

ORIGINAL ARTICLE

FREQUENCY OF ECHOCARDIOGRAPHIC COMPLICATIONS OF DILATED CARDIOMYOPATHY AT A TERTIARY CARE HOSPITAL

Haq Nawaz, Rehan Ahmed*, Nasir Ahmed*, Abdul Rashid

Department of Pharmacology, *Medicine, Ayub Medical College, Abbottabad

Background: Dilated cardiomyopathy can lead to a variety of complications recognisable on clinical, echocardiographic, electrocardiographic and radiographic assessment. Among this, transthoracic echocardiography has the dual advantage of being helpful in making the diagnosis of dilated cardiomyopathy as well as an effective tool in early recognition of certain complications for timely management to improve the quality of life of these patients. **Methods:** This descriptive (case series) study was undertaken at Departments of Medicine, Cardiology, Paediatrics and Obs/Gyn, Ayub Teaching Hospital, Abbottabad from July to December, 2008. Fifty patients of dilated cardiomyopathy without age and gender discrimination were selected by convenience sampling. Those with hypertrophic and restrictive cardiomyopathies, valvular and congenital heart disease, hypertension and ischemic heart disease were excluded. **Results:** Mean age was 47.12 ± 17.9 year with male predominance (males=34, females=16). Mean ejection fraction was $30.6 \pm 6.9\%$. Complications revealed on echocardiography were intracardiac thrombi (5, 10%), spontaneous echo contrast (5, 10%), pericardial effusion (6, 12%), mitral regurgitation (46, 92%), tricuspid (25, 50%), aortic (5, 10%), pulmonary (2, 4%) multi-valvular regurgitation (28, 56%), and left atrial dilatation (36, 72%). **Conclusion:** LV systolic dysfunction, cardiac thrombi, spontaneous echo contrast, mitral and tricuspid regurgitation and left atrial enlargement are important complications of dilated cardiomyopathy. Echocardiography is important tool towards identification of these complications.

Keywords: cardiomyopathy, dilated, cardiomyopathy, complications, cardiomyopathy, congestive, echocardiography

INTRODUCTION

Cardiomyopathies are a group of diseases that affect the heart muscle itself and are not a result of hypertension, congenital or acquired valvular heart disease, coronary artery disease and pericardial abnormalities.¹ These are divided into three types namely dilated, hypertrophic and restrictive, with dilated cardiomyopathy being the most common.^{2,3} Out of various complications of dilated cardiomyopathy congestive heart failure makes a large sub-set^{1,2}, also affecting children⁴. On echocardiography there is dilated poorly contractile ventricle with reduced ejection fraction and fractional shortening. Doppler evidence of abnormal inflow pattern across mitral valve indicates left ventricular diastolic dysfunction. Spontaneous contrast may also be visible in enlarged left atrium and left ventricle.³

Dilated cardiomyopathy may cause sudden death^{1,5} left ventricular thrombi which can lead to systemic embolization^{6,7}, left atrial thrombi⁸, stroke⁹, secondary mitral regurgitation², tricuspid regurgitation² and rarely pulmonary embolism¹⁰.

MATERIAL AND METHODS

The present study was carried out from July 2008–December, 2008 in the departments of Medicine, Cardiology, Paediatrics, and Obs/Gyn at Ayub Teaching Hospital, Abbottabad. This was a Descriptive (case series) study on fifty (50) confirmed cases of dilated

cardiomyopathy collected by Convenience (non-probability) sampling.

Patients with an echocardiographic diagnosis of dilated cardiomyopathy were selected without any discrimination for age and gender. Fully informed consent was taken. The echocardiographic diagnostic criteria set for dilated cardiomyopathy was: Dilatation of the cardiac chambers particularly left ventricle, Global hypokinesia, reduced wall thickness, increased end-diastolic dimension and end-systolic dimension of the left ventricle. Left ventricular systolic dysfunction as reflected by reduced ejection fraction (EF <than 45%).

Patients with hypertrophic and restrictive cardiomyopathies, primary valvular disease, congenital heart disease, hypertension, ischemic heart disease and other causes such as thyroid dysfunction, uraemia, haemochromatosis and autoimmune diseases etc; which secondarily lead to cardiac dilatation and systolic left ventricular dysfunction were excluded from the study.

