duration (90–100 ms). Furthermore, at longer R–R intervals, beats always had LAFB morphology. Two areas can be clearly differentiated in Figure 1C, which compares the morphology of the QRS with the cycle length and the previous QRS complex.[3] In zone 1 (R–R, 400–530 ms), the QRS morphology depends on the previous beat, (ie, if the previous beat is narrow, the following beat will have LAFB morphology). The only exceptions to this rule are beats 32–33, which could be explained by the penetration of the impulse in the supernormal conduction phase of the anterior fascicle.[3,4] However, in zone 2 (R–R >600 ms), the QRS complex always has LAFB morphology independently of the morphology of the previous beat, which is suggestive of bradycardia-dependent block. The curious aspect of this case is that, in contrast to what would be expected in this type of block, after a much longer R-R interval(>1500 ms), the QRS becomes normal.

Figure 2 shows the proposed mechanism for these findings. With short R–R intervals (zone 1), an anterograde and retrograde block occurs in the anterior fascicle, which makes the following impulse able to conduct anterogradely since it has time to repolarize. In this way, the small variations in narrow QRS complexes could be explained by their occurring at different moments in their relative refractory period, with a higher or lower degree of latency (eg, beats 3 and 7, or 13 and 15). With very long cycle lengths, tissue recovery and permanent anterograde conduction take place. Cohen et al[5] described this phenomenon at the end of the 1970s and called it pseudobradycardia-dependent branch block alternans (ie, a phase 3 block). For this to occur, the retrograde effective refractory period of the anterior fascicle should be less than the anterograde effective refractory period and thus favor hidden retrograde conduction.[4]

We were able to confirm this mechanism (Figure 2B) because our patient had been implanted with a DDD pacemaker. Alternating LAFB was produced by AAI pacing at 100 bpm, at 70 bpm all beats were conducted with LAFB morphology, and at 60 bpm all beats were narrow, which confirmed tachycardia-dependent block.

SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found in the online version available at doi:10.1016/j.rec.2016.04.036.

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Available online 4 July 2016

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http://dx.doi.org/10.1016/j.rec.2016.04.036

Clinical Profile of Arrhythmogenic Right Ventricular Cardiomyopathy With Left Ventricular Involvement

Perfil clínico de la miocardiopatía arritmogénica del ventrículo derecho con afección asociada del izquierdo

To the Editor,

The clinical profile of arrhythmogenic cardiomyopathy (ACM) with left ventricular (LV) involvement appears to be distinct from ACM isolated to the right ventricle (RV)[1,2], with a higher incidence of ventricular arrhythmias and sudden cardiac death (SCD) shown in some studies.[3] However, in Spain, there are few published series correlating LV involvement with an increased risk of arrhythmia and SCD.

Our aim was to analyze the differentiating clinical and morphological characteristics of biventricular ACM compared with ACM isolated to the RV in our series. This was a cross-sectional study that included 30 patients with ACM from 20 families; 17 were probands (56.7%) and 13 were relatives. All met the Task Force criteria for ACM. Participants were divided into 2 groups according to whether they had involvement of the RV alone or biventricular involvement (the LV was considered involved when the ejection fraction on echocardiography was < 50%).

Data were collected on age and sex, as well as clinical information on functional class, syncope, ventricular arrhythmias, atrial fibrillation, implantable cardioverter-defibrillator (ICD) shocks, heart transplantation, and death due to end-stage heart failure. All participants were studied with 12-lead ECG, echocardiography, and where possible, cardiac magnetic resonance (MR). Genetic study was performed in 27 patients (90%).

The statistical analysis was performed by comparing these variables in relation to the presence of isolated RV involvement or biventricular involvement, and nonparametric tests (Mann-Whitney *U* test) were used for the study of the mean.

Biventricular involvement was predominant in the probands and relatives. Of a total of 55 relatives studied, 18.2% received a new diagnosis of ACM. Follow-up time from diagnosis was similar in both groups (Table 1). In addition, in the group with biventricular involvement, 89% of the patients already had LV involvement at the time of diagnosis. No significant differences were found in the presence of epsilon waves and bundle branch block on ECG, but there was a trend ($P = .07$) toward an increased presence of inverted T waves in the precordial leads in the group with biventricular involvement.

