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Research Article

A STUDY OF CLINICAL AND ECHOCARDIOGRAPHIC PROFILE IN PATIENTS OF DILATED CARDIOMYOPATHY

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ABSTRACT

Objective: Dilated cardiomyopathy (DCM) is the third most common cause of heart failure (HF) and is the most common cardiomyopathy. The present study was undertaken with the aim to study the different clinical presentations of DCM, to correlate echocardiography findings with different clinical presentations, and to find out the variables which determine the poor outcomes.

Methods: This prospective observational study was conducted in the Department of General Medicine of MKCG Medical College and Hospital, Berhampur, Odisha, India, from November 2019 to November 2021. Fifty cases of dilated cardiomyopathy (28 males and 22 females), diagnosed on clinical and echocardiography criteria in the department of general medicine and cardiology, were selected for the study.

Results: Out of 50 cases, there were 28 (56%) males and 22 (44%) females giving male-to-female ratio 1.27:1. Forty (80%) were idiopathic. Dyspnea was most common presenting clinical feature in 43 (86%) cases. In echo study, maximum number of cases (n=21, 42%) were having ejection fraction in the range of 36–40% and maximum number of cases (n=26, 52%) had severe fractional shortening.

Conclusion: DCM is one of the most common causes of HF and is the most common type of cardiomyopathy found in middle-aged and elderly male population. Biventricular failure followed by the left ventricular failure was the most frequent clinical presentation. Early identification and treatment are very essential to improve cardiac function and alleviate patient symptomology.

Keywords: Dilated cardiomyopathy, Ejection fraction, Fractional shortening.

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INTRODUCTION

Dilated cardiomyopathy (DCM) is a disease of the heart muscle characterized by enlargement and dilation of one or both of the ventricles along with impaired contractility defined as left ventricular ejection fraction (LVEF) <40%. By definition, patients have systolic dysfunction and may or may not have overt symptoms of heart failure (HF). This disease process can be classified as either primary or secondary DCM. Primary DCM is considered idiopathic and the diagnosis can only be made after excluding secondary causes [1].

DCM is characterized by an enlarged left ventricle with reduced systolic function as measured by the left ventricular EF. It represents the final common pathway produced by a variety of ischemic, toxic, metabolic, and immunological mechanisms damaging the heart muscles. Though the initial insult to the myocardium may vary, pathophysiology and clinical presentation are similar in all varieties. Congestive HF, usually left ventricular failure, is the most common clinical presentation. The patient can also present with symptoms secondary to arrhythmias, stroke (embolic infarction), or sudden death. Systolic failure is more prominent than diastolic dysfunction. Although the syndrome of DCM has many disparate etiologies, many converge to common pathways of secondary response and disease progression.

The prevalence of HF is about 1–1.5% of adult population. The mortality and morbidity remain high (median survival of 1.7 years for men and 3.2 years for women). It occurs 3 times more frequently in males as compared to females. It is also more common in Black [2].

In the southern part of Odisha, the prevalence and incidence of HF due to DCM is quite significant. In spite of such a large number of patients with HF due to DCM, very few studies have been conducted with regard to the clinical profile and echocardiographic abnormalities.

Keeping this in view, the present study was undertaken with the following aims and objectives which were

- To study the different clinical presentations of DCM
- To correlate echocardiography findings with different clinical presentations
- To find out the variables which determine the poor outcomes.

METHODS

A prospective observational study was designed and conducted in the Department of General Medicine in MKCG Medical College and Hospital, Berhampur, Odisha, India, over a period of 2 years from November 2019 to November 2021. The study was conducted after the study protocol was approved by the Institutional Ethics Committee (No. 960/Chairman-IEC, MKCG Medical College, Brahmapur-4). Informed consent was obtained from all the patients and the study was done in accordance with the guidelines of the Declaration of Helsinki 2008.

Detailed present, past, personal, drug, and family history of all the patients were taken for the evaluation of DCM and to differentiate secondary causes of DCM.

Exclusion criteria

The following patients with

1) Essential hypertension
2) Congenital heart disease
3) Valvular heart disease

4) Coronary artery disease
5) Pericardial disease were excluded from the study.

Clinical criteria

DCM

These were the group of patients from which all possible non familial causes of DCM were excluded.