The confirmed fifty cases with a definitive diagnosis of dilated cardiomyopathy were evaluated clinically (with special emphasis on cardio-vascular examination) to record clinical complications.

Complications visualised on transthoracic echocardiography were recorded during further evaluation of these patients; Echocardiography was performed both in supine and left lateral positions with TOSHIBA SS-A, 270-A Colour flow Doppler U/S

system. All the echocardiographic windows were utilized during scanning. M-mode and Doppler studies were carried out to record cardiac dimensions and functional valvular regurgitations, respectively.

The data was entered into SPSS-10. Descriptive statistics were used to calculate mean and standard deviation for age and left ventricular ejection fraction. Male to female ratio was calculated. Frequencies (percentages) were calculated for echocardiographically visible complications including intracardiac thrombi, spontaneous echo contrast, pericardial effusion, functional valvular regurgitations and left atrial dilatation; 95% Confidence intervals were also calculated wherever applicable. In addition, *t*-test and *Z*-test were used wherever appropriate as statistical tests for determining significance. The significance level in such cases was set as per convention at 5%. Results were presented in the form of tables.

RESULTS

Of the 50 patients of dilated cardiomyopathy, 34 (68%) were males and 16 (32%) were females. Their overall ages ranged from 7–70 years (47.12±17.9 years) (Table-1). Ages among males ranged from 7–70 years (47.47±18.8 years) and ages among females ranged from 14–65 years (46.37±14.98). Male to female ratio was 2.125:1. Four cases were from paediatric age group (≤12 years). There was statistically no significant differences between males and females with respect to age (*p*>0.05). Overall, mean left ventricular ejection fraction recorded was 30.6%±6.9%, whereas it was 31.56%±6.3% in males and 28.56%±7.6% in females (Table-1). There were no significant differences between males and females with respect to mean left ventricular ejection fraction (*p*>0.05).

We had five (10%) cases of intracardiac thrombi as visualised on transthoracic echocardiography, 3 (6%) located in the left ventricle, 1 (2%) in the left atrium and another 1 (2%) in right ventricle. Mean age recorded in these five patients was 52±8.7 years, with a mean left ventricular ejection fraction of 22.2±1.5%, (Table-2).

The imaging phenomenon of spontaneous echo contrast was observed in 5 (10%) patients, of which 4 (8%) had it in the left ventricle, and 1 (2%) in both the left atrium and left ventricle. One (2%) was associated with embolic phenomenon. Mean age recorded in these cases was 48.6±7.4 years with a mean left ventricular ejection fraction of 22%±4.9%. Mean atrial dimension was increased in these cases being 47.60±4.51 mm (Table-3).

Six (12%) cases were having pericardial effusion on transthoracic echocardiography. Doppler studies revealed functional regurgitations across various cardiac valves as illustrated in Table-4. Mitral regurgitation was the most frequent as detected in 46

(92%) cases, followed by tricuspid regurgitation in 25 (50%) cases, aortic regurgitation in only 5 (10%) cases, and pulmonary regurgitation in only 2 (4%) cases.

Frequency of multi-valvular regurgitation was found to be in 28 (56%) cases. It occurred across 2 valves in 24 (48%) cases, with 21 (42%) involving mitral and tricuspid, and 3 (6%) involving the mitral and aortic valves. Four (8%) cases had regurgitant flow across 3 valves, of which 2 (4%) were involving mitral, tricuspid and pulmonary valves, while 2 (4%) occurred across mitral, tricuspid and aortic valves. Functional regurgitation involving single valve was detected only across mitral valve in 18 (36%) cases.

Left atrial dilatation was appreciated in 36 (72%) patients. Mean age recorded in these patients was 49.22±16.98 years, with an increased mean atrial dimension of 48.22±4.66 mm.

