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Minimally invasive hybrid technique for left ventricular aneurysm repair surgery due to ischemic cardiomyopathy

Técnica híbrida mínimamente invasiva para reconstrucción de aneurisma ventricular izquierdo por miocardiopatía isquémica

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To the Editor,

Chronic heart failure (CHF) is the third leading cause of cardiovascular death in developed countries, and is mostly of ischemic etiology.[1]

Despite the optimal medical therapy based on the clinical practice guidelines, many patients remain symptomatic for whom different procedures have become available over the last few years to stop pathological ventricular remodeling.

The Revivent system (BioVentrix Inc., United States) is a hybrid ventricular reconstruction procedure that works by implanting micro-anchors via endovascular access and left mini thoracotomy to create a longitudinal plication of scar tissue without the need for mid sternotomy or extracorporeal circulation. Basically it is indicated in patients with ischemic heart disease and anterolateral or apical aneurysmal regions with transmural scar in both the left ventricle (LV) and right septum (RS)—according to the magnetic resonance imaging—to prevent muscle tears, and who still have persistent advanced CHF and NYHA functional class (FC) > III despite the optimal medical therapy.[2] Biffi et al. confirmed an in-hospital mortality rate of 1.4%, and a 1-year survival rate of 90% in 203 patients.[3] The STICH[4] and RESTORE[5] clinical trials revealed in-hospital mortality rates of 6% and 5.1%, respectively, and 18-month survival rates of 85% and 88%, respectively, after surgical therapy in patients with a similar profile.

The objective of this letter is to report on the clinical characteristics of the procedure and the 90-day results of the first 2 patients treated at our center. Both gave their informed consent prior to publishing their cases.

Patient no. 1 is a 67-year-old man without cardiovascular risk factors admitted with signs of anterolateral infarction with ST-segment elevation due to thrombotic occlusion in the left anterior descending coronary artery. Plain old balloon angioplasty was performed followed by dual drug-eluting stent implantation on a second stage. The patient was classified as NYHA FC II, and was on daily furosemide 180 mg, and eplerenone 50 mg. The echocardiogram revealed the presence of a dilated LV, a left ventricular ejection fraction (FEVI) of 12%, a large apical aneurysm, and severe pulmonary hypertension. The 60-day magnetic resonance imaging revealed the presence of akinesis in the anteroseptal, anterolateral, and apical segments without viability data (figure 1A). The pre-transplantation study performed anticipated unfavorable prognostic outcomes, which is why the Revivent therapy was proposed 6 months after the infarction.

The procedure was transesophageal echocardiography (TEE) and fluoroscopy guided. The LV apex and anterolateral side were accessed via left mini thoracotomy. A 14-Fr introducer sheath was implanted via right jugular vein to advance a Swan-Ganz catheter. Afterwards, the EnSnare device with 3 interlaced loops (EnSnare Merit Medical Systems Inc., United States) was inserted until the RV. A transseptal guidewire was inserted from the LV through fluoroscopy and TEE guidance that was captured using the snare in the RV and then removed via jugular vein. This circuit is used to implant the first endocavitary anchor that, once cinched, allows the partial obliteration of the aneurysm. Ventricular reduction was completed by implanting 4 pairs of additional extracardiac anchors. The proper reduction and plication was confirmed via fluoroscopy and TEE (figure 1B,F).

After an immediate postoperative without complications the patient was discharged from the hospital on day 13 after the procedure and classified as NYHA FC I-II. After 3 months he was classified as NYHA FC I, which reduced the need for furosemide down to 20 mg/day. The control computed tomography (CT) scan is shown on figure 1G.

Patient no. 2 is a 50-year-old man with a past medical history of peripheral arterial vasculopathy and dilated cardiomyopathy of ischemic origin. He presented with residual LVEF after the infarction of 15% with a LV anterolateral aneurysm. The patient was classified as NYHA FC III and was on daily furosemide 180 mg, eplerenone 50 mg, and chlorthalidone 25 mg.

