

The presence of subtle structural abnormalities could favor the development of reentrant circuits and explain the finding of MVT in these patients. In this setting, quinidine could stabilize right ventricular outflow tract excitability and facilitate the conversion of malignant VA into more stable and regular MVT responsive to ATP. The positive response to ATP reinforces the idea of a reentrant circuit with excitable gap; it might be that quinidine-mediated slowing of conduction could facilitate the ATP burst to propagate to the circuit, depolarize the excitable gap, and extinguish reentry.

In view of this finding, it can be proposed that patients with BrS treated with quinidine due to frequent ICD shocks might benefit from the introduction of a fast VT zone with 1 or 2 ATP bursts since it has proven effectiveness in MVT termination and shock reduction. Further research is needed to confirm this uncommon VA pattern in BrS after quinidine treatment and elucidate its mechanism.

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Inconclusive Exercise Stress Echocardiography in Patients With Chest Pain: Prevalence and Clinical Determinants



Prevalencia y determinantes clínicos de ecocardiografía de esfuerzo no concluyente en pacientes con dolor torácico

To the Editor,

Chest pain is a common presenting complaint in the emergency room. The guidelines recommend using different techniques for diagnosis of chest pain of possible coronary origin.¹ The most important factor for choosing one technique over another is the competence of the local imaging laboratory. In Spain, the technique of choice is exercise stress echocardiography (ESE). This is a simple, inexpensive physiological test that is widely available. However, a certain percentage of ESE studies are inconclusive.

Our objective was to analyze the clinical determinants of inconclusive ESE in 452 consecutive patients who attended our emergency room for chest pain of probable coronary origin between January 2011 and December 2014. The symptom-limited Bruce protocol was used, although use of other protocols such as the modified Bruce protocol or the Naughton protocol was left to the discretion of the clinician, who also determined whether atropine or contrast echocardiography was used. ESE was considered inconclusive when the test was not positive for ischemia due to echocardiographic criteria and a heart rate (HR) of 85% the age-predicted maximum heart rate or a sufficient work load (6 MET for ages ≤ 75 years and 4 MET for ages above 75 years) was not reached or when contractility could not be assessed at the time of peak exercise.² For selection of the predictive logistic regression model, the *allsets* command of STATA version 13.0 was used and the coefficients of the regression model were calculated by binary logistic regression (*enter* method).

In total, 132 ESE (29%) were inconclusive (106 [80%] because they did not reach the HR target, 36 [27%] because they did not reach a sufficient work load, and 11 [8%] because it was impossible to assess segmental contractility at peak exercise). The characteristics of the study population are shown in Table 1. The patients with inconclusive ESE had a longer hospital stay (3 [1–4] days vs 1 [1–2] days; $P < .001$) and a higher number of additional tests (27% vs 4%; $P < .001$). In 23 patients with inconclusive ESE, coronary anatomy was studied and significant coronary artery disease was detected in 8 of these (34%).

Table 2 shows the best-fit model for predicting inconclusive ESE, with C statistic = 0.69 (95% confidence interval [CI], 0.63–0.74), Akaike information criterion index = 485, Bayesian information criterion = 509, and adequate calibration (Hosmer-Lemeshow test, $P = .87$). All factors included in the model for predicting inconclusive ESE were related to the criteria with an impact on the result. Obese patients and those with chronic obstructive pulmonary disease had a worse acoustic window and, along with patients with atrial fibrillation, usually had worse functional class. On the other hand, baseline HR < 70 bpm increased the probability that the HR target for a conclusive test was not reached.