Table-1: Mean age and mean left ventricular ejection fraction gender wise (n=50)

| Gender | Total cases | Age (Year) | Ejection Fraction |
|---------|-------------|-------------|-------------------|
| Male | 34 | 47.47±18.8 | 31.56±6.3 |
| Female | 16 | 46.37±14.98 | 28.56±7.6 |
| Overall | 50 | 47.12±17.9 | 30.6±6.9 |

Table-2: Percentage, mean age and left ventricular systolic function in intracardiac thrombi (n=50)

| Location | cases detected | % | Leading to embolism | % leading to embolism |
|------------|----------------|----|---------------------|-----------------------|
| LV Thrombi | 3 | 6 | 2 (To Sys Cir) | 4 |
| LA Thrombi | 1 | 2 | 1 (To Sys Cir) | 2 |
| RV Thrombi | 1 | 2 | 1 (To PV Cir) | 2 |
| Total | 5 | 10 | 4 | 8 |

Table-3: Percentage, mean age, left ventricular systolic function, and mean left atrial dimensions in spontaneous echo contrast (n=50)

| Location | Cases detected | % | Leading to embolism | % |
|---------------------------|-------------------|-----------------------|---------------------|---|
| Left ventricle | 4 | 8 | 1 | 2 |
| Left atrium and ventricle | 1 | 2 | 0 | 0 |
| Total | 5 | 10 | 1 | 2 |
| Age | Ejection fraction | Left atrial dimension | | |
| 48.6±7.4 year | 22.0±4.9% | 47.60±4.51 mm | | |

Table-4: Percentages of Different Functional Valvular Regurgitations (n=50)

| Site of regurgitation | Number | % |
|---|-----------|-----------|
| Mitral | 46 | 92 |
| Tricuspid | 25 | 50 |
| Aortic | 5 | 10 |
| Pulmonary | 2 | 4 |
| Multi-valvular regurgitation | | |
| Mitral+Tricuspid | 21 | 42 |
| Mitral+Aortic | 3 | 6 |
| Total | 24 | 48 |
| Mitral+Tricuspid + Pulmonary | 2 | 4 |
| Mitral+Tricuspid + Aortic | 2 | 4 |
| Total | 4 | 8 |
| Overall incidence of Multi-valvular regurgitation | 28 | 56 |
| Mitral | 18 | 36 |

DISCUSSION

Dilated cardiomyopathy is a common illness and not an academic rarity.³ It is probably much under-diagnosed.¹¹ Ahmed and Awan³ reported it to be the most frequent (91.47%) among various cardiomyopathies studied. It is most common in middle age.¹² Mean age recorded during our study was in close proximity with mean age documented by Ahmed and Awan.³

Dilated cardiomyopathy is more prevalent in men than women¹² and males have a 2.5-fold increase in risk compared to females.¹³ This was actually demonstrated during our study as we had male patients clearly outnumbering the female patients. Thus the male to female ratio was 2.125:1, alluding to reported risk that is increased in males. Dilated cardiomyopathy has a prevalence across all the age groups.¹² We also had 4 (8%) cases pertaining to paediatric age group.

Left ventricular systolic dysfunction with a low ejection fraction is an important complication of dilated cardiomyopathy.^{3,12} Mean ejection fraction recorded during the current study was low which is almost in accordance with the figure of $32.22 \pm 8\%$ reported by Ahmed and Awan³; demonstrating impaired left ventricular systolic function.

Chronic ischemic heart disease and dilated cardiomyopathy are the major causes associated with left ventricular thrombi.⁷ It can complicate the development and worsen the prognosis in any case of dilated cardiomyopathy.¹⁴ The most common site for these thrombi is the left ventricular apex.¹³

Subjects complicated by intracavitary thrombi observed during our study had severe left ventricular systolic dysfunction. Left ventricular clots were all located in the apical area. This is in accordance with the observation of McCrindle *et al*¹⁵ from Canada, but a bit lower than the figures reported by Napporn *et al*¹⁴ from Senegal. However percentage of intracardiac thrombi is variable as not a single case of thrombus was reported among ninety patients having dilated cardiomyopathy during a study carried out by Kumar¹⁶ at Patna, India.

Impaired left ventricular function is a common denominator in cases with left ventricular thrombi.⁷ This fact was also recognised during the present study as mean left ventricular ejection fraction recorded was $21.33 \pm 1.25\%$, against mean left ventricular ejection fraction of $22.0 \pm 2.5\%$ documented by Ahmed and Awan⁷, both being very low reflecting left ventricular dysfunction, with semblance between the two results.

