test cost:benefit ratio with very valid concerns about lifetime radiation exposure.

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A new twist to HeartMate 3 low flow alarms

Un nuevo giro en un caso de alarmas por bajo flujo en una asistencia HeartMate 3

To the Editor,

We read with interest the scientific letter by Couto Mallón et al.[1] reporting a case of early outflow graft stenosis in a HeartWare (Medtronic, United States) left ventricular assist device (LVAD) diagnosed mainly because of an increase in hemolysis parameters and resolved with a percutaneous intervention with stenting.

We would like mention that the clinical presentation and management of an outflow graft obstruction may vary according to the etiology and type of LVAD. To illustrate the latter, we present the case of a 51-year-old woman with a prior history of hypertension, obesity, chronic obstructive pulmonary disease, and end-stage chronic heart failure due to ischemic cardiomyopathy admitted for cardiogenic shock. A HeartMate 3 LVAD (Abbott, United States) was implanted and the patient had an uneventful postoperative course.

Two years later, she was admitted for new-onset low flow alarms. Her blood pressure was well controlled and laboratory tests were unremarkable with no signs of hemolysis. Transthoracic echocardiography showed severe left ventricular dilatation and severely decreased left ventricular ejection fraction. The aortic and mitral valves could not be assessed due to poor visualization. Hypovolemia was initially suspected, so diuretics were discontinued, and intravenous fluids were administered. A few days later, the patient was readmitted for persistence of low flow alarms, and now overt signs of congestive heart failure with shortness of breath were present. A right heart catheterization was performed. With a baseline speed of 5600 rpm, the right atrial pressure was 13 mmHg, the pulmonary artery pressure was 45/27 mmHg with a mean of 33 mmHg, and the pulmonary capillary wedge pressure was 27 mmHg. Cardiac index was 2.18 lpm/m^2. Despite a progressive increase of speed to 6800 rpm, the pump was unable to unload the left ventricle and the pulmonary capillary wedge pressure remained at 26 mmHg. An outflow graft obstruction was suspected, and a chest computed tomography with 3-dimensional reconstruction was performed (figure 1A) and was suggestive of an outflow graft twist. The twist was confirmed by angiography with catheterization of the outflow graft from the ascending aorta (figure 1B and video 1 of the supplementary data). Surgical untwisting of the outflow graft in a clockwise direction was done without complications and a clip was placed to avoid a recurrence (figure 2). Pump flow immediately increased from 2.6 lpm to 5.2 lpm with a rapid improvement in hemodynamics. Intraoperative transesophageal echocardiography also showed a reduction in left ventricular size and mitral regurgitation. The aortic valve, which had opened with every beat, now remained closed (video 2 of the supplementary data).

Twisting of the outflow graft is a late complication appearing in 1.6% of patients supported with early iterations of the HeartMate 3 with a median time of 500 days after implantation.[2] The mechanism behind the twist is a swivel joint connecting the pump with the outflow graft, designed to allow rotation during implantation to ensure a correct placement of the graft. However, it is believed that, in some cases, cardiothoracic movements are transmitted to the pump causing an insidious rotation of the graft leading to a complete twist with significant outflow graft obstruction, which can manifest as persistent low flow alarms. In addition, thrombosis can occur as a result of the twist and lead to a rise in lactate dehydrogenase levels. Of importance, although thrombosis must always be in the differential diagnosis of pump malfunction, this complication is less common in HeartMate 3 than in other types of LVAD. In fact, in the MOMENTUM trial, thrombosis was suspected in 7 of the 515 implants and was confirmed in only

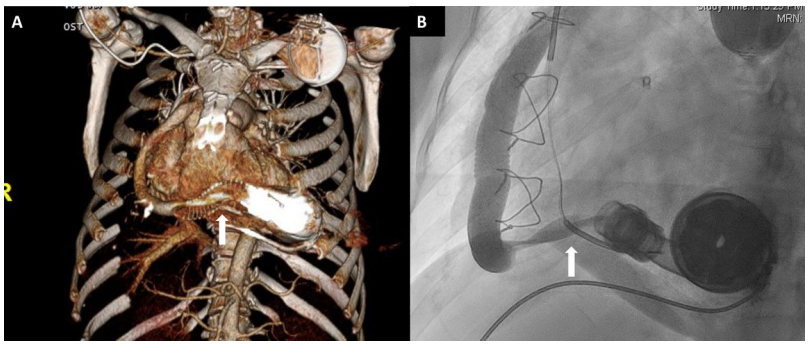

Figure 1. A: chest computed tomography scan with 3-dimensional reconstruction suggesting a twist of the outflow graft (arrow). B: angiogram of the outflow graft confirming a twist in the last portion near the connection with the pump (arrow).