Table 1 shows the clinical characteristics of the groups with isolated RV involvement and with biventricular involvement. The functional class was clearly more advanced in the biventricular group. Although the presence of syncope and ventricular arrhythmias was similar, the burden of family history of SCD

Table 1
Statistical Comparison of Baseline Clinical Variables Between the Groups With Isolated RV Involvement and Biventricular Involvement

Clinical variables	Isolated RV involvement	Biventricular involvement	*P*
Patients	12 (40)	18 (60)	
Men	8 (66.7)	10 (55.6)	.63
Age, y	50.3 ± 18.6	55.3 ± 14.9	.49
Follow-up since diagnosis, y	9.7 ± 7.1	7.8 ± 6.6	.46
Reason for investigation			
VF	0 (0)	1 (5.6)	.12
Ventricular arrhythmias	5 (41.7)	3 (16.7)	
Syncope	3 (25)	3 (16.7)	
Dyspnea	0 (0)	2 (11.1)	
Family history	3 (25)	7 (38.9)	
ECG abnormalities	1 (8.3)	1 (5.6)	
Incidental finding	0 (0)	1 (5.6)	
Relatives who died of SCD	0.4 ± 0.7	1.1 ± 0.8	.04
Family history of SCD (yes), %	33.3	67.7	.13
NYHA functional class	1.1 ± 0.3	2.7 ± 0.8	< .01
I	11 (91.7)	0 (0)	
II	1 (8.3)	9 (50)	
III	0 (0)	5 (27.8)	
IV	0 (0)	4 (22.2)	
Heart transplantation	0 (0)	1 (5.6)	.81
Syncope	4 (33.3)	4 (22.2)	.63
Sustained ventricular arrhythmias at follow-up	7 (58.3)	10 (55.6)	.92
AF	2 (16.7)	3 (16.7)	1
ICD implant	4 (33.3)	15 (83.3)	.02
Ablation	4 (33.3)	2 (11.1)	.33
Death due to end-stage heart failure	0 (0)	2 (11.1)	.63

AF, atrial fibrillation; ECG, electrocardiogram; ICD, implantable cardioverter-defibrillator; NYHA, New York Heart Association; RV, right ventricle; SCD, sudden cardiac death; VF, ventricular fibrillation.
Unless otherwise stated, values are expressed as no. (%) or mean ± standard deviation.

was higher in patients with biventricular involvement (P = .04). However, on dichotomous analysis (yes/no) of this family history, a trend was found; this did not reach statistical significance (P = .13). More ICDs were implanted in the biventricular group, mainly as primary prevention (66.7% of implants); none of the patients with isolated RV involvement received an ICD for this indication. The distribution of ICD therapies differed according to the indication (P < .01): there was a higher number of appropriate shocks in the group with an ICD as secondary prevention (88.9%), while a minority of the patients with an ICD as primary prevention had received appropriate ICD therapies at follow-up (10%). These findings were similar to those observed in other registries.[4]

Investigation of ventricular function showed an increased LV end-diastolic diameter and a higher degree of RV and LV dysfunction in patients with biventricular involvement (Table 2). A limitation of this study is the insufficient availability of additional data from MR.

Table 2
Statistical Comparison of Echocardiographic Data Between the Groups With Isolated RV Involvement and Biventricular Involvement

Echocardiographic variables	Isolated RV involvement	Biventricular involvement	*P*
Qualitative LVEF			< .01
Normal	12 (100)	0 (0)	
Mild LVD	0	6 (33.3)	
Moderate LVD	0	6 (33.3)	
Severe LVD	0	6 (33.3)	
LVEF, %	63.1 ± 4	37.2 ± 8.9	< .01
LVEDD, mm	47.2 ± 7.6	52.3 ± 4.5	.03
Qualitative RVEF			< .01
Normal	5 (41.7)	0 (0)	
Mild RVD	5 (41.7)	4 (22.2)	
Moderate RVD	1 (8.3)	5 (27.8)	
Severe RVD	1 (8.3)	9 (50)	

LVD, left ventricular dysfunction; LVEDD, left ventricular end-diastolic diameter; LVEF, left ventricular ejection fraction; RV, right ventricle; RVD, right ventricular dysfunction; RVEF, right ventricular ejection fraction.
Unless otherwise stated, values are expressed as no. (%) or mean ± standard deviation.