Left ventricular thrombosis can lead to substantial morbidity and mortality as a site for peripheral emboli.¹⁷ There is a definite correlation

between left ventricular thrombosis and systemic embolism as reported in earlier studies.^{6,18}

Mitral regurgitation has been studied to be a non-invasively obtainable marker of a large subgroup of patients with dilated cardiomyopathy 'protected' from left ventricular thrombus formation. Occurrence of both the mitral regurgitation and thrombus was rare (8%) during a previous US study conducted by Blondheim *et al*.¹⁹ Our observations on transthoracic echocardiography showed occurrence of both mitral regurgitation and left ventricular thrombi in one (33%) out of 3 cases detected. The severity of the regurgitation was mild however.

Left atrial thrombi have also been reported in 19% of cases with dilated cardiomyopathy according to some national and worldwide studies.^{8,20} But in the present study only one (2%) among fifty cases, was having left atrial thrombus detected on transthoracic echocardiography. This comparatively lower percentage could be explained by the fact that the studies conducted previously documented higher figures on the basis of observations recorded on transoesophageal echocardiography which is far more sensitive in detecting left atrial thrombi in contrast to the conventional transthoracic echocardiography.²¹ Atrial fibrillation, ventricular extrasystoles and arterial embolic phenomenon to the left upper limb were important associations in this particular case.

Thrombus formation in right cardiac chambers is an uncommon event in subjects with dilated cardiomyopathy.²² We did not have any case of right atrial clot among our study group. Yet one (2%) case of right ventricular thrombus was detected.

Percentage of cases of spontaneous echo contrast visualised on transthoracic echocardiography during the current study, stands low against the figure of 42% reported by Shen *et al*²³, during a French study, through transoesophageal approach, despite the utilisation of transthoracic imaging which was found to be less sensitive. This forms a logical explanation for a relatively lesser percentage visualised during the present study. Therefore transoesophageal echocardiography holds promise for visualising the phenomenon of spontaneous echo contrast.

Majority of our subjects had this smoke-like imaging phenomenon in the left ventricle which is in contrast to results of some international data reported by Shen *et al*²³ and Siostrzonek *et al*²⁰ which demonstrated higher percentages in left atrium (38% and 33% respectively) relying on transoesophageal approach, whilst one (2%) of our subject had it both in left atrium and left ventricle which is in conformity with the findings of Shen *et al*.²³ The same also observed that spontaneous echo contrast was more frequent in the presence of atrial fibrillation, left atrial

enlargement, and severely depressed left ventricular function.²³

Left ventricular dysfunction was observed in the present study, as mean left ventricular ejection fraction was low. Furthermore, left atrial dimension was increased.

Pericardial effusions are present in patients with dilated cardiomyopathy. These are common, but tend to be relatively small (minimal) and do not cause significant haemodynamic problems.²⁴ Percentage of pericardial effusion visualised during the present study, on transthoracic echocardiography lies in between the reported figures by Ahmed and Awan³ (1.6%) and Touze *et al*²⁵ (23%). All pericardial effusions observed in the present study were minimal.

Doppler echocardiographic study may detect clinically inaudible moderate mitral and tricuspid regurgitation in patients of dilated cardiomyopathy.^{13,26} Functional mitral regurgitation is well correlated with the clinical status of the patients and its worsening is suggestive of progression of the disease.²⁷ The comparative analysis of regurgitant lesions observed during the present study and other national and global studies, shows that prevalence of functional mitral regurgitation was the commonest (92%), as documented during the present study. This is almost in accordance with the percentage of 100% reported by Diaz *et al*²⁸, but is higher than the figure (63%) reported by Ahmed and Awan.³ In addition, 50% had tricuspid regurgitation in our study, similar to the results (46.2%) documented by Diaz *et al*²⁸, but higher than the figure of 17% reported by Ahmed and Awan.³ However incidence of aortic regurgitation was lower in our study, i.e., 10% against the figure of 34.6% by Diaz *et al*²⁸; but closer to figure of 17% documented by Ahmed and Awan.³ The frequency of pulmonary regurgitation was also rare (4%) which is though slightly higher than the observation of 1.5% recorded by Ahmed and Awan³, but substantially lower than the observation of 42.3% recorded by Diaz *et al*.²⁸

Considerable occurrence of regurgitant flow across multiple valves also merits some discussion. Multi-valvular regurgitation was observed in 56% of patients in the current study, against 77% documented by Diaz *et al*.²⁸ This phenomenon occurred across 2 valves in 48% of patients in comparison to 30.8% as reported by Diaz *et al*.²⁸ Nonetheless, incidence of regurgitant flow across 3 valves was less usual (8%), contrary to the higher percentage (30.8%) observed by Diaz *et al*.²⁸ Not a single case of regurgitant flow across all the four valves was observed during the present study, in contrast to 15.4% cases documented by Diaz *et al*²⁸ during the Spanish study.