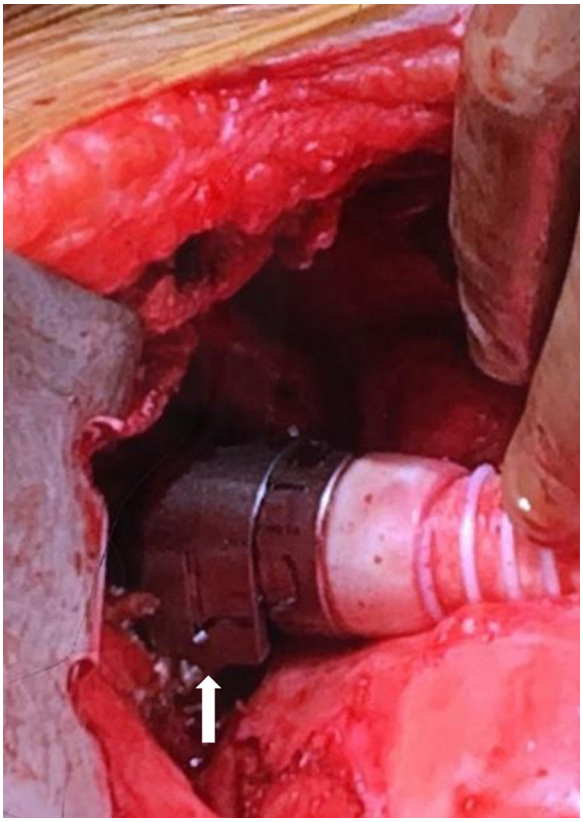

Figure 2. Clip placed (arrow) during the surgery to secure the swivel joint and prevent recurrences.

2 of them.[3] After a careful clinical assessment including laboratory tests, echocardiography and sometimes an invasive hemodynamic ramp test, when pump malfunction is suspected chest computed tomography is recommended to assess the integrity of the outflow graft.[2] Once the twist is diagnosed, the preferred treatment is surgery with manual untwisting of the graft followed by a clip placement to avoid rotation of the swivel joint. Minimally invasive surgical techniques have been also described[4] but due to the nature of the obstruction, it is uncertain if percutaneous approaches can be successful. A clip to secure the swivel joint has been available since the end of 2018 and should be placed during implantation to prevent this complication.[5]

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CONFLICTS OF INTEREST

D.J. Goldstein is an educator and surgical proctor for Abbott and National PI for the MOMENTUM 3 trial. U.P. Jorde is a consultant for Abbott.

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.2020.09.008

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TRICENTO transcatheter heart valve for severe tricuspid regurgitation. Initial experience and mid-term follow-up

Tratamiento percutáneo de la insuficiencia tricuspídea grave con dispositivo TRICENTO. Experiencia inicial y seguimiento a medio plazo

To the Editor,

In the last few years, the increasing clinical importance of functional tricuspid regurgitation (TR) has contributed to the growing interest in the early diagnosis and treatment of this disease, which has historically been neglected. TR has a high prevalence and is associated with adverse prognosis, since the presence of moderate or severe TR is associated with increased morbidity and mortality *per se*. Nevertheless, isolated TR surgery continues to have high operative morbidity and mortality and prolonged hospitalizations, and a recent propensity-score matching study demonstrated that surgery was not associated with improved long-term survival compared with medical therapy alone.[1] In this context, the initial experiences of transcatheter techniques for the treatment of TR have demonstrated feasibility and safety, with promising hemodynamic and clinical results.

TRICENTO transcatheter heart valve (TTHV) (NVT AG, Muri, Switzerland) aims to abolish the systolic backflow in the superior and inferior caval veins, although it does not directly act upon the TR. TTHV is composed of a covered nitinol stent with a lateral bicuspid valve component made of porcine pericardium. Since the first-in-man implantation in 2018,[2] there have only been reports of very limited initial single-center experiences with short-term follow-up results.[3,4]

A total of 6 consecutive patients underwent TTHV implantation at 4 participating centers in Spain between November 2018 and August 2019. The baseline and procedural characteristics are displayed in table 1. All patients had congestive heart failure (HF) and New York Heart Association (NYHA) class III-IV in relation to severe functional TR despite optimal medical treatment. All patients showed dilatation of the inferior vena cava and holosystolic backflow in the hepatic veins. Heart Team discussion deemed them inappropriate candidates for open heart surgery. Baseline transthoracic echocardiogram, right heart catheterization, and multislice computed tomography (MSCT) were performed in all patients. Patients with tricuspid annular plane systolic excursion (TAPSE) $\leq$ 13 mmHg, left ventricular ejection fraction $\leq$ 30%, systolic pulmonary artery pressure $>$ 70 mmHg or unfavorable anatomy by MSCT were excluded according to manufacturer recommendations. The study was conducted in accordance with the principles of the Declaration of Helsinki.

TTHV procedures were performed under general anesthesia (n = 5) or conscious sedation (n = 1) with intraprocedural imaging guidance using transoesophageal echocardiography and fluoroscopy. Three-dimensional MSCT-fluoroscopy fusion imaging was successfully used in 2 patients (figure 1). Baseline right ventriculography was performed and a deflectable catheter marked the junction of the inferior vena cava and right atrium (RA). The TTHV delivery system (24-Fr) was advanced from the right femoral vein. Device implantation was performed by gradual and controlled top-down deployment after the distal radiopaque marker was aligned to achieve correct

Table 1
Clinical, echocardiographic and procedural characteristics of patients undergoing TTHV implantation.

Variables	Baseline	Follow-up	*P*
Baseline characteristics			
Age, y	73.5 (62.5-81.8)		
Female	5 (83.3)		
Body mass index, kg/m²	24.9 (22.2-34.3)		
Congestive heart failure	6 (100)		
Heart failure-related hospitalization	2 (33.3)		
Hypertension	3 (50)		
Diabetes	1 (16.7)		
Dyslipidemia	3 (50)		
Atrial fibrillation	5 (83.3)		
Permanent pacemaker	0		
Ischemic heart disease	1 (16,7)		
Cardiac surgical procedures	5 (83.3)		
Aortic valve replacement	2 (33.3)		
Mitral valve replacement	2 (33.3)		