Electrocardiographic and echocardiographic correlations of dilated cardiomyopathy in Aden Governorate

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Abstract

Idiopathic dilated cardiomyopathy (IDCM), which represents ventricular chamber enlargement and contractile dysfunction is an often fatal cause of heart failure (HF) in young adults. In Yemen, the incidence and prevalence of dilated cardiomyopathy (DCM) appears to be increasing, whether secondary to improved detection or due to local factors, such as chronic khat use. In this prospective study, we sought to investigate the electrocardiographic and echocardiographic findings in patients with IDCM. A total of 50 patients with IDCM, from three hospitals in Aden were studied. The mean age of patients was 44.6 ± 12 years, 39 were males and 11 were females. History of chronic khat use was found in 84% and family history of DCM was found in 32% of the patients. All secondary causes of DCM were excluded. Coronary artery disease (CAD) was excluded by coronary angiography. Electrocardiography (ECG) and two-dimensional (2D) echocardiography were done for all these patients using standard techniques. Diagnosis of DCM was one by echocardiography. Sinus tachycardia and ventricular ectopic beats were common ECG abnormalities, but atrial fibrillation, left bundle branch block, weak R wave progression in the chest leads were found to be associated with advanced left ventricular (LV) systolic dysfunction. There was a markedly dilated LV cavity with mean LV ejection fraction (EF) of 28%. While mitral regurgitation was seen in 40% of the patients, thrombus formation was found in 16% of patients with LVEF of <20%.

Keywords: Idiopathic Dilated Cardiomyopathy, Electrocardiography, 2D Echocardiography.

Introduction

Dilated cardiomyopathy (DCM) is a syndrome characterized by cardiac enlargement and impaired systolic function of one or both ventricles. (24, 29) Most clinical studies showed that, DCM is the third most common cause of heart failure (HF) and the most frequent reason for heart transplantation. (24, 29) According to WHO classification, DCM is categorized in two groups: primary or idiopathic and secondary, which results from certain, causes (cardiac, toxic, inflammatory, metabolic, etc.). (6, 10, 16, 25)

Idiopathic dilated cardiomyopathy (IDCM) is an often fatal cause of HF in young adults. The degree and time course of malfunction are variable and do not always coincide with a linear expression of symptoms. Subjects with DCM may have asymptomatic left ventricular (LV) systolic dysfunction, LV diastolic dysfunction, or both. (24, 29) Overall, CMP is an important problem. In some centers, DCM was present in more than half of patients with age less than 35 years, who were dying suddenly or were requiring cardiac transplantation (27)

Due to the increasing use of electrocardiogram (ECG) and 2D echocardiography, the incidence of dilated cardiomyopathy is also showing a rising trend. (11) During the last 10 years, different studies were published to describe the electrocardiographic and echocardiographic changes among patients with dilated cardiomyopathy. The ECG in patients with DCM may be remarkably normal,

but abnormalities ranging from isolated T wave changes to septal Q wave in patients with extensive left ventricular fibrosis, prolongation of atrioventricular (AV) conduction, and bundle branch block may be observed. (29)

With increasing the awareness of DCM along with the improvement in diagnostic techniques, particularly ECG and echocardiography, dilated cardiomyopathy is being recognized as a significant cause of morbidity and mortality. (12) Early diagnosis and treatment allowed to recognize two distinct subgroups, one with a rapidly progressive downhill course, high mortality and urgent indication to heart transplantation, another with a more favorable outcome. (4) A systematic echocardiographic follow-up was used for accurate evaluation of DCM cases, which showed a significant improvement of the left ventricular ejection fraction (LVEF) with "reverse remodeling", frequently associated with a decrease of severity of functional mitral regurgitation and regression of the restrictive filling pattern. (4)

Regular echocardiographic screenings of DCM patients can detect not only different patterns of chamber dilatation and LV systolic dysfunction but it can also identify and prevent complications among them. (18) Data from the Gulf acute heart failure registry (Gulf CARE) showed that idiopathic DCM (18%) was the second cause of HF with reduced EF, after CAD, among 5005 HF patients admitted to 47 hospitals in seven Gulf countries during February to November 2012. (23)

Previous clinical investigations endeavored to study the demographic and clinical characteristics of DCM in Yemeni subpopulations. (1, 2, 20, 23) However; the ECG and echocardiographic profile of Yemeni patients with DCM was not described thoroughly in clinical publications. In this prospective study, therefore, we aimed to study and to correlate the electrocardiographic and echocardiographic findings in patients with idiopathic dilated cardiomyopathy.