In dilated cardiomyopathy, all of the heart chambers are typically dilated^{24,26} including both

atria.¹³ The left atrium usually is dilated early on, while right ventricular and right atrial enlargement occurs later.²⁴ We also observed echocardiographically demonstrable left atrial enlargement which is in compliance with the other studies^{13,24} reporting mean left atrial dimension of 48.22±4.66 mm against a mean age of 49.22±16.98 years.

CONCLUSION

Dilated cardiomyopathy along with its complications, has prevalence across all the age groups, most prevalent in the middle age, with a particular predilection for males than females. There is usually, marked left ventricular systolic dysfunction with a low ejection fraction. Functional mitral and tricuspid regurgitations and left atrial enlargement are common. Intracardiac thrombi, spontaneous echo contrast and minimal pericardial effusions may also be visible. Transthoracic echocardiography is an important tool towards confirmation of the disease, to determine the objective evidence of functional capacity as a guide to symptomatic treatment and to assess the risk and subsequent development of various complications particularly progressive deterioration.

Prospective echocardiographic studies ought to be carried out that would be handier to identify and manage various complications of dilated cardiomyopathy emerging over the time. These studies will also be helpful in determining the eventual outcome in these patients.

REFERENCES

1. Wynne J, Braunwald E. Cardiomyopathy and myocarditis. In: Kasper DL, Braunwald E, Fauci AS, Hauser SL, Longo DL, Jameson JL. (eds) Harrison's Principles of Internal Medicine: 16th ed. New York: The McGraw-Hill; 2005.p.1408–14.
2. Lavoie HM, Preston C. Cardiomyopathy, Dilated. [On line] 2005 July 7 last Up-date. [Cited 2006 December 15]: Available from: <http://www.emedicine.com>
3. Ahmad R, Awan ZA. An echocardiographic study of 129 cases of cardiomyopathy. J Coll Physicians Surg Pak 1999;9:171–3.
4. Khan MA, Mohammad J, Hussain M. Frequency and echocardiographic study of dilated cardiomyopathy in children presenting with cardiac failure. Pak J Med Sci 2004;20:113–6.
5. Kadish A, Dyer A, Daubert JP, Quigg R, Anderson KP, Calkins H, *et al*. Prophylactic defibrillator implantation in patients with non-ischemic dilated cardiomyopathy. N Engl J Med 2004;350:2151–8.
6. Sadiq M, Rathore AW, Younis M, Haider N, Masud F, Rehman A. Thromboembolism in patients with myocarditis. Ann K E Med Coll 2005;11:50–3.
7. Ahmad R, Awan ZA. A case series study of 26 subjects with left ventricular thrombus to see its etiology and left ventricular function. Pak J Med Sci 2004;20:51–4.
8. Ahmad R, Awan ZA. Atrial clots and their correlation with various denominators: A study of 26 cases. Pak J Med Sci 2005;21:210–2.
9. Mas JL, Arquizan C, Lanny C, Zuber M, Cabanes L, Derumeaux G, *et al*. Recurrent cerebrovascular events associated with patent foramen ovale, atrial septal aneurysm or both. N Engl J Med 2001;345:1740–6.

