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An observational study to identify predictors, characteristics, and treatment of ventricular arrhythmias in patients with arrhythmogenic right ventricular cardiomyopathy

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Abstract

Background: Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC) is an inherited cardiomyopathy identified by gradual and progressive fibro fatty infiltration of the myocardium which put through patients to ventricular arrhythmias and sudden cardiac death. However, selection of patients for Implantable Cardioverter-Defibrillator (ICD) is still controversial.

Aims: The objective of this study was to identify predictors, characteristics, and treatment of ventricular arrhythmias in patients with ARVC coming to a tertiary care hospital in Eastern India.

Methods: A total of 30 patients who visited the hospital fulfilling ARVC Task Force Criteria with corroborative ECG, 2D ECHO, MRI findings, who presented with history of syncope, or episodes of resuscitated cardiac arrest were enrolled in the study.

Results: Of the 30 patients enrolled, 25 (83.333%) received an ICD. Implant complications occurred in 2 patients including an RV perforation and an infection requiring ICD removal and re-implantation. 16 patients had 118 episodes of ventricular arrhythmias, including 105 that were monomorphic and 13 that were polymorphic. In the patients with ICDs, independent predictors of ventricular arrhythmias in follow-up included young age at presentation and T-wave inversions inferiorly. Young age at time of ICD implantation was an independent predictor of life-threatening ventricular arrhythmias.

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Conclusions: This study concluded that risk factors for ventricular arrhythmias were spontaneous ventricular arrhythmias before enrollment, an early age of presentation, and T wave inversion on inferior surface of ECG.

Keywords: Cardiac disease, Implantable cardioverter defibrillator, irregular heart beat

Running Title: Assessment of ventricular rhythm abnormality

Introduction:

Arrhythmogenic Right Ventricular Cardiomyopathy (ARVC), which is characterized by fibro fatty infiltration of Right Ventricle, is a cardiomyopathy associated with sudden cardiac death (SCD). ARVC was first described by the Pope's physician, Giovanni Maria Lancisi, in his book entitled De Motu Cordis et Aneurysmatibus, published in 1736.[1]

ARVC is characterized pathologically by myocardial atrophy, fibro fatty replacement, fibrosis, and progressive thinning of the ventricular wall with chamber dilatation and formation of aneurysm. These changes subsequently produce electrical instability precipitating ventricular arrhythmia and SCD. [2]

Risk factors for sudden cardiac, include marked right ventricular (RV) dilatation, left ventricular (LV) involvement, hemodynamically unstable rapid sustained monomorphic ventricular tachycardia (SMVT), and history of syncope. However, these risk factors have not been consistent from study to study. [3, 4] The focus of the current study is to identify predictors, characteristics, and treatment of ventricular arrhythmias in ARVC patients coming to a tertiary care centre of Eastern India.

Materials and Methods:

A total of 30 patients with a mean age of 40 ±14 years, who visited the hospital fulfilling ARVC Task Force Criteria with corroborative ECG, 2D ECHO, MRI findings, who presented with history of syncope, or episodes of resuscitated cardiac arrest were enrolled. After getting approval from the institutional ethics committee the patients not filling these criteria were excluded. The study population underwent 12-lead electrocardiography (ECG), 24-hour Holter Monitoring, echocardiography, magnetic resonance imaging (MRI) to determine the extent of their cardiological problem. Stored electrocardiograms were reviewed after any device therapy and with each follow-up schedule. Ventricular tachycardia were characterized as monomorphic or polymorphic, and by cycle length.

Statistical Analysis

Descriptive characteristics are provided as mean SD and were compared by means of the Student T Test. Continuous variables that were not normally distributed reported as median and interquartile range and were compared with the use of the Wilcoxon rank-sum test. Categorical variables were compared by means of the chi-square test analysis. The Cox proportional hazard model was used to examine the 2 primary arrhythmic endpoints: ICD or CRT-D treated ventricular arrhythmias of death. Potentially life-threatening arrhythmia (defined as ventricular tachycardia >240 beats/min or ventricular fibrillation)

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Results:

A total of 30 patients were enrolled in the ARVC registry. The mean age at enrollment was 40 ± 14 years. The presentation of the patients included syncope due to sustained monomorphic VT or cardiac arrest (n=30, 100%). 25 patients underwent an ICD, 3 patients received a CRT-D implantation, and 2 patients were conservatively managed. Implant complications occurred in 2 patients including an RV perforation and an infection that required ICD removal and re-implantation. During the 1.7 years of follow up, 16 patients with an ICD had the combined endpoint of any ventricular arrhythmia or death.