Patients and Methods:

This is a prospective study of 50 patients with DCM, who had been admitted in three hospitals in Aden/Yemen (Al-Gamhouria Teaching Hospital, 22nd May Hospital and Al-sadaqa Hospital), from April 2008 through September 2014.

Patients had undergone all investigations, including cardiac catheterization to exclude the presence of coronary artery disease (CAD). All patients were diagnosed with idiopathic DCM, as all possible known causes were excluded. During the course of study, such patients were evaluated for demographic and clinical characteristics and mainly, for ECG and echocardiographic findings.

Included patients

Included patients were all subjects ($\geq$ 20 years) with idiopathic DCM. Diagnosis of DCM was made mainly by echocardiography (17,9)
Echocardiographic criteria
• LV ejection fraction <40%
• LV end-diastolic dimension >3 cm/body surface area
• Global hypokinesia
• Dilatation of LV, alone or with one or more heart chambers

Clinical criteria:
▪ Diagnosis of HF was confirmed by the use of Framingham criteria for symptoms and signs of CCF (24)
▪ HF patients were classified by NYHA and staging HF classifications (5)
▪ Asymptomatic HF were included as they were referred accidently during periodic evaluation or cardiac consultations for surgery.

Excluded patients

Patients were excluded from the study due to the following causes:

1. Coronary artery disease (CAD) which was confirmed by coronary artery angiography
2. Untreated arterial hypertension (II-III stage)
3. Diabetes mellitus (DM)
4. Primary significant valve disorders
5. Congenital heart disease.
6. History of chronic alcohol use
7. History of chronic drug use (cocaine, amphetamines)
8. Thyrotoxicosis
9. History of chronic infections, associated with myocardial damage (HIV, viral hepatitis B and C).
10. Serum electrolyte disturbances
11. Elevated serum uric acid with or without gout
12. Systemic and connective tissue diseases
13. Malignant diseases
14. Pregnant females

Clinical and diagnostic approach:

Paraclinical methods:

1. Laboratorial study including biochemical, hormone and viral investigations
2. Resting ECG
3. Holter ECG
4. 2 D- Echocardiography with Doppler study
5. Cardiac catheterization to exclude the presence of CAD

Electrocardiography (ECG):

Standard 12 lead electrocardiograms were recorded as 25 mm per second and 1 mV per cm standardization (14). Rate, rhythm, P-R interval, QRS interval, corrected QT 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 (15). 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 leads II, III, and aVF. Left ventricular hypertrophy was defined as per Sokolow criteria 103,104 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 of this ratio with ventricular dilatation and ejection fraction. Weak R progression in the precordial leads was evaluated. ST segment depression and elevation and T wave abnormalities were noted (14).

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 end diastolic diameter in (LVEDD), Left ventricular systolic diameter (LVSD), Ejection fraction (EF), Mitral Regurgitation (MR), Tricuspid Regurgitation (TR). Thrombus formation was considered as intracavitary clot or Smokey like appearance. Patients having left ventricular dilatation and ejection fraction less than 40% were diagnosed as dilated cardiomyopathy and were included in the study. Scars and akinetic segments were considered and such patients were excluded from study. Valvular regurgitations were semi-quantitatively assessed with color flow Doppler echocardiography (30) Patients with

echo features like diastolic dysfunction, pulmonary hypertension, pericardial effusion were excluded.

Statistical methods:

Data analysis was performed using reported version 17 (SPSS Inc., Chicago, IL, USA).Continuous variables were summarized using means or medians based on the normality; normally distributed variables were summarized using the mean and standard deviation (SD), while the non-normally distributed variables were summarized using the median and interquartile range (IQR). Categorical variables were summarized using frequencies and percentages. Summary statistics were reported and P value < 0.05 was considered as significant.

