In conclusion, in our series of patients with severe TR who underwent surgery, short- and long-term clinical outcomes bore little relation to the suboptimal findings of our previous series. Left ventricular ejection fraction < 45% was identified as a predictor of perioperative mortality, while duration of extracorporeal circulation was a predictor of long-term mortality.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found in the online version available at https://doi.org/10.1016/j.rec.2017.12.017

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Cardiac Sympathetic Innervation and Appropriate Therapies in Patients With an Implantable Cardioverter-defibrillator in Primary Prevention

Inervación simpática cardiaca y terapias apropiadas en pacientes portadores de desfibrilador automático implantado en prevención primaria

To the Editor,

Determination of cardiac sympathetic innervation status, using ^{123}I-metaiodobenzylguanidina (^{123}I-MIBG) scintigraphy, could improve risk stratification for ventricular arrhythmias in patients with heart failure and reduced left ventricular ejection fraction (LVEF).[1] Myocardial washout (WO) reflects the degree of sympathetic activity: a high value reflects hyperactivity and excess noradrenaline release.[2] The late (4 hour) heart-to-mediastinum (H/M) ratio reflects the status of the synaptic terminals: a low value indicates sympathetic denervation and reduced noradrenaline reuptake.[2]

We studied 36 patients with symptomatic heart failure (New York Heart Association functional class II), LVEF < 35% and optimized treatment, who had an implantable cardioverter-defibrillator (ICD) in primary prevention (median = 4.7 [interquartile range, 2.0-5.9] years since implantation): 18 patients had at least 1 appropriate therapy and 18 had no therapies. To avoid bias, we excluded patients with decompensated heart failure, infarction, or coronary revascularization in the past year, those aged < 18 or > 70 years, with severe pulmonary disease, creatinine > 2 mg/dL, diabetes mellitus with organ damage, or on treatment with alpha-blockers. The study was approved by the local Ethics Committee, and written informed consent was obtained. Patients received an intravenous injection of 10 mCi (370 MBq) of ^{23}I-MIBG (AdreView, GE Healthcare) and planar images were acquired of the anterior thorax at 15 minutes and at 4 hours. Quantification of the early and late H/M ratio and WO was performed blinded. After scintigraphy (median, 4.2 [3.2-5.0] years), 1 patient from the no-therapy group died prematurely from sepsis and 2 received therapies, therefore the final sample was 15 with no therapy and 20 with therapy: 75% received shocks and 25% received antitachycardia pacing only. The final follow-up was a median of 9.1 [6.3-10.2] years after ICD implantation.

The values for early H/M ratio, late H/M ratio, and WO were 1.45 ± 0.17, 1.37 ± 0.18, and 32% ± 26%, respectively. The late H/M ratio was lower in patients with a previous infarct (1.32 ± 0.16 vs 1.5 ± 0.16; P = .005) and was correlated with LVEF (r = 0.4; P = .016); there were no other correlations between parameters and patient characteristics. When we compared patients with therapy vs patients without (Table 1), the late H/M ratio was lower (1.32 ± 0.17 vs 1.45 ± 0.18; P = .039) and the WO was higher (40.2 ± 29 vs 21.2 ± 16.6; P = .021) in the group with therapy (Figure 1), while the early H/M ratio was similar (1.43 ± 0.15 vs 1.47 ± 0.20; P = .5). When we looked only at shock therapy, the late H/M ratio lost significance (1.31 ± 0.14 vs 1.43 ± 0.20; P = .068) and the WO increased (45 ± 29 vs 17 ± 21; P = .007). ROC curve analysis showed an area under the curve of 0.70 (95% confidence interval [95%CI], 0.52-0.84; P = .021) for late H/M ratio and 0.68 (95%CI, 0.5-0.83; P = .043) for WO. The optimal cutoff point was ≤ 1.3 for late H/M ratio (55% sensitivity, 80% specificity) and > 54% for WO (45% sensitivity, 100% specificity). On analysis of the combined variable (late H/M ratio ≤ 1.3 and/or WO > 54%), 100% of patients with abnormalities in both parameters received therapy (n = 7), as did 67% of those with just 1 abnormality (n = 9), and 37% (n = 19) of those with no abnormalities (P = .004) (Figure 1). After scintigraphy (n = 12), these rates were 100%, 44%, and 10%, respectively (P = .007). The ordinal combined variable maintained significance after adjusting for LVEF, infarction, age, N-terminal pro-brain natriuretic peptide, QRS, and end-diastolic volume (OR = 12.55; 95%CI, 1.51-104.26; P = .019).

