

# High-Resolution Electrocardiography in Patients with Eisenmenger Syndrome

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Eisenmenger syndrome (ES) represents the most severe end of the disease spectrum in pulmonary arterial hypertension associated with congenital heart disease. Structural and electrical remodeling of the right ventricle is characteristic of ES. We aimed to evaluate advanced ECG parameters using high-resolution electrocardiography (HR-ECG) in ES patients.

The comparison of HR-ECG obtained heart rate variability parameters, ventricular depolarization, and repolarization between ES patients and matched healthy controls.

	ES (n=19)	Controls (n=38)	p
Number of beats	256	256	NS
RR interval (ms)	820	895	NS
<b>HRV</b>			
SDNN RR (ms)	27.9	42.9	<b>0.002</b>
RMSSD RR (ms)	20.4	32.8	<b>0.033</b>
Lo T	5.6	6.5	NS
Lo LF	4.7	5.3	<b>0.025</b>
Lo HF	4.3	5.3	<b>0.037</b>
RR ecc	0.64	0.61	NS
<b>QRS</b>			
QRS width (ms)	111	110	NS
HFQRS_M (units)	2.1	1.7	<b>0.016</b>
HFQRS_A (units)	4.8	3.7	<b>0.010</b>
dVdt1 (1/ms)	47.9	53.3	NS
dVdt2 (1/ms)	50.1	56.8	<b>0.007</b>
QRST angle (°)	139	40	<b>0.000</b>
<b>T wave</b>			
QTc (ms)	451	420	<b>0.009</b>
SDNN QT (ms)	2.9	2.1	NS
RMSSD QT (ms)	2.1	1.3	<b>0.030</b>
QTVi (units)	-1.4	-1.9	<b>0.006</b>
lnDPVT (units)	9.0	9.1	NS
IDRT (units)	0.76	-0.33	<b>0.001</b>
TWR (units)	0.26	0.07	<b>0.000</b>

Nineteen adult ES patients (67% female, median age 34 years) without chronic atrial fibrillation, other uncontrolled arrhythmias, permanent ventricular pacing, acute or advanced heart failure were included.

For comparison, 38 age and sex-matched controls were also included. Each participant underwent a 5-minute HR-ECG recording at rest acquired using a 1000-Hz recording device (Cardiax, IMED Ltd.) without filter applied. Several parameters were analyzed using dedicated software.

We observed significant abnormalities in several HR-ECG acquired parameters in ES patients compared to healthy controls. The best performers were the T wave intra-dipolar ratio IDRT, the residual TWR ( $p < 0.001$ ), the spatial QRST angle ( $p < 0.001$ ), and QTVI ( $p < 0.006$ ) that also correlated with the increased level of NT-proBNP.

Our HR-ECG study results are consistent with the altered cardiac autonomic function, ventricular depolarization, and repolarization in ES patients. The prognostic value of these simple and easily acquired parameters warrants further investigation in more extensive studies.