The results confirm that biventricular involvement represents a more advanced stage of isolated RV disease. Our study corroborates the association between LV involvement and a more advanced functional class. Certainly, previous studies have established the relationship between LV involvement and an increased mortality rate due to heart failure.[1,5,6] However, although the analysis of our series does not demonstrate a significant association, it does shows a trend: the 2 patients who died from heart failure and the single patient who received a transplant were all from the biventricular involvement group. The lack of significance is probably due to an insufficient sample size. Regarding the risk of arrhythmia, of the group with isolated RV involvement, 4 patients had ICDs as secondary prevention compared with only 2 in the biventricular group. In contrast, all ICDs implanted as primary prevention were in patients with biventricular involvement, because their risk profile was higher based on the presence of significant LV dysfunction[3] (Table 1). These differences could explain why the incidence of arrhythmic events was similar in both groups at follow-up, even though a relationship with the presence of LV dysfunction would have been expected.

We can conclude that LV dysfunction is associated with greater RV dysfunction, worse functional class, and an increased tendency to events due to heart failure. No clear relationship was found between LV involvement and an increased rate of arrhythmic events, although there was an association with an increased burden of family history of SCD.

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Available online 9 July 2016

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http://dx.doi.org/10.1016/j.rec.2016.04.037

Incidence and Prognosis of Mechanical Complications of STEMI After Primary Angioplasty: Data From a Single-center Registry of an Infarction Code Program

Incidencia y pronóstico de las complicaciones mecánicas del IAMCEST sometido a angioplastia primaria: datos de un registro unicéntrico de Código Infarto

To the Editor,

Mechanical complications (MC) of ST-segment-elevation acute myocardial infarction (STEMI) are an important cause of morbidity and mortality and dramatically worsen prognosis. The introduction of early reperfusion therapy has significantly reduced the classical incidence of MC (5%-10%).[1,2] In particular, the widespread use of primary angioplasty (PA) has reduced its current incidence to between 1% and 2%.[3,4] The implementation of regional PA programs has decreased reperfusion times and improved prognosis, most likely due to the decreased incidence of MC. We evaluated the incidence, treatment, course, and predictors of MC in a cohort who underwent PA under a STEMI emergency treatment protocol, in which fibrinolysis was only used when there were delays or logistic difficulties.

Four researchers retrospectively reviewed the medical records of 950 consecutive patients who underwent PA between 2005 and 2012 with hospital and 30-day follow-up. Qualitative variables are expressed as percentages and quantitative variables as mean or median ± standard deviation according to the normality of the distribution. The Student *t* test was used to compare means and chi-square for percentages. Univariable and multivariable analyses were used to identify the predictors of MC. A *P* value of $< .05$ was used as a cutoff for statistical significance.

The incidence of MC was 2.02% (19 patients). Of these patients, 14 (73.6%) had free wall rupture (FWR), 2 (10.5%) had interventricular septal rupture (IVSR), and 3 (15.8%) had papillary muscle rupture (PMR). Most MCs occurred within 24 hours of admission (52.6%) and a significant proportion (26.3%) occurred after 96 hours. Table 1 shows the baseline characteristics of the patients and Table 2 shows the characteristics of the patients with MCs. The

Table 1
Baseline Characteristics of Patients With and Without Mechanical Complications and Their Comparison

	MC (n = 19)	Without MC (n = 931)	*P*
Age, y	76.8 ± 8.9	65 ± 13.5	<.01
Men, %	52.6	80.2	<.01
BMI	25.3	28.2	.54
HT, %	52.6	59.5	.54
DM, %	36.8	26.4	.77
Dyslipidemia, %	57.9	42.9	.19
Smoking, %	41.2	21.1	.12
Previous ischemic heart disease, %	5.3	11.7	.38
Peripheral artery disease, %	0	8.3	.19
CCR < 60 mL/min, %	20.1	17	.22
Site of AMI			.35
Anterior/septal, %	61.1	44.4	
Inferior/posterior, %	16.7	25.7	
Lateral, %	3.3	9.8	
Other, %	18.9	20.1	