The procedure was performed in a similar way compared to the former case. No significant complications were reported, and the patient was discharged on day 20 of the postoperative period and classified as NYHA FC II that improved at 3 months (I-II), which

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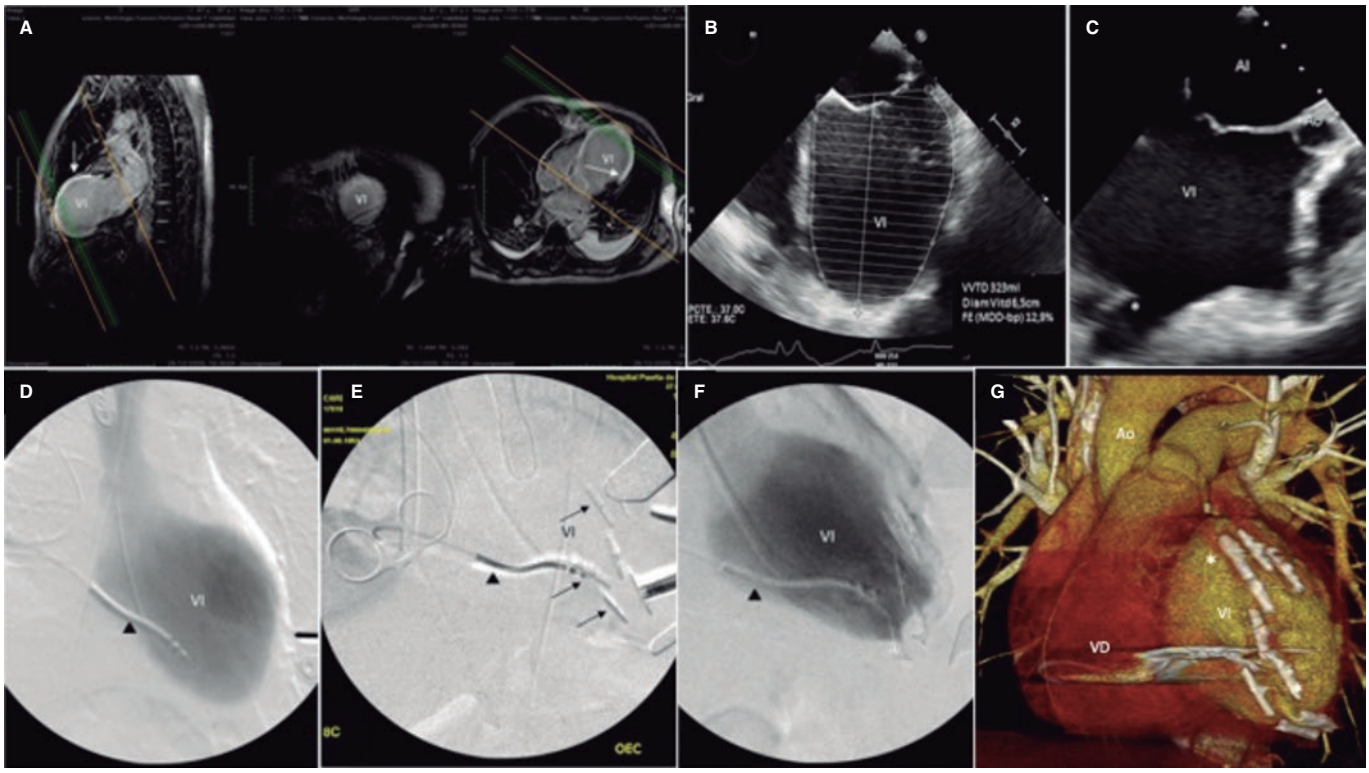

Figure 1. **A:** preoperative magnetic resonance imaging. Two-chamber long axis view, and 3-chamber long axis view, ischemic scar (arrows). **B:** preoperative transesophageal echocardiography (TEE), 4-chamber view, LV end-diastolic volume. **C:** intraoperative TEE, 3-chamber view, remodeled LV chamber, first anchor. **D:** intraoperative fluoroscopy, ventriculography, implantable cardioverter-defibrillator leads (arrowhead). **E:** reconstruction anchors (arrows). **F:** ventriculography final outcomes. 3D CT scan reconstruction. **G:** Final outcomes (asterisks). Ao, aorta; LA, left atrium; LV, left ventricle; RV, right ventricle.