Our study showed a rate of inconclusive ESE of 29%. In the literature, the rate of inconclusive provocation tests varies widely according to the type of study, the patient profile, and the level of care in which testing occurs. The series of simple ergometry in chest pain units have a rate of inconclusive studies of 22% to 39%.³ Although ergometry includes electrocardiogram-dependent criteria, the main reason for an inconclusive study is not attaining target HR,⁴ a criterion shared with ESE and one that was also a main reason for inconclusive results in our study. A meta-analysis of ESE or a pharmacologically-based test showed a rate of inconclusive studies of 27%.⁵

The importance of inconclusive ESE should not be ignored. On the one hand, patients with inconclusive ESE have a higher risk of

Table 1
Baseline Characteristics of the Study Population by ESE Outcome

Variables	Total population (n = 452)	ESE result		
		Conclusive (n = 320)	Inconclusive (n = 132)	P
Age, y	62 ± 12	62 ± 12	63 ± 12	.302
Sex, male	301 (67)	207 (65)	94 (71)	.181
BMI	29 ± 4	29 ± 5	30 ± 4	.187
Hypertension	327 (72)	227 (71)	100 (76)	.298
Diabetes mellitus	140 (31)	94 (29)	46 (35)	.252
Dyslipidemia	342 (76)	239 (75)	103 (78)	.451
Current smoker	112 (25)	87 (27)	25 (19)	.065
Ischemic heart disease	166 (38)	100 (31)	66 (50)	< .001
Atrial fibrillation	44 (10)	18 (6)	26 (20)	< .001
Peripheral artery disease	15 (3)	10 (3)	5 (4)	.774
COPD	26 (6)	11 (3)	15 (11)	.001
Anxiety/depression	118 (26)	77 (24)	41 (31)	.123
LVEF < 50%	28 (6)	19 (6)	9 (7)	.724
SCA in baseline echocardiogram	92 (20)	56 (18)	36 (28)	.017
Left bundle branch block	5 (1)	3 (1)	2 (2)	.632
Creatinine, mg/dL	0.9 ± 0.3	0.9 ± 0.3	1.0 ± 0.4	.002
Hemoglobin, g/dL	14.1 ± 1.4	14.2 ± 1.4	14.0 ± 1.5	.185
Baseline HR, bpm	80 ± 16	81 ± 16	76 ± 10	.008
Baseline HR < 70 bpm	133 (29)	78 (24)	55 (42)	< .001
Baseline SBP, mmHg	138 ± 23	139 ± 23	135 ± 23	.060
Maximum HR, bpm	132 ± 21	138 ± 17	118 ± 22	< .001
Maximum SBP, mmHg	156 ± 25	159 ± 25	149 ± 25	< .001
Exercise duration, min	7 [4-9]	7 [5-9]	6 [4-8]	< .001
MET	8 ± 3	8 ± 3	7 ± 3	< .001
Use of atropine in ESE	22 (5)	14 (4)	8 (6)	.443
Use of contrast-enhanced echocardiography in ESE	7 (2)	6 (2)	1 (1)	.384
ESE protocol				.011
Bruce	416 (93)	301 (95)	115 (88)	
Modified Bruce/Naughton	33 (7)	17 (5)	16 (12)	
ESE in less than 24 h	273 (60)	198 (62)	75 (59)	.318
Negative chronotropic agents	200 (44)	125 (39)	75 (57)	.001
Negative chronotropic agents and ESE in less than 24 h	115 (26)	71 (22)	44 (33)	.014

BMI, body mass index; COPD, chronic obstructive pulmonary disease; ESE, exercise stress echocardiography; HR, heart rate; LVEF, left ventricular ejection fraction; SBP, systolic blood pressure; SCA, segmental contractility abnormalities.

Values expressed as No. (%), mean ± SD, or median [interquartile range].

events than those with negative ESE (2.08% vs 0.77%).⁵ Furthermore, as was the case in our study, an inconclusive result implies the need for further studies to clarify the cause of symptoms, with the resulting increase in length of hospital stay and costs.³

The present study has important implications for decision-making in clinical practice, as it could help to identify patients with a high probability of inconclusive ESE. It is also the first study on this topic in patients who mostly belonged to the era of

ultrasensitive troponin measurements. This makes it more relevant because the characteristics of patients with chest pain undergoing exercise stress tests at an early stage have changed after the introduction of these biomarkers. In view of our findings, we consider that certain measures should be assessed to improve the performance of the diagnostic process in patients with a high probability of inconclusive ESE. Such measures include delaying study of those who take agents with negative chronotropic effects, increasing the use of atropine or contrast-enhanced echocardiography, or selecting another modality of ischemia provocation test or cardiac computed tomography.⁶