In a meta-analysis of 18 studies (1755 patients), a low late H/M ratio or a high WO were shown to be independently associated with increased risk of adverse cardiac events.[3] The AdreView Myocardial Imaging for Risk Evaluation in Heart Failure (ADMIRE-HF) study (symptomatic heart failure with LVEF < 35%) found that a late H/M ratio < 1.2 was associated with ventricular arrhythmias.[1] In patients with an ICD, a lower late H/M ratio was associated with appropriate therapy,[4] as was higher WO in a study of 25 patients.[5] In comparison with previous studies, ours had a longer follow-up (median 9.1 years after ICD implantation),

Table
Characteristics of Patients With and Without Appropriate ICD Therapy

	Appropriate therapy		*P*
	Yes (n = 20)	No (n = 15)	
Age, y	64 ± 9	64 ± 8	.803
Male	19 (95)	14 (93%)	.839
Weight, kg	91 ± 14	91 ± 24	.989
Height, cm	171 ± 11	164 ± 24	.274
Systolic blood pressure, mmHg	118 ± 15	123 ± 17	.367
Diastolic blood pressure, mmHg	66 ± 7.4	68 ± 8	.774
Heart rate, bpm	68 ± 11.2	67 ± 8	.753
Atrial fibrillation	3 (15)	2 (13%)	.153
QRS, ms	158 ± 31	131 ± 29	.018
Previous infarct	13 (65)	11 (73%)	.612
Diabetes mellitus	10 (50)	8 (53%)	.692
Renal failure	10 (50)	6 (40%)	.570
Cardiac resynchronization therapy	9 (45)	6 (40%)	.775
Left ventricular ejection fraction, %	29 ± 6	31 ± 9	.544
End-diastolic left ventricular volume, mL	224 ± 97	166 ± 76	.043
Left atrial volume, mL/m^2	48 ± 19	41 ± 21	.322
Creatinine, mg/dL	1.27 ± 0.33	1.21 ± 0.32	.610
Urea, mg/dL	57.2 ± 21	54.4 ± 15.5	.680
Calcium, mg/dL	9.3 ± 0.46	9.5 ± 0.5	.175
Total bilirubin, mg/dL	0.74 ± 0.42	0.72 ± 0.37	.918
Total cholesterol, mg/dL	155 ± 26	155.9 ± 47.5	.985
GGT, U/L	48 ± 53	54 ± 54	.760
Sodium, mEq/L	138 ± 3	140 ± 3	.146
NT-proBNP, pg/mL	789 [629-1553]	665 [315-1239]	.020
Troponin T, pg/mL	10 (5-19)	16 (10-23)	.752
Magnesium, mg/dL	2.0 ± 0.25	2.0 ± 0.39	.332
Thyrotropin, μIU/mL	1.7 ± 0.8	1.9 ± 0.84	.590
Hemoglobin, g/dL	14 ± 1.8	14 ± 1.1	.711
ACEI/ARB-II	20 (100)	15 (100)	1
Beta-blockers	30 (100)	15 (100)	1
Digoxin	4 (20)	3 (20)	1
Diuretics	20 (100)	15 (100)	1
Aldosterone blockers	16 (80)	13 (87)	.600

ACEI, angiotensin-converting enzyme inhibitor; ARB-II, angiotensin II receptor blocker; GGT, gamma glutamyl transferase; NT-proBNP: N-terminal pro-brain natriuretic peptide.
Data are expressed as No. (%), mean ± standard deviation, or median [interquartile range].

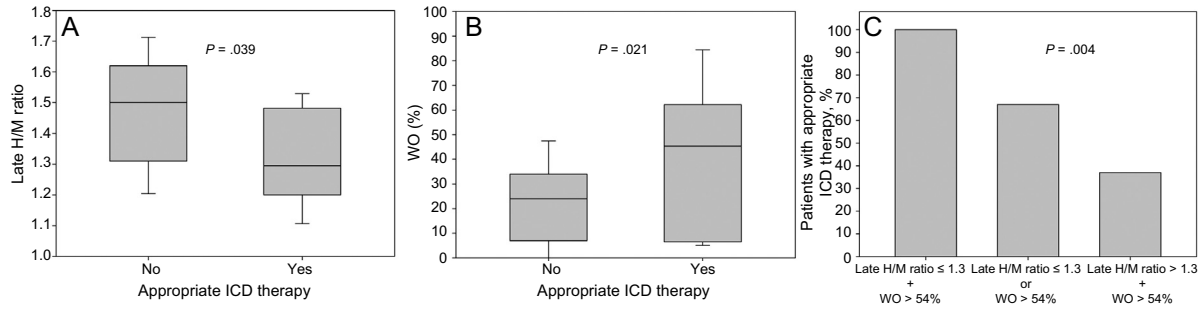

Figure. Late heart/mediastinum ratio (A) and WO in patients with and without therapy (B); appropriate therapy according to late H/M ratio values ≤ 1.3 and WO > 54% (C). ICD, implantable cardioverter-defibrillator; H/M ratio, heart/mediastinum ratio; WO, myocardial washout.