Non-familial dilated cardiomyopathies

a) Peripartum cardiomyopathy – American Heart Association (AHA)
   - Development of cardiac failure in the last month of pregnancy or within 5 months of delivery.
   - Absence of identifiable causes of cardiac failure.
   - Absence of recognizable heart disease before the last month of pregnancy.

b) Alcoholic cardiomyopathy (AHA)
   DCM developing in patients taking 80 g per day for males and 40 g per day for females for more than 5 years.

c) Anthracycline cardiomyopathy
   DCM in patients (susceptible individuals) on cancer treatment receiving a cumulative dose of > 550 mg/m^2 of doxorubicin.

Echocardiographic criteria

1) Internal dimension of ventricles at end diastole is increased while septal and free wall thickness reminds normal or reduced.
2) Abnormal ventricular contractility is the sine qua non of IDC (idiopathic DCM) and EF <45% is generally required for diagnosis.
3) Global hypokinesia.
4) Intracavitary thrombi most frequently seen at the left ventricular apex.
5) Mitral regurgitation and tricuspid regurgitation due to dilation of annulus.

Assessment of LV systolic function

The left ventricular end-diastolic diameter (LVEDD) is the end of diastole. The normal ranges 3.5–5.6 cm.

The left ventricular end-systolic diameter (LVESD) is at the end of systole, which occurs at the peak downward motion of the interventricular septum (IVS). The normal ranges 2–4 cm.

Fractional shortening (FS) is the % change in the LV internal dimensions between systole and diastole.

$$FS=\frac{LVEDD-LVESD}{LVEDD}\times 100$$

Normal ranges 30–45%.

The ejection of fraction (EF) is the % change in LV volume between systole and diastole and is calculated by,

$$EF=\frac{LVEDD-LVESD}{LVEDD}\times 100$$

Wall thickness can be measured.

Normal ranges 6–12 mm

Thin <6 mm as DCM

Thick >12 mm as LV hypertrophy.

Diastolic function

2D echo does not help to make care direct assessment of LV diastolic dysfunction. Using M mode, motion of anterior mitral value leaflet (AMVL) during diastole has a characteristic M-shaped (EA) pattern. In the normal heart, there is characteristic mitral flow pattern.

The E wave is the result of passive early diastolic LV filling. The A wave represents active late diastolic LV filling due to LA contraction.

The acceleration time (AT) and deceleration time (DT) of the E-wave can be measured. AT is the time from onset of diastolic flow to the peak of E wave. The DT is the time from peak to the point where the deceleration slop hits the baseline.

If the LV is stiffer than usual then diminished AMVL excursion (E wave), increase in A wave size and reduced E: A ratio are seen.

The isovolumic relaxation time is usually 48–65 ms. The IVRT (isovolumic relaxation time) often increases the diastolic dysfunction.

Two abnormal mitral flow patterns are recognized.

Slow relaxation pattern – E wave small, A wave large, AT is prolonged, IVRT prolonged. Decrease LV relaxation due to diastolic dysfunction associated with LV hypertrophy or myocardial ischemia.

Restrictive pattern – E wave very tall, A wave is small, DT short, IVRT short. Reduced LV filling may be caused by restrictive cardiomyopathy or constrictive pericarditis (conditions causing rapid use of LV diastolic pressure).

RV function

Using M mode and 2D echo, estimates can be made of RV internal dimension, wall thickness, and EF.

Intracardiac thrombus

2D imaging is the best technique to identify thrombus which is usually echo bright, the following favor the diagnosis of thrombus.

Mural thrombus does not thicken during systole while myocardium thickens.

Wall motion near a thrombus is nearly always abnormal whereas it is often normal near other pathology (e.g., tumor)

Thrombus usually has clear identifiable edge which distinguishes it from hazy stagnant blood.

Color floor mapping can distinguish thrombus from stagnant flow.

Fifty cases of dilated cardiomyopathy (28 males and 22 females), diagnosed thus on clinical and echocardiography criteria in the department of general medicine and cardiology, were selected for the study.

Then, detailed investigations were done which included blood examinations such as fasting blood sugar, postprandial blood sugar, serum urea, serum creatinine, Na^+, K^+, sickling test, Hb electrophoresis, thyroid function tests, liver function tests (LFTs), HIV, hepatitis C, serum ferritin, Vitamin B-12 and folate and ECG, chest X-ray, and echocardiography (2D and Doppler). The results thus obtained were documented, analyzed and conclusion drawn about clinical features, electrocardiography and echocardiographic correlation of DCM were recorded.

