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Predictors of ventricular tachycardia induction in syncopal patients with mild to moderate left ventricular dysfunction

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Abstract

Background: *In patients with mild to moderate left ventricular dysfunction (LVD) (35% ≤ LVEF ≤ 50%) who present with syncope, demonstration of tachy and/or brady-arrhythmia has prognostic value. In this group of patients electrophysiological study (EPS) is often necessary.*

Methods: *A total of 53 consecutive patients with mild to moderate LVD and history of undetermined syncope underwent EPS. Sinus node function, His-Purkinje system conduction and ventricular electrical stability were evaluated.*

Results: *Twenty eight patients (52.8%) had induction of sustained monomorphic ventricular tachycardia (VT) and five (9.4%) patients had a sustained ventricular arrhythmia other than monomorphic VT (ventricular flutter, ventricular fibrillation, and polymorphic VT) induced during EPS. Abnormal sinus node function and/or His-Purkinje system conduction was found in five (9.4%) patients. Age, gender, history of myocardial infarction, type of underlying heart disease and history of revascularization were not predictors of VT induction. Wide QRS morphology independently, and lower left ventricular ejection fraction and presence of pathologic q wave in precordial leads dependently, could increase risk of VT induction.*

Conclusions: *The EPS can determine which patient with syncope and mild to moderate LVD is likely to benefit from placing an ICD for prevention of sudden cardiac death. Pathologic precordial q wave, wide QRS morphology and lower left ventricular ejection fraction could be predictors of VT induction during EPS. Wide QRS morphology has an independent effect in this category.* (Cardiol J 2009; 16, 4: 327–331)

Key words: syncope, left ventricular dysfunction, electrophysiology study

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Introduction

Syncope is temporary loss of consciousness and posture, usually related to temporarily insufficient blood flow to the brain. In patients with structural heart disease, the occurrence of syncope heralds an increased risk of sudden arrhythmic death [1]. The management of patients with unexplained syncope, no documented ventricular arrhythmias and structural heart disease with mild to moderate ventricular dysfunction is not well established. After initial clinical assessment in many patients with a history of syncope, the underlying etiology remains unexplained. Although the real value of electrophysiological study (EPS) in patients with unexplained syncope, no documented ventricular arrhythmias and structural heart disease, is not precisely defined, this approach is commonly used for further risk stratification and guided antiarrhythmia management [2]. It is the purpose of this retrospective study to analyze the predictive factors of electrophysiologically ventricular arrhythmia induction in patients with history of unexplained syncope and mild to moderate left ventricular dysfunction (LVD).

Methods

Definitions

Syncope: sudden transient loss of consciousness and postural tone with spontaneous recovery.

Unexplained syncope: true syncope where cardiac origin is highly suspected and has no correlation with abnormal findings in past medical history (for example: neurally mediated syncope), physical examination (for example: orthostatic hypotension), electrocardiography (ECG; for example: sustained ventricular tachycardia or complete heart block) and echocardiography (for example: severe aortic stenosis).

Mild to moderate LVD: left ventricular ejection fraction (LVEF) > 35% and < 50% on echocardiography in patients with coronary artery disease or dilated cardiomyopathy.

Sustained monomorphic ventricular tachycardia: ventricular tachycardia manifesting a beat to beat uniform surface ECG QRS configuration lasting ≥ 30 s or that is hemodynamically intolerable and needs termination.

Polymorphic ventricular tachycardia: ventricular tachycardia that has no constant morphology for more than five complexes, has no clear isoelectric baseline or has QRS complexes that are asynchronous in multiple simultaneously recorded leads.

Ventricular fibrillation (VF): presence of irregular undulations of varying contour and amplitude and absence of distinct QRS complexes, ST segments and T waves.

Old anterior wall infarction: diagnosed by the presence of initial deep and broad q waves in any two consecutive precordial leads.

Old inferior wall infarction: diagnosed by the presence of initial deep and broad q waves in at least two of three inferior leads (II, III and aVF).

Study populations

We evaluated 53 consecutive patients (male/female: 43/10) with unexplained syncope and mild to moderate LVD between April 2004 and April 2008. Inclusion criteria were:

- one or more episodes of unexplained syncope;
- no documented ventricular arrhythmias on surface ECG or Holter monitoring;
- presence of mild to moderate LVD on echocardiography;
- electrophysiological testing.

Exclusion criteria were:

- history of any episode of tachycardia;
- history of cardiac arrest;
- diagnosis of long QT syndrome;
- susceptibility to neurally mediated syncope.

The study was approved by the local bioethical committee and all patients gave their informed consent.

