

Original Research Article

Electrocardiography can be a clue to underlying cardiomyopathy

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ABSTRACT

Background: Electrocardiography (ECG) is an accessible, low cost diagnostic and prognostic tool. Recent studies have shown increased risk of deaths associated with cardiomyopathy and to study the patients with symptoms of cardiomyopathy on basis of ECG.

Methods: A total of 50 patients were explained the procedure and the purpose of the study, informed consent was taken from the patient or the relative in a language they can understand. Required physical examination and necessary investigations were carried out. In our study, maximum subjects had normal voltage (80%) low voltage ECG findings were in 20%, normal QRS complex in 78%, wide QRS complex in 20% LBBB/RBBB in 24%. Evidence of ischemia like T wave changes in 34%, ST wave changes in 24% and tachycardia (26%). Thus ECG can give a clue for diagnosing cardiomyopathy and guide us for further managements but it is not a diagnostic marker for it since most of the patients had normal ECG findings.

Results: In our study, electrocardiogram findings among patients are: Maximum subjects had normal voltage (80%). Low voltage ECG findings were in 20%. Normal QRS complex in 78%, wide QRS complex in 20% LBBB/RBBB in 24%. Evidence of ischemia in 58% and tachycardia (26%).

Conclusions: ECG is an accessible, low cost diagnostic and prognostic tool. Most common findings in cardiomyopathy is biventricular hypertrophy and left bundle branch block with wide QRS complex, low voltage ECG and ST changes as also seen in present study. Thus, ECG can be initial investigation for cardiomyopathy and can give us clue for further investigations and management.

Keywords: Cardiomyopathy, ECG, Wide QRS complex, LBBB

INTRODUCTION

Cardiomyopathies are diseases of heart muscles which can be due to genetic defects, heart muscle injury or permeation of myocardial tissues and can affect people of all ages and races.^{1,2} It starts with thickening, stiffness, thin out or fill with substances which are not seen in normal heart muscle leading to reduced ability of the heart muscle to pump blood which can lead to arrhythmias. Males and females of all ages and races can be affected while black more than white and male more than female affection is commonly seen.¹⁻⁴ Dilated cardiomyopathy is characterized by ventricular chamber dilatation with

impaired cardiac concert, hypertrophic cardiomyopathy characterized by thickening of ventricular walls with improved cardiac presentation while restrictive cardiomyopathy characterized by thickening firm ventricular walls that hampers filling of ventricle during diastole Arrhythmogenic right ventricular cardiomyopathy which is the second common cause of sudden death in young due to cardiac disease while being the first cause of sudden death associated with athletes.^{1,2} Hypertrophic obstructive cardiomyopathy is the most common inherited genetic heart disease that can occurs at any ages, but common in children and in young.¹⁻⁵ Most of cardiomyopathy patients are asymptomatic but common

symptoms include breathlessness, weakness, pedal oedema, palpitation, syncope, sudden death and sign of heart failure.^{1,2,4,5,6}

Our study was done to investigate the electrocardiography changes seen in patients with cardiomyopathy.

Common ECG findings seen in different types of cardiomyopathy:

Dilated cardiomyopathy – LVH, RVH, LBBB, RBBB, AV BLOCK, SINUS BRADYCARDIA. However, LBBB is more common than RBBB. Restrictive cardiomyopathy- low voltage QRS complexes, non specific ST-T changes, bundle branch block, pathological Q waves. Hypertrophic cardiomyopathy- LVH, deep narrow Q waves in inferior and lateral leads, atrial fibrillation, SVT. Arrhythmogenic cardiomyopathy- inverted T wave in right precordial leads, epsilon wave which a characteristic finding of ARVD seen after QRS complex in V1 lead representing early afterdepolarizations

METHODS

Place of study

Dr. D. Y. Patil Medical College, hospital and Research Centre (Medicine OPD/Cardiology OPD/wards).

Period of study

The period of the study was August 2018 to September 2020.

Sample size

The sample size for the study was 50 cases.

Inclusion criteria

Patients with age group of 18- 80 years. Patient with symptoms of dyspnea on exertion, orthopnea, palpitation, syncope, heart failure for more than 2 years.

Exclusion criteria

Patients with known case of Congenital heart disease. Rheumatic valvular heart disease. Acute myocardial infarction. Chronic Respiratory disease. Informed written consent was taken from patients.

Institutional Ethics Committee clearance was taken before start of study.