Statistical analysis

Data were entered using Microsoft Excel and exported to SPSS version 17.0. The association between variables was analyzed using Chi-square test for categorical variables. $p<0.05$ was considered statistically significant.

RESULTS

Out of 50 cases who fulfilled clinical and echocardiographic criteria for DCM, 28 (56%) were male and 22 (44%) were female, with a male: female ratio of 1.27:1. The maximum number of cases was found

to be 18 (36%) which appeared in the age group (61–70 years). The youngest case was of age 14 years and oldest case was of age 77 years (Table 1 and Fig. 1).

Out of 50 cases, 40 cases were idiopathic for which an etiology could not be found out by history or investigations. Ten cases belonged to non-familial/secondary type of DCM of which two were peripartum cardiomyopathy, four were associated with alcoholism, two with thyrotoxicosis, and two with hypothyroidism. None of these cases were having diabetes mellitus, hypertension, or history of ischemic heart disease. The mean age of presentation of peripartum cardiomyopathy was 27 years. Out of these two cases, one case was Gravida III and one was Gravida II (Table 2 and Fig. 2).

Table 3 shows the various types signs and symptoms at the time of admission. Dyspnea was the most common presenting clinical feature (n=43, 86%), followed by palpitation (n=14, 28%), peripheral edema (n=10, 20%), and syncope (n=8, 16%). Two cases were presented with left hemiparesis (embolism) (Fig. 3).

Out of 43 cases presenting with dyspnea, 17 cases (39.53%) belonged to NYHA Class-IV, 15 cases to NYHA Class-II (34.88%), and 11 cases to NYHA Class-III (25.58%) (Table 4).

Maximum number of cases (n=21, 42%) were having EF in the range 36–40% followed by 16 cases (32%) in the range 31–35% (Table 5 and Fig. 4).

Out of 50 patients, 52% of patients had severe FS, 40% had moderate, and 8% had mild FS (Table 6 and Fig. 5).

Out of 18 mitral regurgitation cases, two were of Grade III, one was of Grade I, and others were of Grade II in severity. The aortic regurgitation noted in six cases were of Grade I in severity. Out of the two pericardial effusions, one was associated with peripartum cardiomyopathy and the other with hypothyroidism. Pulmonary artery hypertension was noted in three cases. The left ventricular clot was found in three cases, of which two patients presented with left-sided hemiparesis. Diastolic

Table 1: Age and sex distribution of cases

Age in years	No. of cases in percentage				Total	
	Female		Male		No.	%
	No.	%	No.	%		
14–20	1	2	0	0	1	2
21–30	2	4	0	0	2	4
31–40	1	2	2	4	3	6
41–50	3	6	4	8	7	14
51–60	7	14	9	18	16	32
61–70	8	16	10	20	18	36
71 and above	0	0	3	6	3	6
Total	22	44	28	56	50	100

Table 2: Distribution of types of DCM (idiopathic and other causes)

Types of DCM	No. of cases	Percentage
Idiopathic	40	80
Alcohol-induced cardiomyopathy	4	8
Hypothyroidism	2	4
Thyrotoxicosis	2	4
Peripartum cardiomyopathy	2	4
Total	50	100

DCM: Dilated cardiomyopathy

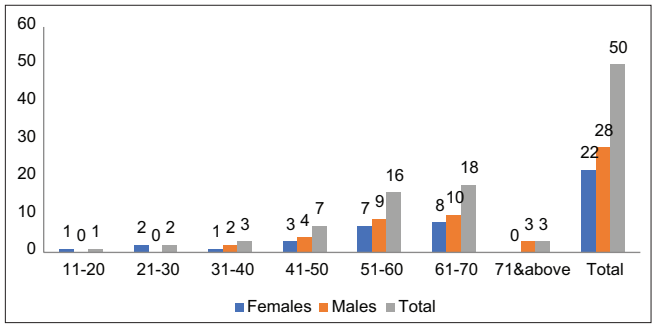

Fig. 1: Age and sex distribution of cases

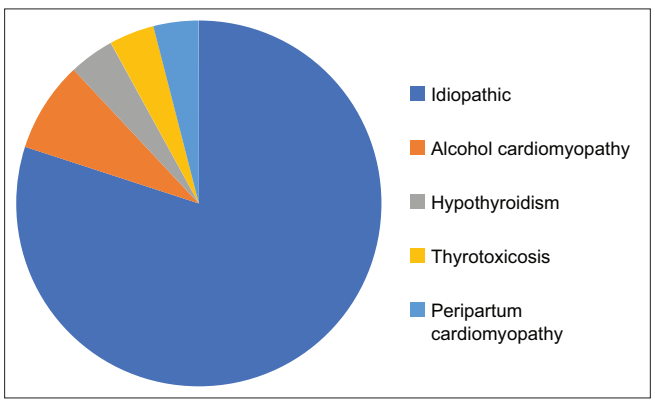

Fig. 2: Distribution of types of dilated cardiomyopathy (idiopathic and other causes)