Table 1. Volumes, ventricular diameters, and left ventricular ejection fraction before and after implantation

	Patient no. 1			Patient no. 2		
	Before implantation	After implantation	Third month	Before implantation	After implantation	Third month
LVEDV (mL)	285	224	200	178	131	73
LVESV (mL)	227	161	139	150	108	54
LVEDD (mm)	70	63	65	68	53	50
LVEF (%)	12	28	28	15	20	26

LVEDD, left ventricular end-diastolic diameter; LVEDV, left ventricular end-diastolic volume; LVEF, left ventricular ejection fraction; LVESV, left ventricular end-systolic volume.

is why the dose of furosemide was reduced to 120 mg/day. In both cases ventricular parameters improved (table 1).

These 2 patients are the first cases ever reported in the medical literature treated with the Revivent system in Spain. Cardiac surgeons and interventional cardiologists alike participated in the procedure. Although an initial learning curve is required, no complications were reported, and both the functional class, and the volumes improved. The 2 patients had long hospital stays, which were attributed to the management of hydroelectrolytic balance in patients with severe CHF. Since control echocardiograms were performed 3 months after surgery, it is anticipated that left ventricular end-diastolic volume (LVEDV) will be reduced even further.[6]

Randomized clinical trials are needed with a large number of patients to determine whether the Revivent system is an effective, safe, and long-lasting therapeutic option in patients with post-ischemic severe ventricular dilatation and dysfunction.

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AUTHORS' CONTRIBUTIONS

J. E. De Villarreal: drafted the manuscript, processed, and edited the images, 1st, 2nd, and 3rd reviews; M. del Trigo: edited the manuscript 2nd review; C. Esteban Martín: edited the manuscript 1st review; J. Goicolea Ruigómez: edited the manuscript 2nd review; S. Mingo: collaborated to acquire the images and the

echocardiography volumes; A. Forteza Gil: edited the manuscript 1st and 3rd reviews.

CONFLICTS OF INTEREST

None reported.

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Micra leadless pacemaker and transcatheter aortic valve implantation at the same procedure

Implante de marcapasos sin cables Micra y prótesis aórtica transcatéter en un mismo procedimiento

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To the Editor,

Transcatheter aortic valve implantation (TAVI) is a common therapeutic option in patients with degenerative severe aortic stenosis. In our setting, the need for definitive pacemaker implantation after TAVI is around 14%,[1] which is an additional cause for morbidity and longer length of stay. In elderly patients both aspects can be especially relevant. Micra leadless pacemaker (Medtronic, United States) is a recent alternative to traditional endocavitary pacemakers. The lack of electrodes or need for subcutaneous bag to carry the generator added to femoral venous access implantation reduce some of the complications associated with conventional pacemakers (especially pneumothorax, hematoma, bag and electrode-related infections). Although initially available for VVI pacing mode only, the new Micra AV (Medtronic, United States) has appeared recently. It maintains atrioventricular synchrony in patients in sinus rhythm by detecting atrial mechanical contraction and the corresponding ventricular pacing.

After over 120 Micra implantations including an early favorable experience after TAVI,[2] and widening the indication to patients in sinus rhythm too, we thought of the possibility of implanting both devices at the same procedure. In this work we present the very first series of patients who, after TAVI, were implanted with the Micra leadless pacemaker as permanent pacing therapy at the same procedure. Patients gave their informed consent to analyze and publish the results.

A total of 3 patients treated with TAVI due to symptomatic severe aortic stenosis developed an advanced atrioventricular conduction disorder during the procedure. Table 1 shows the characteristics of patients and procedures. Once the hemostasis of the femoral arterial access used for valve implantation was achieved, the Micra leadless pacemaker via femoral venous access was implanted (figure 1). The procedure went on for an average 28 minutes (19 to 36 min interval), and it was completed successfully in all 3 patients.

Although limited to very short series, the experience with leadless pacemakers in patients treated with TAVI is satisfactory.[2-4] Retrospectively, shorter length of stay, less tricuspid regurgitation, and lack of complications like pneumothorax, bleeding or bag-related infections have been reported compared to conventional pacemaker implantation.[3,4]

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