Procedure/ method of study

Informed consent was taken from the patient or the relative in a language they can understand. A total of 50 patients were explained the procedure and the purpose of the study

Required physical examination and necessary investigations which included ECG, 2D echo, coronary angiography were carried out.

Data analysis

Data was entered in Microsoft excel and analysed using Statistical package for social science (SPSS) 2020. Qualitative or categorical variables were expressed in terms of frequency and percentage.

RESULTS

In our study, out of 50 patients, the highest incidence were seen in the age group of 51-60 years (34%), followed by 61-70 years (61%).

Table 1: Age distribution in cardiomyopathy.

Age group (years)	Frequency	Percent
<30	4	8.0
31-40	4	8.0
41-50	8	16.0
51-60	17	34.0
61-70	9	18.0
>70	8	16.0
Total	50	100.0

Table 2: Gender distribution in cardiomyopathy.

Gender	Frequency	Percent
Female	1	24.0
Male	38	76.0
Total	50	100.0

As age increases the risk of developing cardiomyopathy also increases.

Hypertrophic cardiomyopathy which is genetically inherited is usually seen in young adults. Mean age for study participants was 55.6±15.25 years and were in range of 18-80 years.

Male were found to be more affected than female. Male:Female was 3.2:1.

Multiple ECG findings can be seen in patients with cardiomyopathy such as T-wave inversion, ST-segment depression, pathologic Q waves. Certain ECG findings gives clue regarding the type of Cardiomyopathy. In our study, 80% is normal voltage and 20% low voltage ECG. Usually low voltage ECG are seen in restrictive type of cardiomyopathy. QRS complex normal in 78% with wide QRS complex with LBBB/ RBBB in 24 %, however LBBB is more common than RBBB. Sign of ST T changes were seen in 58% of subjects and was confirmed with cardiac enzymes to rule out signs of ischemia. Sinus tachycardia were seen in 26%.

Table 3: Frequency of various ECG findings in cardiomyopathy.

ECG findings		Frequency	Percent
Voltage	Normal	40	80
	Low	10	20
QRS complex	Normal	39	78
	Wide	10	20
Wide QRS	With LBBB/RBBB	12	24
	Without LBBB/RBBB	0	-
Evidence of ischemia	T Wave changes	17	34
	ST Wave changes	12	24
Tachycardia		13	26

DISCUSSION

Cardiomyopathies are diseases of the heart muscle producing impairments in construction or function of heart muscle without any evidence of pre-existing heart disease.^{1,2,7}

Types of cardiomyopathy

Most of cardiomyopathy patients are asymptomatic but some people may have breathlessness, feel tired, or have swelling of the legs due to heart failure, irregular heart beat as well as syncope and sudden cardiac death.² Cardiomyopathy is divided into two types on basis of aetiology: ischemic example- ischemic heart disease, non ischemic, hypertrophic cardiomyopathy, dilated, restricted, arrhythmogenic, post-partum, takotsubo (Stress) cardiomyopathy.

Traditionally cardiomyopathies are classified as- dilated, restrictive and hypertrophic on basis of autopsy specimen and prior to that on ECG as well as 2D- echo.

Dilated (congestive cardiomyopathy): This is the most common form of the disease that associated with heart cavity enlargements and stretched (cardiac dilation), resulting in weak and slow pumping of the blood, which causes formation of blood clots.^{1,2,4-10} Abnormal heart rhythms (arrhythmias) and disturbances in the electrical conduction processes in the heart may also occur. Most patients with this type of cardiomyopathy develop congestive heart failure. Barth syndrome a genetic disorder that can cause dilated cardiomyopathy mostly affects male children, and is usually diagnosed at birth or within the first few months of life.¹ Pregnant women during the last trimester of pregnancy or after childbirth may develop a type of dilated cardiomyopathy referred to as peripartum cardiomyopathy.^{1,2,4,11-13}

Hypertrophic cardiomyopathy

Hypertrophic cardiomyopathy, the muscle mass of the left ventricle enlarges, or hypertrophies. In hypertrophic obstructive cardiomyopathy (HOCM), the septum (wall) between the two heart ventricles (pumping chambers) becomes enlarged and obstructs blood flow from the left ventricle.^{1,2,14} HOCM is most common in young adults. HOCM is often hereditary, caused by genetic mutations in the affected person's DNA.^{1,2,4,15} The disease is either inherited through one parent who is a carrier or through both parents who each contribute a defective gene. HOCM is also referred to as asymmetrical septal hypertrophy (ASH) or idiopathic hypertrophic subaortic stenosis (IHSS). In another form of hypertrophic cardiomyopathy, non-obstructive cardiomyopathy, the enlarged heart muscle does not obstruct the blood through the heart.^{1,2,16-18}