Measurement of left ventricular function

A complete M-mode and two-dimensional imaging were performed using an ultrasonographic machine (Vivid 7, General Electric, Wauwatosa, WI, USA). Images were obtained using a 3.5 MHz transducer at a depth of 16 cm in the parasternal and apical views (standard long axis and two and four chamber views). Left ventricular end-systolic and diastolic dimensions and volumes and LVEF were calculated using the biplane Simpson's technique. Patients with LVEF more than 35% and less than 50% were included in the study.

Electrophysiological study

After written consent was obtained, studies were done in the fast and non-sedated state. Before the study, all antiarrhythmic drugs were stopped for at least five half lives. Three quadric-polar electrode catheters were used. They were percutaneously inserted under local anesthesia through the femoral vein and positioned under fluoroscopic guidance in the high right atrium, His bundle area and right ventricle. Programmed ventricular stimulation

Table 1. Clinical and para-clinical characteristics of the two study groups.

	Induced ventricular arrhythmias	Non-induced ventricular arrhythmias	P
Gender (male/female)	28/5	15/5	0.374
Age	56 ± 13.6	53.5 ± 13	0.149
Etiology (ischemic/non-ischemic)*	24/9	12/8	0.336
Post myocardial infarction status (yes/no)	14/19	3/17	0.038
Revascularized (yes/no)**	10/23	8/12	0.470
QRS duration [ms]	118.6 ± 25.7	111.0 ± 34.3	0.367
QTc interval [ms]	400.5 ± 43.3	392.9 ± 51.1	0.564
Wide QRS morphology (yes/no)***	23/10	7/13	0.013
Pathologic q wave in anterior leads (yes/no)	9/24	1/19	0.045
Pathologic q wave in inferior leads (yes/no)	6/27	6/14	0.319
Left ventricular ejection fraction	39.9 ± 3.8%	42.2 ± 3.4%	0.028

*history of documented coronary artery disease; **history of interventional revascularization and/or aorto-coronary bypass grafting; ***abnormal QRS morphology including: RBBB, LBBB, biphascicular block and intraventricular conduction delay

(PVS) was performed with pulse duration of 1.5 ms at twice diastolic threshold. The PVS protocol utilized up to three extra-stimuli delivered during sinus rhythm and after eight paced ventricular cycle lengths at 550 and 400 ms. Minimum delivered extra-stimuli was 200 ms. First the right ventricular apex, then the right ventricular outflow tract were tested, with and without procainamide stress test (10 mg/kg), in case no sustained ventricular arrhythmia was induced before.

Statistical analysis

Results are expressed as mean (SD) for interval and frequency (relative frequency) for categorical data. Independent sample t and χ^2 tests were used for comparison between the two groups. Pearson correlation coefficient (r) was used to find the linear correlation between interval data. A p value less than 0.05 was considered statistically significant. Logistic regression model was fitted to determine the associations between the presence and absence of sustained ventricular arrhythmia induction during PVS in syncopal patients with mild to moderate LVD. STATA 8 SE (STATA Corporation, Texas, USA) was used for statistical analysis.

Results

Fifty three patients with syncope and mild to moderate LVD underwent electrophysiological testing. Forty three males and ten females with a mean age of 57 ± 13.3 years were enrolled in the study. The underlying heart disease was coronary artery disease in 36 patients (67.9%) and non-ischemic dilated cardiomyopathy in 17 (32.1%). Seventeen patients (32.1%) had a documented history of myocardial infarction. Eighteen patients (34%) were revascularized, interventional revascularization (seven patients), bypass grafting (ten patients) or both of them. Mean QRS duration was 115.7 ± 29.1 ms and mean LVEF was 40.8 ± 3.8%. Based on surface ECG, ten (18.9%) and 12 (22.6%) pathological q waves were detected in anterior precordial and inferior leads respectively. Abnormal electrical conduction pattern was found in 30 patients and categorized into the following groups: left bundle branch block pattern in 14 (26.4%), right bundle branch block pattern in four (7.5%) and intraventricular conduction delay (IVCD) in 12 (22.6%).

Predictors of ventricular arrhythmia induction

Based on EPS results, the patients fell into two groups. In group 1, ventricular tachyarrhythmias were induced during EPS and in group 2 ventricular arrhythmias were not inducible. EPS could induce ventricular arrhythmias in 33 (62.3%) patients and 26 of them accepted cardioverter-defibrillator implantation. Five patients received a permanent pacemaker due to the sinus node, atrioventricular node and/or His-Purkinje system abnormality. Tilt table test was done for 12 patients after negative EPS and was positive in four patients (mixed type pattern in three and vasodepressor type in one). The clinical and para-clinical characteristics of the two study groups are detailed in Table 1. History of myocardial infarction, presence of pathologic q wave in anterior leads, abnormal QRS morphology and LVEF less than 40% were predictors of ventricular tachyarrhythmia induction. Logistic regres-

Table 2. Logistic model for arrhythmia induction during electrophysiological study in syncopal patients with mild to moderate left ventricular dysfunction.