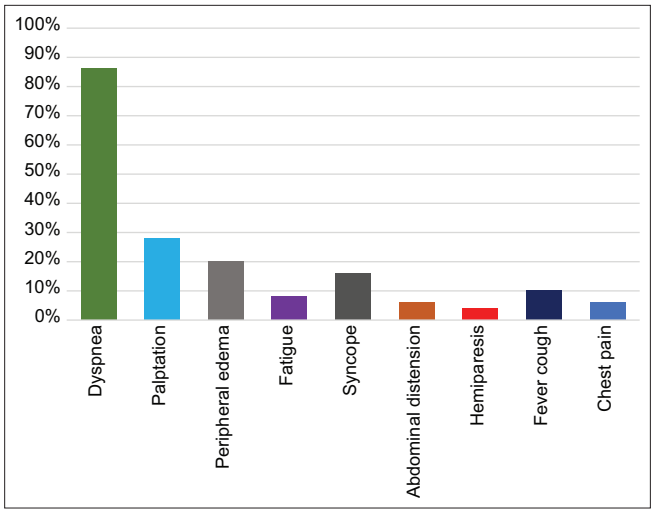

Fig. 3: Presenting clinical features at the time of admission

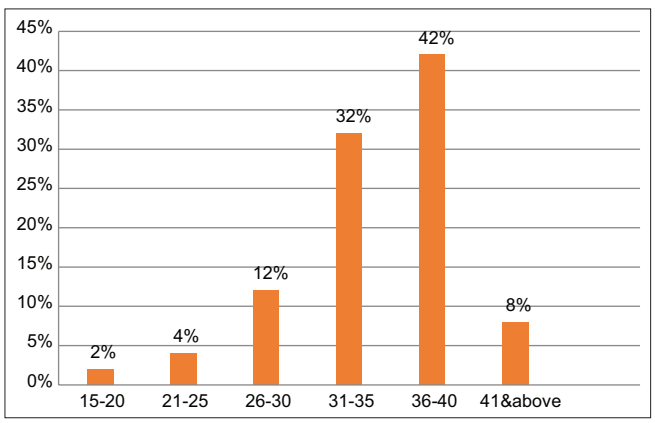

Fig. 4: Ejection fraction in %

Table 3: Presenting clinical features at the time of admission

Presenting features	No. of cases	Percentage
Dyspnea	43	86
Palpitation	14	28
Peripheral edema	10	20
Fatigue	4	8
Syncope	8	16
Abdominal distension	3	6
Hemiparesis	2	4
Fever cough	5	10
Chest pain	3	6
Total	50	100

Table 4: Distribution of patients presenting with dyspnea according to NYHA classification

NYHA	Number of cases	Percentage
I	0	0
II	15	34.88
III	11	25.58
IV	17	39.53
Total	43	100

Table 5: Ejection fraction in %

Ejection fraction in %	No. of cases	Percentage
15–20	1	2
21–25	2	4
26–30	6	12
31–35	16	32
36–40	21	42
41 and above	4	8
Total	50	100

Table 6: Severity of fractional shortening

Fractional shortening in %	No. of cases	Percentage
Mild (20–25%)	4	8
Moderate (15–20%)	20	40
Severe (<15%)	26	52
Total	50	100

Table 7: Other associated findings in echocardiography

Findings	No. of cases	Percentage
Mitral regurgitation	18	36
Tricuspid regurgitation	13	26
Aortic regurgitation	6	12
Left ventricular clot	3	6
Left atrial enlargement	25	50
Right ventricular dilatation	18	36
Pericardial effusion	2	4
Diastolic dysfunction	5	10
Pulmonary artery hypertension	3	6
Total	50	100

dysfunction was noted in five cases, four in idiopathic and one with alcoholic cardiomyopathy. The left atrial dilatation >40 mm (normal 19–40 mm) was noted in 25 cases (50%) and the right ventricular dilatation internal dimension >26 mm was noted in 18 cases (36%) (Table 7 and Fig. 6).