Results:

Basic data

The current study included 50 individuals, of whom 78% were male and 84% were with history of chronic khat use. Mean age of patients was 44.6±12 years, as 30% of them were with the age of less than 40 years. Family history of DCM was found in 32% of patients. Clinical presentations included asymptomatic patients in 10%, LVF- 14%, CCF- 56%, pulmonary edema- 10%, cardiogenic shock-6% and ischemic stroke in 4%. The mean follow-up duration was 28 months (range, 1– 48). During the acute phase, therapy was conducted with diuretics, cardio-tonics, angiotensin-converting Enzyme Inhibitors (ACEI) or angiotensin receptor blockers (ARBS). After patients' stabilization, therapy was conducted with combinations of ACEI or ARBS and the β-blocker (carvedilol). When indicated, aspirin, Clopidogrel, or oral anticoagulants were added. Follow up data revealed that death occurred in 22%, worsening and readmission in 12% and improvement occurred in 66% of patients.

ECG profile (Table 2)

The electrocardiographic profile included abnormalities of rate, rhythm, and chamber enlargement. While the most common arrhythmias were sinus tachycardia 62% and ventricular extra-systoles (56%), poor R progression in leads V1-V4 was the most frequent ECG finding, not related to arrhythmias. Left bundle branch block (LBBB) was observed in 38 %, while left anterior hemi-block (AHB) was seen in 32%. Left ventricular hypertrophy (LVH) and P abnormalities were seen in 26% and 22% of patients respectively. While atrial fibrillation (AF) was found in 18% of patients, supraventricular tachycardia (SVT), ventricular tachycardia (VT) and first degree atrio-ventricular block (AVB) were observed in 12%, 8% and 10 % of patients, correspondingly. ST-T wave changes were observed in different rates, as T wave inversions were found in 20%, ST depression in 16% and ST elevations were present in 14%.

Echocardiographic profile (Table 3, 4)

The echocardiographic profile included different patterns of cardiac dilation and global systolic dysfunction. The mean left ventricular (LV) end diastolic diameter was 61.85 mm with the majority of subjects (65%) having LV end diastolic diameter more than 60 mm. The mean LV end-systolic diameter was 53.86 mm, with majority of patients (69%) having end systolic diameter more than 50 mm. The study of cardiac chamber dilation revealed an isolated dilation of LV in 30%, dilation of 2 chambers (LV+LA or LV+ RV) in 20% and global dilation in 50% of cases. Global hypokinesia was seen in all the patients with mean LVEF of 28%. AF, LBBB and P abnormalities were found to be associated with more reduced LVEF. While 40% of patients had isolated mitral regurgitation, 34% had both mitral and tricuspid regurgitation. In this study, 28% had LVEF< 20% and 16% had echocardiographic signs of LV thrombus formation. Table 4 demonstrates the echocardiographic measurements and findings in DCM patients with thrombus formation,

compared to that of patients with no thrombus formation. Thrombus formation was found in 16% of patients with EF<20%. This complication was occurred in association with marked LV dilatation.

Table 1: Demographic and clinical profile of all studied IDCM patients

Patient's findings	Patients with positive findings, n (%)	P value
Demographic findings		
Number of patients	50	
Mean age ± SD	44.6 years ±12	-
Male gender	39 (78%)	0.01
Khat chewing	42 (84%)	0.001
Age groups Age < 40 years Age 40-50 years Age 51-60 years	15 (30%) 16 (32%) 19 (38%)	0.001
Family history	16 (32%)	0.02
Clinical presentations		
Asymptomatic patients	5 (10%)	0.01
LVF	7 (14%)	0.04
CCF	28 (56%)	0.04
Pulmonary edema	5 (10%)	0.02
Cardiogenic shock	3 (6%)	0.02
Ischemic stroke	2 (4%)	0.03
Prognostic findings		
Death cases	11 (22%)	0.001
Improved patients	33 (66%)	0.001
Non-improved patients	6 (12%)	0.001