Table 1: Occurrence and non-occurrence of various events in the study group

Parameters	With events (n=16)	Without events (n=14)
Age at Enrollment	40 ± 4	
Females	4 (25%)	5 (35%)
Sustained VT or Cardiac arrest at presentation	15 (94%)	14 (100%)
Syncope	4 (25%)	2 (14%)
NSVT	1 (6%)	0 (0%)
Diagnosis of ARVC by TASK FORCE CRITERIA	16 (100%)	14 (100%)
Family History	5 (31%)	5 (35%)
Anti-arrhythmic agents after enrollment (Amiodarone)	16 (100%)	14 (100%)
Beta Blockers	12 (75%)	7 (50%)
RV EF (%) mean by MRI	43 ± 12	46 ± 12
LV EF (%) mean by MRI	58 ± 6	57.7 ± 4.1
T wave inversion V1-V3	13 (82%)	5 (35%)

16 patients (64%) had events in the form of SMVT or Sustained polymorphic VF. There was no difference in the mean age or sex of those who had or did not have an event in 1.7 years of follow-up. The group which had an event post implantation had an early age of presentation and T-wave inversions in leads V1 to V3.

Table 2: Predictors of life-threatening VT/VF in patients with ICD

Clinical	VT/VF (n=16)	No Arrhythmias (n=14)
Age at earliest symptoms	31±17	37±14
Females	4 (25%)	5 (35%)
Arrhythmic events before enrollment	16 (100%)	14 (100%)
Family h/o sudden death	5 (31%)	0 (0%)
Anti-arrhythmic drugs (Amiodarone)	16 (100%)	14 (100%)
Beta-blockers	12 (75%)	7 (50%)
RV EF (%) mean by MRI	41 ± 8	43 ± 13
LV EF (%) mean by MRI	55.6 ± 4	59.7 ± 6

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T wave inversion II, III, avf	13 (82%)	5 (35%)
VPC>1000/24hrs	12 (75%)	5 (35%)

Of the 25 patients who received an ICD, 16 patients had ventricular arrhythmias treated by the ICD during follow up. In a multivariate analysis, the only two predictors of ICD treatment of ventricular arrhythmias were young age at presentation and T- wave inversions in leads V1 to V3. There were no sudden deaths.

Among the study population 16 individuals had the occurrence of SMVT (>=240 beats/min) or SPVF after ICD implantation. In a multivariate analysis, only younger age at the time of ICD implantation was predictive of life-threatening ventricular arrhythmias.

Among the study groups 16 patients had 118 episodes of ventricular arrhythmias, including 105 SMVT and 13 SPVF. The mean cycle length of the SMVT was 317 ± 39 ms and the mean cycle length of the SPVF was 216 ± 40 ms.

In this study 2 patients who did not receive ICD or CRT-D therapy had episodes of NSVT. Of the 105 SMVTs, 92 (87%) responded to Anti-tachycardia pacing (ATP). Most had shorter cycle lengths. Remaining 13 SMVTs responded to shock therapy. All the SPVFs (13) responded to shock therapy. 1 individual had inappropriate ICD therapy for atrial fibrillation.

Discussion:

In this analysis of the patients with ARVC attending the tertiary care centre of Eastern India, ventricular arrhythmias, including those defined as life-threatening, occurred in more than 50% of patients who received an ICD. The most important predictors of ICD-treated ventricular arrhythmias were predominantly the occurrence of previous episodes of SMVT or SPVF.[5] In follow-up, T wave inversions were a predictor of any ventricular arrhythmia, younger age at presentation predicted for SPVF. Therefore, use of ICDs is supported by these data. The observation that there were no sudden deaths in the patients without an ICD, points to the fact that patients without spontaneous ventricular arrhythmias or syncope may have a reasonable prognosis without ICDs. This study also revealed most ventricular arrhythmias in ARVC patients were monomorphic VT. ATP was successful in terminating 87% of VTs, and its efficacy and success did not depend on the rapidity of the SMVT. Therefore, ATP should be programmed for all patients with ARVC and should include ATP even for rapid VTs.

Conclusion:

This study was a small-scale registry to evaluate the risk factors of arrhythmias and sudden death in patients with ARVC. Majority of individuals in this registry were treated with ICD, and approximately two third of them received ICD therapy for SMVT or VF. Risk factors for ventricular arrhythmias were spontaneous ventricular arrhythmias before enrollment, a younger age at time of ICD implantation and T wave inversions on surface ECG. This study also concludes that whenever an ICD is placed, ATP is highly successful in terminating SMVT and should be programmed for all SMVT, regardless of heart rate.

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Conflict of Interest: None

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