

# Electrocardiographic and echocardiographic characteristics of patients with dilated cardiomyopathy

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## Abstract

**Background:** Dilated cardiomyopathy (DCM) is a syndrome characterized by cardiac enlargement and impaired systolic function of one or both ventricles. Due to increased awareness of this condition along with improvement in diagnostic techniques, dilated cardiomyopathy is being recognized as a significant cause of morbidity and mortality. The current study aimed at understanding the electrocardiographic and echocardiographic characteristics of DCM patients. **Material and Methods:** A total of 50 patients (30 males and 20 females) of dilated cardiomyopathy were studied. ECG and 2D Echocardiography was done among all these patients using standard techniques. Diagnosis of dilated cardiomyopathy done by echocardiography. **Results:** All ages were affected but elderly and middle aged population were found to be predominantly affected. Left axis deviation, LVH, bundle branch block, atrial fibrillation were common ECG abnormalities. The ECHO findings in patients revealed a dilated LV cavity with low ejection fraction. Valvular regurgitation were seen in 86% of patients predominantly MR.

**Key Words:** Dilated cardiomyopathy, electrocardiography, 2D Echo, Screening.

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## INTRODUCTION

Cardiomyopathy is a primary disorder of the heart muscle that causes abnormal myocardial performance and is not result of disease or dysfunction of other cardiac structures, systemic arterial hypertension and valvular stenosis or regurgitation<sup>1</sup>. World Health Organization (WHO) and American Heart Association (AHA) classified cardiomyopathies into dilated, hypertrophic and restrictive type depending upon the basic disturbance of the function<sup>2,3</sup>. Dilated cardiomyopathy (DCM) is a

syndrome characterized by cardiac enlargement and impaired systolic function of one or both ventricles. With increasing awareness of this condition along with improvement in diagnostic techniques dilated cardiomyopathy is being recognized as a significant cause of morbidity and mortality. DCM is considered to be an important cause of heart failure and accounts for up to 25% of all cases of congestive heart failure<sup>4</sup>. The Framingham study has reported 10% annual mortality rate for subjects having congestive cardiac failure<sup>5</sup>. Due to the increasing use of electrocardiogram (ECG) and 2D echocardiography, the incidence of dilated cardiomyopathy is also showing rising trend. It is a topic of interest of physician, cardiologist, cardiac surgeons and many other group of scientists. The present study was therefore undertaken to study the electrocardiographic and echocardiographic findings in patients with dilated cardiomyopathy.

## MATERIAL AND METHODS

The present study was performed in 50 patients of dilated cardiomyopathy either admitted in a teaching hospital or

attending cardiology clinic. 30 patients were male and 20 were female. Patients were selected from those presenting with signs and symptoms of congestive cardiac failure, asymptomatic patients having unexplained cardiomegaly on chest X-ray and abnormal ECG changes. Diagnosis of dilated cardiomyopathy was done by echocardiography<sup>1</sup>. Patients were excluded from the study with signs and symptoms of congestive cardiac failure with cardiomegaly on chest X-ray due to other diseases like coronary artery disease (past history of myocardial infarction, significant Q wave in ECG, scars or akinetic segment on ECHO), rheumatic valvular heart disease (by history echocardiography), congenital heart disease (by echocardiography) and pericardial disease (by echocardiography). After selection of patients, detail history was obtained from each patients. Each patient was specifically asked about dyspnea, palpitation, fatigability, sweating, swelling over feet, abdominal pain, syncope, and chest pain. Patient was asked regarding the major illness like Hypertension, Diabetes Mellitus, Myocardial Infarction, Renal disease, COPD. Family history suggestive of dilated cardiomyopathy was asked. Complete clinical examination was carried out. On physical examination, special attention was given to presence of raised JVP, edema, gallop rhythm, systolic murmur, respiratory rate and congestive hepatomegaly. Routine laboratory investigations such as BSL profile, Liver function tests, Renal function tests, Serum calcium and phosphorus, and serum cholesterol were done.