LVF: left ventricular failure, CCF: congestive cardiac failure

Table 2: ECG findings with related LVEF in DCM patients

ECG findings	Patients with positive findings (n(%))	EF%	P value
S tachycardia	31 (62%)	27.84	0.08
AF	7 (14%)	14.55	0.001
VEBs	28 (56%)	27.14	0.01
AEBs	6 (12%)	27.50.	0.04
SVT	6 (12%)	26.12	0.01
VT	4 (8%)	14.76	0.01
LBBB	19 (38 %)	17.05	0.001
LAHB	16 (32%)	24.12	0.01
First degree AV block	5 (10%)	26.20	0.01
Small R in V1-V4	29 (58%)	20.05	0.001
LVH	13 (26%)	36.63	0.06
P abnormalities	11 (22%)	17.86	0.001
ST depression	8 (16 %)	33.19	0.04
ST elevation	7 (14 %)	27.07	0.04
T wave inversion	10 (20%)	30.10	0.04

S tachycardia= Sinus tachycardia, AF=Atrial fibrillation, VEBs = Ventricular ectopic beats, AEBs= Atrial ectopic beats, SVT= Supra ventricular tachycardia, VT= Ventricular tachycardia, LBBB=Left bundle branch block, LAHB= Left anterior hemi-block, Small R in V1-V4= R regression in chest leads V1-V4, LVH= Left ventricular hypertrophy, P abnormalities= P wave abnormalities, ST depression= ST segment depression > 0.5 mm, ST elevation= ST segment elevation > 0.5 mm, T wave inversion=T wave inversion > 10 ms

Table 3: Echocardiographic findings in all studied DCM patients

Echocardiographic measurements and findings	
Number of patients	50 (100%)
Measurement	Mean value
Mean ESDLV	53.86 mm
Mean EDDLV	61.85 mm
Mean LA dimension	41.83 mm
Mean RV dimension	27.80 mm
Mean LVEF in all patients	28.00%
Mean EF in patients with EF> 20%	29.50%
Mean EF in patients with EF<20%	16.00%
Mean EF in asymptomatic patients	38.50%
Finding	Number of patients with positive findings
Pattern of cardiac dilation Only 1 chamber (LV) 2 chambers (LV+LA or LV+ RV) Global dilation	15 (30%) 10 (20%) 25 (50%)
EF% <20%	14 (28%)
Thrombus formation Organized thrombus Non-organized (Smoky like appearance)	8 (16%) 4(8%) 4 (8%)
Secondary valvulopathy Mitral regurgitation Mitral and tricuspid regurgitation	20 (40%) 17 (34%)

LA=left atrium, LV= left ventricle, RV= right ventricle, LVEDD= left ventricular end-diastolic dimension, LVESD= left ventricular end-systolic dimension, LVEF= left ventricular ejection fraction

Table 4: Echocardiographic findings in DCM patients with thrombus formation, P value=0.001

Patients' finding	No of patients	Mean LA size	Mean LVd D	Mean LVdS	Mean LVEF %
Thrombus formation	8 (16%)	43.22 mm	65.66 mm	56.81 cm	16.11
No thrombus formation	42 (84%)	41.24 mm	61.06 mm	52.12 mm	31.81
P value		0.01	0.01	0.001	0.001

LA=left atrium, LVEDD= left ventricular end-diastolic diameter, LVESD= left ventricular end-systolic diameter, LVEF= left ventricular ejection fraction

Discussion

The current study was undertaken to evaluate and correlate the electrocardiographic and echocardiographical profile of Yemeni patients with idiopathic dilated cardiomyopathy.
IDCM in our patients was diagnosed by accepted echocardiographic criteria for DCM, whereas clinical identification of cases was made by the exclusion of secondary possible causes.