Table 2
Factors Included in the Model for Predicting Inconclusive ESE

Variables	OR (95% CI)	P
Obesity (BMI > 30)	1.54 (1.01-2.38)	.048
Atrial fibrillation	2.91 (1.24-6.83)	< .001
COPD	4.09 (2.10-7.95)	< .001
Baseline HR < 70 bpm	2.34 (1.49-3.68)	< .001

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National Trends in Heart Failure Hospitalization Rates in Patients With Diabetes Mellitus: 1997–2010



Tendencias nacionales en hospitalización por insuficiencia cardíaca de pacientes con diabetes mellitus: periodo 1997–2010

To the Editor,

Heart failure (HF) is a major public health problem in developed countries, with an increasing prevalence mainly due to population aging and significant advances in the treatment of associated comorbidities, and it is one of the leading causes of hospital admission.¹

Furthermore, the prevalence of diabetes mellitus (DM) in Spain has increased significantly in recent decades and now affects 14% of the adult population.^{2,3}

The incidence of HF increases in patients with DM, with the risk being 2.4 times higher in men and up to 5 times higher in women than in individuals without DM, even after exclusion of coronary

heart disease.⁴ Persons with DM also have a higher mortality rate and a higher probability of hospitalization due to worsening of HF compared with nondiabetic individuals.¹

The aim of this study was to describe the trend in hospital admissions due to HF in patients with DM in Spain. A national, retrospective, observational study was conducted in all DM patients admitted for HF between 1997 and 2010. The data were obtained from the Minimum Basic Data Set for hospitals in the Spanish national health system. We included all patients with a secondary discharge diagnosis of DM in whom the reason for admission or the main diagnosis was HF (diagnosis-related groups [DRGs] 398.91, 402.0, 402.11, 402.91, 404.0, 404.1, 404.9, 428.0, 428.1, 428.2, 428.3, 428.4 and 428.9). We evaluated the time trend of hospital admissions in general and by age and sex, the percentage of readmissions, mean length of hospital stay, the Charlson comorbidity index, mortality, and mean weight (complexity) per DRG. The trend in the number of admissions was adjusted for the Spanish reference population in each of the years of the study period.

Between 1997 and 2010, 5,447,725 diabetic patients were admitted to hospital in Spain (94.4% with type 2 DM). We

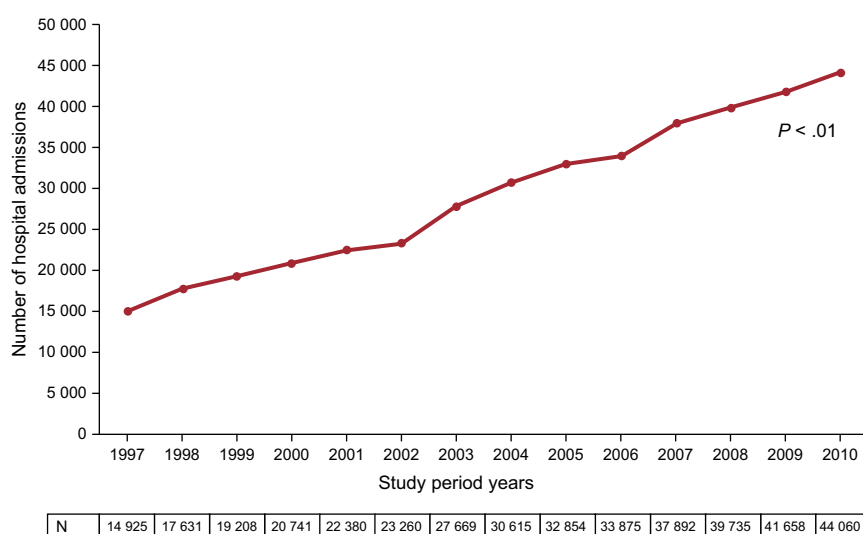


Figure 1. Time trend of hospital admissions due to heart failure in diabetic patients (1997–2010). The absolute number for each year of the study period is shown.