10. Pengo V, Lensing AWA, Prins MH, Marchiori A, Davidson BL, Tiozzo F, *et al.* Incidence of chronic thrombo-embolic pulmonary hypertension after pulmonary embolism. *N Engl J Med* 2004;350:2257–64.
11. Taylor MR, Carniel E, Mestroni L. Cardiomyopathy, familial dilated. *Orphanet J Rare Dis* 2006;1:27–35.
12. Bashore TM, Granger CB. Heart. In: Tierney LM, McPhee SJ, Papadakis MA. *Current Medical Diagnosis & Treatment* 45th ed. California: McGraw-Hill: 2006:p. 400–2.
13. Dec G.W, Fuster V. Idiopathic dilated cardiomyopathy. *N Engl J Med* 1994;331:1564–75.
14. Napporn AG, Kane A, Damorou JM, Dia AA, Diop IB, Sarr M, *et al.* Intraventricular thrombosis complicating peri-partum idiopathic myocardopathy. *Ann Cardiol Angeiol (Paris)* 2000;49:309–14.
15. Mc Crindle BW, Karamlou T, Wong H, Gangam N, Trivedi KR, Lee KJ, *et al.* Presentation, management and outcomes of thrombosis for children with cardiomyopathy. *Can J Cardiol* 2006;22:685–90.
16. Kumar H. Incidence of intracavitary thrombus in dilated cardiomyopathy. *J Assoc Physicians India* 1994;42:753–4.
17. Mazzone M, La Sala M, Portale G, Ursella S, Forte P, Carbone L, *et al.* Review of dilated cardiomyopathies: Dilated cardiomyopathies and altered prothrombotic state: a point of view of the literature. *Panminvera Med* 2005;47:157–67.
18. Falk RH, Foster E, Coats MH. Ventricular thrombi and thromboembolism in dilated cardiomyopathy: a prospective follow-up study. *Am Heart J* 1992;123:136–42.
19. Blondheim DS, Jacobs LE, Kotler MN, Costacurta GA, Parry WR. Dilated cardiomyopathy with mitral regurgitation: decreased survival despite a low frequency of left ventricular thrombus. *Am Heart J* 1991;122:763–71.
20. Siostrzonek P, Koppensteiner R, Gossinger H, Zangeneh M, Heinz G, Kreiner G, *et al.* Hemodynamic and hemorheologic determinants of left atrial spontaneous echo contrast and thrombus formation in patients with idiopathic dilated cardiomyopathy. *Am Heart J* 1993;125:430–4.
21. Tramarin R, Torbicki A, Franchini M, Forni G, Febo O, Gibellini R, *et al.* Transoesophageal echocardiography in the definition of intracardiac sources of emboli in patients with recent ischemic stroke. *G Ital Cardiol* 1990;20:713–9.
22. Dall'Aglio V, Nicolosi GL, Zanuttini D. Transthoracic and transoesophageal echocardiographic documentation of disappearance of massive right atrial and pulmonary artery thromboemboli after fibrinolytic therapy and normalization of left ventricular dimensions and function. *Eur Heart J* 1990;11:863–5.
23. Shen WF, Tribouilloy C, Rida Z, Peltier M, Choguet D, Rey JL, *et al.* Clinical significance of intracavitary spontaneous echo contrast in patients with dilated cardiomyopathy. *Cardiology* 1996;87:141–6.
24. Afridi HR, Hartnell GG. Cardiomyopathy, dilated. [On line] 2005 February 10 last up-date. [Cited 2008 December 15]: Available from: URL: <http://www.emedicine.com/>
25. Touze JE, Mouanodji G, Mardelle T, Akani F, Ekra A, Bertrand E. Primary congestive cardiomyopathies of the adult in a tropical environment: nosologic, diagnostic and developmental data. *Med Trop (Mars)* 1987;47:95–9.
26. Luthra A. (editor) *Echo made easy*. 1st ed. New-Dehli: Jaypee Brothers Medical Publishers; 2005.p.77–83.
27. Venturi F, Gianfaldoni ML, Melina G, Cecchi A, Petix NR, Monopoli A, *et al.* Mitral effective regurgitant orifice area versus left ventricular ejection fraction as prognostic indicators in patients with dilated cardiomyopathy and heart failure. *Ital Heart J* 2004;5:755–61.
28. Diaz RA, Nihoyannopoulos P, Oakley CM. Valvular insufficiency in dilated cardiomyopathy diagnosed by color Doppler echocardiography. *Rev Med Chil* 1989;117:1232–5.

Address for Correspondence:

Dr. Haq Nawaz, Department of Pharmacology, Ayub Medical College, Abbottabad. **Cell:** +92-345-9627240

Email: drhnawaz@hotmail.com