**Electrocardiography (ECG)**

Standard 12 lead electrocardiograms were recorded as 25 mm per second and 1 mV per cm standardization. Rate, rhythm, P-R interval, QRS interval, QTc interval were measured. QRS axis was determined in frontal plane. Axis directed to the region between 0 counter clockwise to 90 was taken as left axis deviation. P wave abnormalities were noted. Left atrial enlargement was defined as P terminal force in V1 equal to more negative than -0.04 mm sec or notched P wave with duration of 0.12 second or more. Right atrial enlargement was the presence of peaked P wave with a height of 2.5 mm or more in a lead II, III, and avF. Biatrial enlargement was defined as presence of large diphasic P wave in lead V1 with the initial positive component reading greater than 1.5 mm and the terminal negative component reading 1 mm in amplitude and 0.04 sec. in duration. Left ventricular hypertrophy was defined as per Sokolows criteria<sup>103,104</sup> as R-wave in V5 or V6 + S-wave in V1 > 35 mm. ratio of R wave in V6 and maximum R wave in leads I, II, III (RV6/R max.) was calculated to find out the correlation the correlation of this ratio with ventricular dilatation and ejection fraction<sup>103</sup>. ST segment and T wave abnormalities were noted.

**Echocardiography**

Comprehensive M-mode, two dimensional and Doppler echocardiographic examinations were performed in all patients. Various measurements were done using long axis, short axis, two chamber and four chamber views. Measurements of left ventricular inner diameter in diastole (LVIDd), Left ventricular inner diameter in systole (LVIDs), Ejection fraction (EF), Right ventricle, Left atrium(LA), Intraventricular septum (IVS) and of Left Ventricular Posterior wall thickness (LVPW) were taken and compared with standard normal values in adults. Patients having left ventricular dilatation and ejection fraction less than 40 per cent were diagnosed as dilated cardiomyopathy and included in the study. Patients looked for scar and akinetic segments and such patients were excluded from study. Valvular regurgitations were semi-quantitatively assessed with colour flow Doppler echocardiography. Other features like diastolic dysfunction, pulmonary hypertension, pericardial effusion and intra-cavitary clots were looked for.

**RESULTS**

In present study dilated cardiomyopathy was more common in the middle age, most common in fifth decade. Males were affected more common than female (M: F ratio - 3:2) (Table 1).

**Table 1: Age and Sex distribution**

Demographic data	No. of cases	%
<b>Age in years</b>		
10-19	02	04
20-29	06	12
30-39	06	12
40-49	17	34
50-59	08	16
>60	11	22
<b>Sex</b>		
Male	30	60
Female	20	40

In the present study, range of QRS axis was from -50<sup>0</sup> to + 90<sup>0</sup>. Left axis deviation was seen in 22 (44%) patients. Mean ventricular rate in the present study was 107.0±10.51 per min. PR interval ranged from 0.16 to 0.26 seconds with mean of 0.176±0.0303 seconds. 5 patients (10%) had first degree AV block. No patients had second or third degree AV block. P waves were absent in 5 patients with atrial fibrillation, 14 (28%) patients had abnormal P waves. Mean left ventricular QRS voltage (S in V<sub>1</sub> + R in V<sub>5</sub> or V<sub>6</sub>) was 32.38 ± 11.08 mm. 22 patients had evidence of LVH on ECG (Table 2 and 3).

**Table 2: ECG Features in dilated cardiomyopathy patients (n=50)**

ECG features	No. of patients	Percentage
Left axis deviation (<math>\lt;0^{\circ}</math>)	22	44
Atrial enlargement Total	14	
Right	04	28
Left	08	
Biatrial	02	
Left ventricular hypertrophy (S in V1 + R in V5/V6 > 35mm)	22	44
R V6 / R max $\geq$ 0.3	19	38
QRS duration $\leq$ 0.10 sec	31	62
0.11 to 0.12 sec	10	20
$\geq$ 0.12 sec	09	18
AV Blocks Total	05	10
First degree	05	10
Second degree	00	00
Third degree	00	00
Bundle branch block Total	19	38
LBBB	09	18
RBBB	03	06
LAHB	07	14
Arrhythmia Total	09	18
Atrial fibrillation	05	10
Ventricular ectopics	03	06
Non-sustained VT	01	02

**Table 3: ECG Abnormalities in Dilated Cardiomyopathy**

ECG Features	Mean	SD
Rate (per min)	107.0	10.51
PR Interval (sec)	0.176	0.0303
QRS Interval (sec)	0.0986	0.0293
QT Interval (sec)	0.4118	0.0245
S1+RV6	32.38	11.08
RV6/RMAX	02.605	0.851