In the present study, dilated cardiomyopathy was more common in middle age, i.e age group 51-60 years (38%) but the commonest age affected was between 21-50 years (62%). Males were affected more than females (78% vs. 22%)

Evaluation of electrocardiographic findings:
   In the present study, the electrocardiographic profile of patients showed two types of cardiac abnormalities:
ECG findings, related to rhythm and conduction defects and
ECG findings, not related to rhythm and conduction defects. The latter group involve ECG changes due to altered cardiac depolarization and repolarization (like poor R progression), LVH, ST-T changes and left atrial abnormalities.
   While the most common arrhythmias were sinus tachycardia (62%) and ventricular extra-systoles (56%), AF, SVT and VT were occurring less frequently (14%, 12%, 8% respectively). However, AF, SVT and VT were more significantly associated with advanced LV dysfunction.
LBBB was the main conduction defect (38 %), and was significantly associated with reduced LVEF. LAHB was also common, occurring in 32%. Smilowitz NR et al mentioned that, in comparison with dilated CMP. LBBB on ECG is rarely associated with ischemic CMP (22). In patients with cardiomegaly of unknown cause, the presence of LBBB further supports the diagnosis of primary myocardial disease (22).
   Regarding ECG findings, not related to rhythm and conduction disorders, we investigated poor R wave progression in the precordial leads V1-V4, LVH, P-wave abnormalities, ST segment elevations, ST segment depression and T wave inversions. Poor R wave progression in V1-V4 was not the only most common ECG finding, but it was significantly associated with advanced LV impaired function (EF=20%). Signs of LVH were more frequently found in asymptomatic patients and in cases with less impaired LV function (EF=32.63%). P-wave abnormalities were more found in advanced CCF and with more impaired LV function (EF=17.86%). ST segment elevations, ST segment depression and T wave inversions were found to be associated with less impaired LV function. According to some authors, left atrial enlargement is more common than right atrial or bi-atrial enlargement (17, 28).
   Recently, Navneet Saxena and Darshan M reported similar rates for sinus tachycardia (40%), AF (13%), VT (3.3%), SVT (6.6%), LBBB (40%), ST-T changes (26.6%), LVH (20%) and atrial enlargement (20%). (11) In other studies, the incidence of arrhythmias was higher because they have used 24 hours ambulatory ECG monitoring for the detection of arrhythmias (11). According to Saha et al (19), the main ECG findings in 30 DCM cases were sinus tachycardia (40%), LV ectopics (46%), LBBB (40%), ST-T changes (26.6%) and AF (13%). Rana and others found similar rates of sinus tachycardia and ST-T changes (63%), ventricular premature contractions, LVH and Q-wave (13%). (15) They found that LBBB, AF, SVT and VT were less frequently seen in their studied patients (15).
   In the present study, first-degree AV block was observed in 8% of the patients, while second or third degree AV block were occurred in none of them. In a study by Sadanand D et al, first degree AV block was found in 10% of patients (18). Barbosa (3) and others found first and second degree AV block in 11%. Scholler and others found first-degree AV block in 17.6% and second-degree AV block in 10.6% (22). As already known, AV blocks are poor prognostic markers in dilated cardiomyopathy and the disease progress over time with increasing fibrosis and myocytes hypertrophy (26).

Evaluation of echocardiographic findings:
   In the current study, we classified our patients according to patterns of LVEF and cardiac chamber dilation (table 4). It was found that 65% of patients were with LV end diastolic diameter

more than 60 mm and 69% with LV end systolic diameter more than 50 mm. The mean LV dimension at end diastole and end systole were 61.85 mm and 53.86 mm respectively. Left atrial enlargement was present in only 20% of our cases The mean LVEF was 28% . 78% of patients were with LVEF >20% and 22% were with LVEF <20%.