	Odds ratio	P	95% confidence interval
Age	1.021211	0.477	0.9638512–1.081984
Gender	0.7210881	0.733	0.1101075–4.722368
Left ventricular dysfunction etiology	1.544607	0.726	0.1361272–17.52634
Revascularized	0.7723971	0.811	0.0926586–6.438662
Left ventricular ejection fraction	0.9568714	0.681	0.7754235–1.180778
Pathologic q wave in inferior leads	0.3198513	0.287	0.0391474–2.613322
Pathologic q wave in anterior leads	5.666612	0.278	0.246509–130.2609
QRS duration	0.9721224	0.120	0.9381292–1.007347
Abnormal QRS morphology	27.5493	0.009	2.314415–327.9291
History of myocardial infarction	3.513314	0.477	0.9638512–1.081984

sion model was adjusted for the following factors: age, gender, LVEF, pathologic q waves in anterior and/or inferior leads, abnormality of QRS morphology, etiology of LVD, history of myocardial infarction and history of revascularization. P value for goodness-of-fit was 0.1161. Among all mentioned factors, only abnormal QRS morphology had a significant effect on the probability of ventricular arrhythmia induction during PVS in syncopal patients with mild to moderate LVD (Table 2).

Discussion

Using EPS, in 62.3% of our patients potentially life-threatening tachyarrhythmias could be induced. Reported results in the literature for induction of sustained ventricular tachyarrhythmias in syncopal patients and organic heart disease are about 21–50% [2–4]. Patients with positive test results were considered at high risk of sudden arrhythmic death and received implantable defibrillator devices [5, 6]. In our study, clinical and paraclinical predictors of inducible ventricular tachycardia during EPS were as follows: history of myocardial infarction, presence of pathological q wave in anterior leads, wide QRS morphology and more depressed LVEF (less than 40%) (Table 1).

EPS has a more prognostic value in syncopal patients with ischemic heart disease and myocardial infarction [7]. Pathologic q wave in anterior leads may be showing presence of myocardial scar or aneurysm. In our study, this finding was a predictive factor of ventricular induction during EPS. Pathologic q wave in inferior leads could not significantly increase risk of arrhythmia induction. This finding can be explained with the smaller mass of myocardial scar in the mentioned group, comparing with the patients, who have pathological q wave in the anterior leads. Left ventricular ejection fraction less than 40% and wide QRS morphology were other ominous predictors. Krol et al. [8] found similar results in their study. They reported that in patients with unexplained syncope, an LVEF less than or equal to 0.40 was the most powerful predictor of a positive EPS (p less than 0.00001), followed by the presence of bundle branch block (p less than 0.00003), coronary artery disease (p less than 0.0003), remote myocardial infarction (p less than 0.00006), use of type 1 antiarrhythmic drugs (p less than 0.00003), injury related to loss of consciousness (p less than 0.01) and male sex (p less than 0.01). In patients with severe LVD (LVEF < 30%), history of previous myocardial infarction and no spontaneous ventricular tachycardia clinical variables do not have practical usefulness in identifying patients inducible at electrophysiological testing. These patients are candidates for cardioverter-defibrillator implantation [9]. In other syncopal patients with and without history of coronary artery disease in the presence of impaired left ventricular function or structural heart disease, EPS is recommended to evaluate electrical stability [10, 11]. In our study, LVEF less than 40% significantly increased the risk of ventricular arrhythmias induction but it was dependent on the wide QRS morphology (Table 2). This finding suggests that in syncopal patients with mild to moderate LVD, LVEF is not per se the most powerful predictor of ventricular arrhythmia induction during EPS. Other factors, such as abnormal conduction and presence of myocardial scar, can be effective in arrhythmia induction during EPS.

Limitations of the study

The effects of predictive factors in arrhythmia induction should be checked during follow-up. The p value for goodness-of-fit was nonsignificant and the model is fit, but 95% confidence interval of wide QRS morphology shows a wide range from 2.3 to 327 (odds ratio: 27.5) (Table 2). Increasing the sample size could reduce this wide range. Evaluation of myocardial scar by echocardiography and/or radionuclide imaging in syncopal patients with mild to moderate LVD may be more important than ECG parameters like pathological q wave in anterior leads.

Conclusions

Left ventricle impairment is an important issue in syncopal patients. In patients with mild to moderate LVD, other factors such as previous myocardial infarction, presence of pathologic q wave in precordial leads and wide QRS morphology can significantly increase the risk of ventricular tachyarrhythmia induction during EPS. Among the mentioned factors, wide QRS morphology had an independent effect on the risk of arrhythmia induction.

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