In present study, left ventricular dimensions were less but all patients had global hypokinesia and poor ejection fraction. LVPW and IVS thickness was within normal limits. Right ventricular dilatation was seen in 20 (40%)

of patients and mean right ventricular diameter was  $22.84 \pm 7.20$  mm. Left atrial enlargement was seen in 27 (54%) patients and mean LA diameter was  $40.94 \pm 6.30$  mm. Valvular regurgitation was seen in 43 (86%) of patients. There was isolated MR in 12 (24%) of patients, while MR was associated with TR in 26 (52%) patients and with TR and AR in 4 (8%) patients. There was isolated TR in 1 (2%) patient. Diastolic dysfunction was present in 21 (42%) patients in the present study. Pericardial effusion was present in 15 (30%) patients. In 5 (10%) patients, clots were detected (Table 4 and 5) (Fig. 1 and 2).

**Table 4: Echocardiographic Features of DCM**

2D ECHO Features	No. of cases	%
LA>40	27	54
RV>23	20	40
Diastolic Dysfunction	21	42
Valvular Regurgitation	43	
MR	12	
TR	01	86
MR+TR	26	
MR+TR+AR	04	
Pericardial Effusion	15	30
CLOTS	05	10
Pulmonary HT	12	24

**Table 5: 2D ECHO features of DCM**

2D ECHO Features	Mean	SD
LVIDd	60.78	06.56
LVIDs	50.38	07.86
RV	22.84	07.20
LA	40.94	06.30
IVS	09.39	01.57
LVPW	09.52	01.45
EF	28.60	06.60

**Fig 1 and 2: Echocardiographic features of dilated cardiomyopathy**

## DISCUSSION

In the present study dilated cardiomyopathy was more common in middle age and elderly but commonest age group affected was 31-70 years. Males were affected

more than females. Studies by Roberts *et al*<sup>6</sup>, Pelliccia *et al*<sup>7</sup> and Parale *et al*<sup>8</sup> reported 45, 48 $\pm$ 11 and 51.6 years commonest age group respectively. Mean ventricular rate in the present study was 107.0 $\pm$ 10.51 per min. Most of

the patients had sinus tachycardia as they were in congestive heart failure. Tachycardia in patients with dilated cardiomyopathy is also reported by studies done by Werner *et al*<sup>9</sup>, Wilensky *et al*<sup>10</sup>. In the present study, range of QRS axis was from  $-50^{\circ}$  to  $+90^{\circ}$ . Left axis deviation was seen in 22 (44%) patients. Roberts *et al*<sup>6</sup> have reported left axis deviation in 43% and right axis deviation in 7% of patients. Wilensky *et al*<sup>10</sup> have found that range of QRS axis was from  $-130^{\circ}$  to  $+130^{\circ}$  and mean QRS axis was  $-21^{\circ}$ . Parale *et al*<sup>8</sup> have found left axis deviation in 59% of patients. Techuan Chou<sup>11</sup> mentioned left axis deviation in 42% of patients of dilated cardiomyopathy. Findings in the present study were comparable with other studies. In the present study, PR interval ranged from 0.16 to 0.26 seconds with mean of  $0.176 \pm 0.0303$  seconds. 5 patients (10%) had first degree AV block. No patients had second or third degree AV block. In a study by Wilensky *et al*<sup>10</sup>, mean PR interval was 0.20 sec. (Range 0.14 – 0.29). Barbosa *et al*<sup>12</sup> found first and second degree AV block in 11% and Scholler *et al*<sup>13</sup> found first degree AV block in 17.6% and second degree AV block in 10.6%. AV blocks are poor prognostic markers in dilated cardiomyopathy and the progress over time with increasing fibrosis and myocyte hypertrophy. In the present study, AV block were seen in 10% of cases comparable to other studies. In the present study, P waves were absent in 5 patients with atrial fibrillation, 14 (28%) patients had abnormal P waves. Techuan Chou<sup>11</sup>, in a series of 40 patients, noted P wave abnormalities in 15 patients. Left atrial enlargement was the most common feature. Roberts *et al*<sup>6</sup> and Barbosa *et al*<sup>12</sup> also found left atrial enlargement more commonly than right atrial or biatrial enlargement. In the present study mean left ventricular QRS voltage (S in  $V_1 + R$  in  $V_5$  or  $V_6$ ) was  $32.38 \pm 11.08$  mm. 22 patients had evidence of LVH on ECG. Results in the present study were comparable with other studies<sup>6,14</sup>. Techuan Chou<sup>11</sup> mentioned that relative incidence of LBBB in idiopathic dilated cardiomyopathy is higher than in IHD. In patients with cardiomegaly of unknown cause, the presence of LBBB further supports the diagnosis of primary myocardial disease. Abnormal left axis deviation consistent with LAHB was also common, occurring in as many as 42% in some series<sup>15</sup>. Many of the studies had used 24 hours ambulatory ECG monitoring for the detection of arrhythmia, incidence in studies by Scholler *et al*<sup>13</sup>, Anderson *et al* (19%)<sup>16</sup> and Parale *et al* (12%)<sup>8</sup> was much higher than present study. 2D Echocardiographic observations during the study period revealed dilated poorly contracting ventricles as features of dilated cardiomyopathy. Left ventricular dimensions were less (mean LVIDd= $60.78 \pm 6.56$  mm; LVIDs= $50.38 \pm 7.86$  mm) but all patients had global hypokinesia and poor ejection fraction (mean ejection