Restrictive cardiomyopathy

This is a less common type of cardiomyopathy, in which the heart muscle of the ventricles becomes rigid. Restrictive cardiomyopathy affects the diastolic function of the heart, that is, it affects the period when the heart is relaxing between contractions. Since the heart cannot relax adequately between contractions, it is harder for the ventricles to fill with blood between heart beats. This type of cardiomyopathy is usually the result of another disease.^{1,2,4,5,10,19}

Arrhythmogenic right ventricular cardiomyopathy (ARVC)

ARVC is very rare and is believed to be an inherited condition. With ARVC, heart muscle cells become disorganized and damaged and are replaced by fatty tissues. The damaged cells are replaced with fat, leading to abnormal electrical activity (arrhythmias) and abnormal heart contractions. ARVC is the most common cause of sudden death in athletes.^{1,2,4,5,10,20-23} Extrinsic cardiomyopathies: Extrinsic cardiomyopathies are those that are not uniquely due to heart muscle cell abnormalities. Intrinsic cardiomyopathies: Intrinsic cardiomyopathies are due to abnormalities that originate in the heart muscle cell. Cardiomyopathy and myocarditis globally increase morbidity and mortality.^{1,2,4} Nowadays cardiomyopathy is the leading cause of cardiac transplantation. 11225% of heart failure patients associated with dilated cardiomyopathy.²⁴⁻²⁶ The most common non-ischemic cardiomyopathy with prevalence rate of 1:500 in the general population, on basis of recognition of the phenotype.²⁹ It is characterized by heterogeneous clinical expression and varies from asymptomatic to mild symptoms or severe heart failure and sudden cardiac death.⁷¹ Restrictive cardiomyopathy (RCM) is considered by diminished ventricular filling and drop in volume in both ventricle or only one with normal or near-normal systolic function.^{1,2,4,27} Because of the high prevalence of chronic congestive cardiac failure due to underlying

cardiomyopathy and the nonexistence of data on cardiomyopathy in study areas, this study was taken on among 50 cases of cardiomyopathy fulfilling inclusion criteria in a medicine department of tertiary care hospital in Pimpri Pune. Incidence of various cardiomyopathies in study population was ICM in 36 (72%) followed by DCM in 11 (22%), HOCM in 2 (4%) and RCM in 1 (2%). Cardiomyopathies can be without symptoms in early stages, but most important symptoms are due to low ejection fraction i.e systolic or preserved ejection fraction (diastolic type) of congestive cardiac failure. Commonest symptoms of congestive heart failure including breathlessness, palpitation, syncopal attack, easy fatigability, cough, orthopnoea, paroxysmal nocturnal dyspnoea, and oedema feet. All these features of congestive heart failure are associated with patients of dilated cardiomyopathy but their life expectancy with cardiomyopathy differs with aetiology, and death rate 20% in 1st year and 70-80% in 8th years after the development of congestive heart failure while most of patients with hypertrophic cardiomyopathy present with heart failure, but most common initial presentation would be sudden cardiac death.⁷¹ The commonest presentation in our study was instituted with right ventricular and LV failure which was seen in 76 % cases. Majority of patients had dyspnoea of NYHA grade 3 (42 %), grade 4 (30 %) while 24 % of patients were presented with NYHA grade 2. Commonest (96%) presentation being dyspnoea that was found in most of patients, followed by pedal oedema (76%), cough (34%) and fatigue (30%).

Electrocardiographic profile

Electrocardiography is one of the good modalities for initial assessments of underlines cardiac diseases including MI, heart block, bundle block, cardiomyopathy, electrolyte imbalance. It is easily available with low cost, non-invasive investigations. ECG can identify left ventricular hypertrophy, broad QRS complex with Q waves without any history of Coronary artery disease, and ST-changes. According to American College of Cardiology as well as European Society of Cardiology mentions that 1st degree relatives with hypertrophic obstructive cardiomyopathy who underwent for history and examination, Electrocardiography, and 2D echo in every patient with age group of 12 -18 years.⁵⁴ In present study maximum subjects had normal voltage (80%) low voltage ECG findings were in 20%, normal QRS complex in 78%, wide QRS complex in 20% and LBBB/RBBB in 24%. Evidence of ischemia like T wave changes in 34%, ST wave changes in 24% and tachycardia (26%) (Table 10). In one Indian study, they found ST-T changes seen in 90% of cases, while Left bundle branch block seen in 30% with atrial fibrillation in 5% of cases.⁹² In another study, ST-T changes were seen in 51%, while Left bundle branch block was found in 21% and atrial fibrillation (AF) in 15.7% cases.¹⁰⁴ ECG of restrictive cardiomyopathy in most of patient shows low voltage in spite of signs of left ventricular hypertrophy.²⁸

Same findings remained found in a case of restrictive cardiomyopathy in our study.