Table 8 shows that out of 50 cases, eight cases were presented with syncope out of which seven were associated with severe LV dysfunction. On applying the Fisher exact test to test the association of syncope with

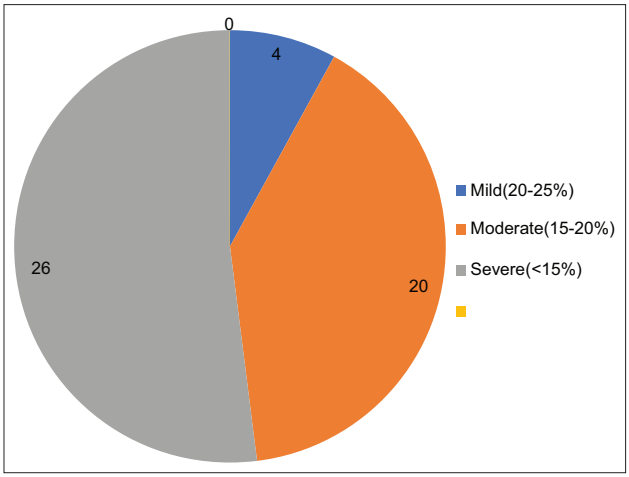

Fig. 5: Severity of fractional shortening

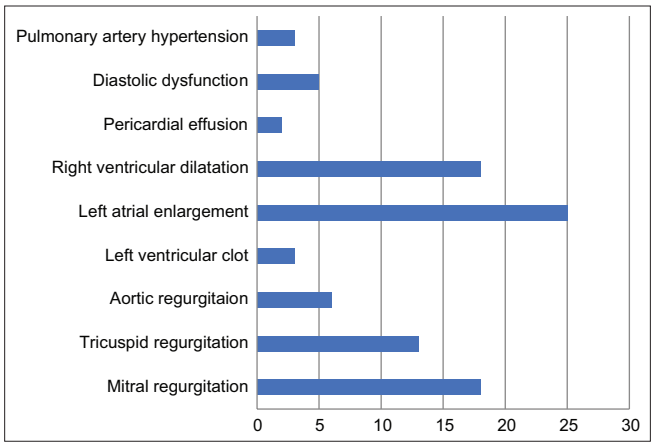

Fig. 6: Other associated findings in echocardiography

severity of LV function, with probability of significance (0.05), the value is 0.0488 and p<0.05 was considered. Hence, the association of syncope and severity of LV function is statistically significant and so syncope can be considered as poor prognostic factor.

From Table 9, it is evident that severe symptoms (NYHA – IV) have statistically significant association with EF <35%. At degree of freedom, the Chi-square statistic with Yates correction is 4.5037, p=0.033822 was considered. The severity of symptoms has statistically significant association with enlarged left atrial size (>40 mm) and right ventricular dilatation (>26 mm). The X^2 value was 7.4449 and 13.1435, respectively, and p=0.006362 and 0.000289, respectively, was considered. However, the extent of the left ventricular end-diastolic internal dimension has no statistically significant association with severity of symptoms. The χ^2 value was 0.061 and p=0.804933 was considered.

FS has moderate correlation with EF and is a good predictor of LV dysfunction (Fig. 7).

Analysis of clinical and echocardiographic findings with final outcome

Out of 50 cases, nine patients died, 17 patients were in NYHA Grade IV, 15 were in NYHA Grade II, and 11 were in NYHA Grade III.

DISCUSSION

Out of 50 cases, there were 28 males (56%) and females 22 (44%), giving male-female ratio of 1.27:1, the maximum number of cases (n=18) appeared in the age group of 61–70 years. The mean age was

56 years. The mean age of males was 60 years and that females was 53 years.

In various epidemiological studies, the incidence and prevalence of DCM were found to be more in males than in females.

In 2021, Orphanou *et al*. reported that prevalence seemed to slightly higher in males with a female-to- male ratio between 1:1.3 and 1:1.5 [3]. Minnesota study reported male/female sex ratio as 3:1 [4].

