We decided to perform emergency transcatheter aortic valve implantation with an EVOLUT device (Medtronic; Minneapolis, Minnesota, United States) (figure 1B–D). The patient's subsequent clinical course and blood tests were favorable and he was discharged with good functional status, which continued until at least 6 months after the implantation.

The HeartMate 3 long-term LVAD is a continuous flow device that can be used as destination therapy. Experience with this type of LVAD is slight. Accordingly, early identification of complications can be a challenge.

Although technological advances have reduced device thrombosis and embolic events,<sup>2</sup> AR occurrence is still common. Its development is related to a fall in the percentage of valve opening (which favors commissure fusion and tissue remodeling) and the effects of the nonpulsatile flow on the aortic root, which is subjected to hemodynamic stress during the entire cardiac cycle. The end result is valve failure and the establishment of an inefficient cycle—LVAD-aorta-left ventricle-LVAD (figure 2)—with decreased peripheral perfusion and recurrent symptoms of heart failure. Various patient-dependent factors predispose its development: small body surface, female sex, and advanced age. Other factors are the age of the LVAD, a persistently closed valve, excessive left ventricular unloading, and the anastomosis angle from the outflow graft. No significant differences have been found among devices.<sup>1</sup>

Diagnosis can be complicated due to a sometimes atypical and deceptive clinical presentation. The acoustic window is usually limited and traditional echocardiographic parameters underestimate the severity of the regurgitation, given that the AR continues throughout the entire cardiac cycle, increasing the regurgitant volume. New parameters have been described for its quantification: the systolic-to-diastolic peak velocity ratio and the outflow cannula diastolic acceleration.<sup>3</sup>

The management of this complication is challenging because surgical risk can sometimes be prohibitive in these patients. Accordingly, percutaneous devices are becoming a therapeutic option, despite limited evidence. Both transcatheter aortic prostheses<sup>4</sup> and percutaneous occlusion devices<sup>5</sup> have been used. Both approaches achieve favorable short-term hemodynamic outcomes.

For this patient, transcatheter aortic valve implantation was chosen due to the experience of our center and the availability of the technique.

In conclusion, the atypical clinical presentation, early development of valve disease, and comorbidity of this patient are another example of the challenge posed by LVAD therapy and of the importance of a multidisciplinary approach.

## CONFLICTS OF INTEREST

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Available online 11 January 2020

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<https://doi.org/10.1016/j.rec.2019.10.022>  
1885-5857/

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### Gadolinium based contrast agent-free cardiac magnetic resonance imaging for the assessment of heart anatomy. A feasibility study



### Imágenes de resonancia magnética cardíaca sin contraste basadas en gadolinio para la evaluación de la anatomía del corazón: un estudio de viabilidad

#### To the Editor,

Cardiac magnetic resonance imaging (MRI) is an established diagnostic tool in medicine. To improve image quality, gadolinium-based chemicals are commonly used. Since gadolinium-based

contrast agents (GBCA) are primarily excreted by the kidney, patients with decreased kidney function showed an increased risk of GBCA retention leading to a potential risk of nephrogenic systemic fibrosis. In the last few years, magnetic resonance signal hyperintensity due to gadolinium retention was observed in the central nervous system in patients having received multiple GBCA doses over time even in patients with normal renal function.<sup>1</sup> This resulted in warnings by the US Food and Drug Administration, Japan's medical device agency, and the European Medicines Agency. In cardiology, imaging also plays an important role in the rapidly growing area of catheter ablation for atrial fibrillation (AF). The aim of the current study was to evaluate the feasibility