Electrocardiography of DCM

The ECG is usually abnormal and nonspecific.¹⁻⁵ 10May manifest with any of the following features.

Atrial enlargement

Left atrial or bi-atrial enlargement is common feature. First degree AV block: prolongation of P-R interval is common finding. Higher degrees of AV block are rare. Abnormalities of QRS complex- these include: a) Generalized low amplitude deflexions particularly affect frontal plane leads. b) Left QRS axis deviation. This is common manifestation, the mean manifest QRS axis being directed to the region of -30 to -50 degree. It is an expression of left anterior hemiblock and is due to involvement of anterosuperior division of the left bundle branch by the fibrotic process. c) Right QRS axis deviation. Is rare and is due to left posterior hemiblock or due to right ventricular hypertrophy. d) Left bundle branch block. DCM manifest with all degrees of LBBB. Complete LBBB is not uncommon. LBBB is usually associated with LAD. e) Right bundle branch block. It usually manifests with concomitant LAD. f) Left ventricular hypertrophy. Inverted T wave with slightly depressed convex upward S-T segment in V5 and V6 may be an expression of LVH and primary myocardial disease. g) Pathological Q waves- are infrequent and may involve left oriented or inferiorly oriented leads. It represents areas of inert fibrous tissue. Abnormalities of S-T segment and T wave- these are non-specific and may take form of T wave inversion and/or S-T segment depression in the left precordial leads or inferiorly oriented leads. Wide frontal and horizontal plane QRS-T angles exceeding 45 degree. Arrhythmias. – atrial and ventricular extrasystoles are common as well as atrial fibrillation.^{1,29}

Electrocardiography of hypertrophic cardiomyopathy

Ventricular hypertrophy- may affect one or more of the following regions.^{1,2,4,30} a) Interventricular septum-hypertrophy of the IVS may result in an increase in magnitude of the septal vector and will result in prominent, relatively deep but narrow Q waves in the left and inferiorly oriented leads. b) The free left wall- left ventricular hypertrophy due to systolic overload i.e deep S waves in right oriented leads (V1 and V2) and tall R waves and inverted T in left oriented leads (V5 and V6). c) Apical and para septal ventricular hypertrophy- resulting in tall R waves in leads V2 and V4 and lead II. The associated T waves in mid precordial leads are deeply inverted. d) Right ventricular hypertrophy- uncommonly affected may present with right axis deviation, right ventricular systolic overload, right atrial enlargement, complete or incomplete RBBB. Intraventricular conduction defects- HCM most commonly associated with left anterior hemiblock and left bundle branch block. Atrial enlargement- ECG reflects left

and/or right atrial enlargement. An uncommon presentation of right atrial enlargement with left ventricular hypertrophy or strain is very suggestive of HCM. Short P-R interval in few cases. WPW syndrome-HCM has an uncommon association with WPW syndrome in few cases. Prolongation of Q-T interval. Disturbances of cardiac rhythm- ventricular extrasystoles, paroxysmal ventricular tachycardia may cause sudden death. SVT and atrial fibrillation can occur.

Limitations

Less number of cases have been included in our study. Due to low socio-economic status, most of the patients denied follow up and refused to get specific investigations such as ECG, 2D echo, coronary angiography. Genetic disease such as ARVC, HCM are not oftenly diagnosed with genetic studies. There may be conflicts arising from cultural bias and other personal issues.

CONCLUSION

ECG is an accessible, low cost diagnostic and prognostic tool. Most common findings in cardiomyopathy is biventricular hypertrophy and left bundle branch block with wide QRS complex, low voltage ECG and ST changes as also seen in present study. In addition HFrEF <45%, are associated with more ECG changes. Thus ECG can be initial investigation for cardiomyopathy and can give us clue for further investigations and management of different types of cardiomyopathy.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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