whereas in others follow-up has been < 3 years.[1,4,5] In addition, this study included patients with ICD in primary prevention, and only the study by Boogers et al.[4] included a majority (103 or 116) with ICD in primary prevention. Our study also shows that both parameters, late H/M ratio and WO, provide complementary information and that their combination could be the best approximation to identify the probability of receiving therapy (100% of patients with abnormalities of both variables received therapy, even after scintigraphy), a point not identified in other studies.

Our study has some limitations, for example, the findings cannot be extrapolated to the time of implantation, given that scintigraphy was done later and at a variable time. The small sample means that the findings must be interpreted in the context of other studies, in particular the ADMIRE-ICD trial (NCT02656329), which will assess the value of the late H/M ratio in the indication for ICD in primary prevention with LVEF 30-35%.

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CONFLICTS OF INTEREST

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Extracorporeal Membrane Oxygenation in Patients With Electrical Storm: A Single-center Experience

Utilización del oxigenador extracorpóreo de membrana en pacientes con tormenta eléctrica: experiencia de un centro terciario

To the Editor,

Electrical storm is a life-threatening medical emergency, characterized by 3 or more episodes of ventricular tachycardia (VT) within 24 hours that are only resolved by cardioversion or defibrillation. The most effective treatment for this condition is catheter ablation, particularly in patients with myocardial scarring.[1,2] However, hemodynamic instability in this clinical state leads to a higher risk of procedure-related complications and mortality. In the last few years, several studies have reported ablation procedures performed with venoarterial extracorporeal membrane oxygenation (VA-ECMO) for circulatory support.[3,4] This device provides hemodynamic stability and adequate organ perfusion during the procedure. In Spain, there is growing interest in the use of VA-ECMO in various clinical situations, but it is rarely applied and the published evidence to date is limited to case series.[5]

This study reports a retrospective analysis of patients undergoing VA-ECMO implantation in our center due to refractory electrical storm. All patients received antiarrhythmic and vasoactive drugs, deep sedation, intubation, and intra-aortic balloon pump (IABP) counterpulsation support. The interventional cardiologist performed femoro-femoral cannulation in the cardiac catheterization laboratory.

Between November 2014 and February 2017, 7 VA-ECMO were implanted in patients with electrical storm. All were men (mean age, 61.4 ± 9 years; left ventricular ejection fraction, 17.1% ± 9.9%). Baseline characteristics are summarized in the Table. The etiology of the condition was ischemic heart disease in 6 patients: 4 following an acute coronary syndrome and 2 with chronic ischemic heart disease. The patients received a median of 5 shocks (range, 3-23) before ablation. The median time interval from support implantation to ablation was 2 [interquartile range, 1-4] days.

Following VA-ECMO implantation, the VT episodes remitted in 1 patient, enabling removal of the system. Electrophysiology study with ablation was carried out in 5 patients, but not in the remaining patient because of severe sepsis of respiratory origin and a state of irreversible shock.

Unfractionated heparin (aPTT, 2.5-3) was used during the procedure. A trans-septal approach was performed in 3 patients and a retroaortic approach with temporary withdrawal of IABP in the remaining 2 patients. In 4 of the 5 patients, electroanatomical reconstruction in sinus rhythm was performed with the CARTO-3 system; in the last case (Patient 4) cartography and ablation were performed in VT rhythm, facilitated by VA-ECMO hemodynamic support. The arrhythmic substrate was treated using an endocardial approach guided by the voltage map and late potentials in all patients (Patient 2 in Table 1 required a mixed endocardial-epicardial approach). With the exception of 1 case of extreme electrical instability (Patient 3), pace mapping was also carried out, with a perfect pace-map match (12/12 leads). Following ablation, clinical VT was not induced with up to 3 extra stimuli in 3 patients; nor were other VT induced. The induction protocol was not performed in Patient 3, but development of clinical VT was not