   Our patients' findings of cardiac chamber dilation and systolic dysfunctions were in agreement with other several studies. According to a study by Rana et al, (15) mean LV diastolic dimension was 64.5 mm, and mean LV systolic dimension was 58.0 mm. An enlarged LA atrium was found in 36.6% of patients. LV EF < 25% was observed in 45.4%, EF in range of 26-30% in 30% and EF range of 31-35% in 26.6%. They also found mitral regurgitation in 48.3% and tricuspid regurgitation in 63.3%, but aortic regurgitation, LV outflow obstruction and ventricular thrombus were not seen. (15) Similar to our findings were observed in a study by Sadanand et al, who found mean LVEDD of 60.78 cm, mean LVESD of 50.38 cm, mean RV dimension of 22.84 cm, mean left atrium dimension of 40.94 cm and mean LV EF of 28.6%. (18) However, other studies mentioned a less degree of mean LV chamber dilatation and mean LV systolic dysfunction (11, 19) In general, we observed a higher frequency of patients with LVEF<20% (28%). This is in contrast with other studies, where LVEF<20% occurred only in less than 7%) (11, 15, 18, 19). This could be explained by the varying sample studied groups with different underlying causes. A dilated and poorly contracting ventricle even in sinus rhythm predisposes to thrombus formation. In our study, intra-ventricular thrombus was observed in 16% of patients. Thrombus formation was found in 16% of the patients with EF<20%. This complication was found to be associated with marked dilatation with mean LVESD of 56.81 mm, mean LVEDD of 65.66 mm, mean left atrial dimension of 43.22 mm and mean LVEF of 16.11%. Similarly, to this, a study by Ganesh et al found LV cloth in 4% of his DCM patients (7) and Patil et al (13) in 19% of patients. These findings of larger LVEDD and lower EF indicate the necessity of periodic echocardiographic assessment in DCM patients with more dilated ventricles and advanced systolic dysfunction. (16) In this study, mitral regurgitation was less frequent (40%), compared to that in other studies (11, 15, 18, 19). None of our patients had aortic regurgitation (AR).This was in comparable with some studies (12) but was in contrast with Jain et al, who found AR in 17.8% of patients (8).

Conclusion: The most common ECG findings were sinus tachycardia and poor R wave progression in precordial leads, while the most common echo- findings were marked LV chamber dilatation and markedly reduced LV systolic function. Only AF, LBBB and P wave abnormalities in ECG were significantly associated with low LVEF of <20%.

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نتائج رسم القلب الكهربي والتصوير القلبي (الايكو) لمرضى اعتلال العضلة القلبية المتوسع في محافظة عدن - اليمن

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الملخص

يعد اعتلال العضلة القلبية المتوسع الأولي - الذي يمثل توسعًا مرضيًا للتجاويف القلبية واعتلالا لعضلة القلب -سببا خطيرًا لحدوث قصور القلب وإجراء زراعة القلب عند الشباب. فقد أشارت دراسات سابقة في اليمن إلى علاقة بين تعاطي القات المزمن وحدوث اعتلال العضلة القلبية المتوسع. هدف هذه الدراسة هو تقييم المميزات المتعلقة برسم القلب الكهربي والتصوير القلبي (الايكو) لمرضى اعتلال العضلة القلبية المتوسع.

تم إدخال ما مجموعه خمسون مريضًا مصابًا باعتلال العضلة القلبية المتوسع منهم 39 رجلا و 11 امرأة، حيث بلغ العمر المتوسط للمرضى 44.6 عامًا. أجريت فحوصات رسم القلب الكهربي والتصوير القلبي(الايكو) لكل المرضى باستخدام جهاز تخطيط القلب الالكتروني وجهاز الايكو القلبي. تم استثناء مرضى اعتلال العضلة القلبية المتوسع الثانوي و خضع الجميع للقسطرة القلبية لاستثناء نقص التروية القلبية من الدراسة. خلصت نتائج الدراسة إلى أن أهم التغيرات شيوعًا في رسم القلب شملت تسارع النبض القلبي والضربات البطينية الشاردة ولكن حصار الغصن الأيسر وَ ضعف تطور موجة R في المؤشرات الصدرية (V1-V4) بينت ارتباطا بالاعتلال العضلي القلبي. أهم مؤشرات الإيكو القلبي شملت ارتفاع متوسط الأبعاد التقلصية والانبساطية للبطين الأيسر ونقص معامل القلوصية القلبية. أيضًا تبين وجود ارتجاع ثانوي للصمام التاجي (40%) إضافة إلى وجود خثرات قلبية (16%) فقط بالمرضى الذين يتميزون بمعامل قلوصية أقل من 20%.

الكلمات المفتاحية: اعتلال العضلة القلبية المتوسع، رسم القلب الكهربي، الإيكو القلبي.