fraction= $28 \pm 7.0\%$ ) which was comparable to studies by Karl *et al*<sup>17</sup> and Fazio *et al*<sup>18</sup>. Abbassi *et al*<sup>19</sup> found that left ventricular posterior wall motion was markedly reduced in congestive cardiomyopathy. According to Harvey Feigenbaum<sup>20</sup>, both septal and posterior ventricular walls moves poorly, however, wall thickness in within normal limits. In the present study, LVPW and IVS thickness was within normal limits. In the present study, right ventricular dilatation was seen in 20 (40%) of patients and mean right ventricular diameter was  $22.84 \pm 7.20$  mm. According to Dec *et al*<sup>21</sup>, idiopathic dilated cardiomyopathy is diffuse process and concomitant right ventricular dysfunction is seen in 85-90% of patients. Werner *et al*<sup>9</sup> found that mean right ventricular diameter was  $27 \pm 6$  mm in surviving patients and  $29 \pm 4$  mm in patients who died at the end of study. Right ventricular dilatation was a predictor of mortality. In the present study, left atrial enlargement was seen in 27 (54%) patients and mean LA diameter was  $40.94 \pm 6.30$  mm. In a study done by Karl *et al*<sup>17</sup>, mean left atrial diameter was  $47 \pm 7$  mm. In the present study, valvular regurgitation was seen in 43 (86%) of patients. There was isolated MR in 12 (24%) of patients, while MR was associated with TR in 26 (52%) patients and with TR and AR in 4 (8%) patients. There was isolated TR in 1 (2%) patient. Werner *et al*<sup>9</sup> found the presence of MR in most of the patients with dilated cardiomyopathy. Karl *et al*<sup>17</sup> found that MR was present in 89% of the patients. This finding was a marker of poor outcome in patients with either ischemic or idiopathic dilated cardiomyopathy. In heart failure, the functional MR is frequently attributed to one of 3 factors – LV enlargement, dilatation of mitral valve annulus or dysfunction of the papillary muscles. Diastolic dysfunction was present in 21 (42%) patients in the present study. Bahl *et al*<sup>22</sup> in their study of LV diastolic dysfunction in patients of idiopathic dilated cardiomyopathy that patients with advanced disease demonstrate a restrictive pattern on pulse Doppler echocardiography. Similar findings were reported by Karl *et al*<sup>17</sup>. Diastolic dysfunction is very complex and is influenced by several factors such as age, systolic function, heart rate atrioventricular pressure gradient, preload and mitral regurgitation Anderson *et al*<sup>16</sup> have shown the presence of diastolic dysfunction even in patients without LV dilatation. In the present study, pericardial effusion was present in 15 (30%) patients. In the present study, in 5 (10%) patients clots were detected. In a study done by Robert *et al*<sup>6</sup> on necropsy of patients of dilated cardiomyopathy, intracavitary thrombi were present in 53% cases. Blood stasis and low shear rate in that hypocontractile ventricle lead to the activation of coagulation process. Intracavitary thrombi are most commonly seen at the left ventricular apex<sup>21</sup>. The study

concluded that regular echocardiographic screening of patients with dilated cardiomyopathy is very important to identify and prevent complications among them.

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