In Indian studies, Singh *et al.* reported that M: F ratio is 1.55:1 [5]. Ahmad *et al.* reported M: F ratio 1.17:1 [6]. Canata *et al*. studied the sex differences in the long-term prognosis of patients in a total of 1113 patients with DCM and found out that long-term outcomes of women affected by DCM are more favorable than those of men, and sex emerged as an important independent factor, particularly for cardiovascular outcomes [7]. Mahmaljy *et al*. reported that most patients were seen between ages of 20 and 60 years. However, the disorder may also affect children and the elderly [1].

This study matches with the study conducted by Dudharejia *et al.*, with idiopathic as the leading cause [8]. Many studies have included ischemic cardiomyopathy as one of the causes of DCM. In a study by Srinivasan *et al.*, only 12% were idiopathic but 47% were ischemic cardiomyopathy. According to new definition of DCM, we have excluded ischemic cardiomyopathy, hence, the variation in etiological profile compared to other studies. Idiopathic is the most common cause in most of the studies. As genetic studies could not be done in MKCG, familial causes DCM could not be identified (Table 10).

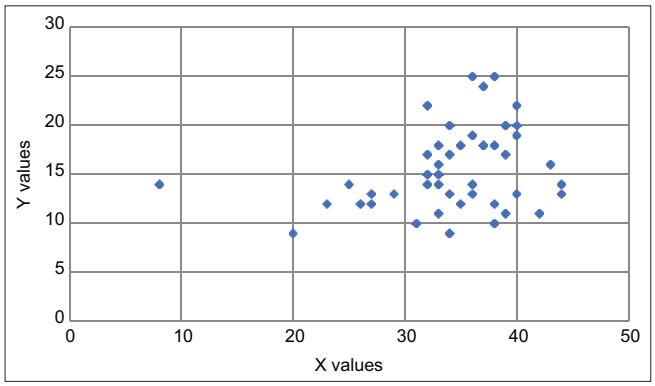

Fig.7: Correlation between ejection fraction and fractional shortening. R factor – 0.3. p<0.05

Table 8: Association of syncope with ejection fraction (EF)

Clinical feature	EF (<35%)	EF (>35%)	Total
Syncope	7	1	8
Without syncope	18	24	42
Total	25	25	50

Table 9: Comparison of echocardiographic features with clinical outcomes and its statistical significance

Variables	Severe symptoms	Mild to moderate symptoms	p value
EF<35%	12	13	<0.05
EF>35%	4	21	
LA size>40 mm	13	12	<0.05
LA size<40 mm	3	22	
RV size>26 mm	12	6	<0.05
RV size<26 mm	4	28	
LVEDD>52 mm	10	24	>0.05
LVEDD<52 mm	6	10	

EF: Ejection fraction

Symptomatology

Dyspnea was the most common presenting clinical feature in 43 cases (86%), followed by palpitation 14 cases (28%), peripheral edema 10 cases (20%), syncope of 8 cases (16%), chest pain in 3 cases (6%), and embolism in 2 cases (4%). About 65.2% of patients presented with NYHA Grades III and IV.

This was almost in accordance with Dec and Fuster who reported that the most common presentation was dyspnea which occurred in 75.85% of patients; out of which 90% of patients had symptoms typical of NHYA Classes III and IV at the time of diagnosis. He also found palpitation in 30%, peripheral edema in 29%, chest pain on acceleration was present in 8–20% of patients, and systematic embolism in 1.5–4% of cases [9]. In an Indian study by Routray *et al.*, almost all cases presented with dyspnea [10] (Table 11).

As shown in Table 8, patients who presented with syncope had severe left ventricular dysfunction. After applying χ^2 test, the association of syncope and sudden death was statistically significant and syncope can be considered as a poor prognostic factor. Rami *et al.* assessed the prevalence, to describe the underlying mechanisms and to identify risk factors for syncope in patients with DCM, and concluded that even though syncope is a rare finding, it carries a poor prognosis in patients with DCM which is in accordance with our study [11].

Dec and Fuster reported that syncope sudden deaths were rarely the initial manifestation of the disease. He also reported that sudden death accounted for 28% all deaths in his study and syncope was strongly predictive of sudden death [9]. Komajda proved in his study that syncope was as an independent predictor of severe LV dysfunction [12]. Olshausen (AHJ), in his study, showed that syncope was associated with 19% of death [13].

Echocardiogram

In echocardiography, mitral regurgitation was noted in 36% of cases, tricuspid regurgitation in 26% of cases, LV clot in 6%, pericardial effusion 4%, pulmonary hypertension in 6% of cases, and left atrial enlargement and right ventricular dilatation in 50% and 36% of cases, respectively.

As shown in Tables 5 and 9, symptoms EF <35% have statistically significant association with severity of symptoms but do not have significant association with the left ventricular end-diastolic dimension.

Table 10: Etiological profile

Etiology	Our study (%)	Dudharejia *et al.* (%)	Srinivasan *et al.* (%)
Idiopathic	80	74	12
Alcohol	8	12	15
Peripartum	4	2	9
Thyrotoxicosis	4		
Hypothyroidism	4		
Diabetic	-	12	11
Ischemic	-		47

Table 11: Symptomatology

Symptomatology	Our study (%)	Ahmad *et al.* (%)	Sachin *et al.* (%)
Dyspnea	86	96.3	100
Pedal edema	20	56	70
Cough	10	56.3	60
Palpitation	28	65.4	56.6
Abdominal pain	6	41.8	33.3
Syncope	16	1.8	16.6

Furthermore, the severity of symptoms had association with the left atrial size (>40 mm) and the right ventricle dilatation. Gentile P sought to define the characteristics, evolution, and long-term prognosis of DCM patients with mrEF (medium range) at diagnosis. He analyzed all DCM patients consecutively from 1988 to 2013 and found that the mrEF group presented a lower rate of death/heart transplantation and sudden cardiac death or major ventricular arrhythmias (4.5% vs. 15%, p<0.001) than rEF patients. Restrictive LV filling pattern emerged as the strongest predictor of rEF development following multivariable analysis [14].

Associated findings in echocardiography

Rossi *et al.* described that functional mitral regurgitation was strongly associated with the outcome of patients with HF independently of LV systolic function [15]. Puwanant *et al*. demonstrated that the right ventricular dilatation and dysfunction have prognostic significance and are correlated with a worse functional status and advanced LV failure [16].

Ahmad *et al*. given a picture of LV diastolic dysfunction in 27.8% of DCM patients [6].

The left ventricular clot was present in three cases, out of which two cases presented with the left side hemiparesis. The EF and left atrial diameter of these three patients were 27%, 39%, and 40% and 32 mm, 38 mm, and 46 mm, respectively. According to Vasan *et al*. (NEJM), increase in echocardiographic left ventricular internal dimensions was a risk factor for the development of congestive HF in DCM [17].

In studies, elsewhere investigators were divided over the significance of the left ventricular end-diastolic dimension in assessing the severity. According to Unverferth *et al.,* factors such as duration of symptoms, presence of mitral regurgitation, and end-diastolic diameter were not significant predictors [18]. A study by Hagar *et al.* of IDCM patients from 2009 to 2016 showed an improved prognosis: Patients with LVEF ≥40%, with device therapy, and those admitted to a cardiology ward [19].

Thapa *et al*. [20] conducted echocardiographic evaluation from February 1, 2018, to July 31, 2018, in Kathmandu and the results are as follows. Patients were presented mostly with congestive HF, echocardiographic evaluation showed with mildly dilated left ventricle, majority had reduced left ventricular systolic function with an average (EF) of 39.6%, no significant difference between male and female, and no significant relation between age and average EF% (p=0.091).

As shown in Fig. 7, FS has moderate correlation with EF and is a good predictor of LV dysfunction. This is in accordance with a study conducted by Zoccaliet *et al.* where systolic function was evaluated by Endo FS, mid-wall FS, and EF and there was moderate correlation between LV systolic function and FS, but failed to predict all-cause mortality [21]. Srinivasan *et al.* used echocardiography (echo)-based linear FS for assessing right ventricular dysfunction (RV_{dys}) and concluded that FS indices yielded good overall diagnostic performance and parasternal long-axis RV_{OT} width, four-chamber RV width, and length are independently associated with RVEF, supporting use of multiple FS indices for RV functional assessment [22].

CONCLUSION

DCM is one of the most common causes of HF and is the most common type of cardiomyopathy found in middle-aged and elderly male population. Biventricular failure followed by the left ventricular failure was the most frequent clinical presentation. Echocardiography is the first-line imaging test in the assessment of patients with DCM. Early identification and treatment are very essential to improve cardiac function and alleviate patient symptomology.

AUTHORS' CONTRIBUTIONS

The authors declare that all the named authors have contributed equally to this article.

CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

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