Original Article

Echocardiography in Patients with Chest X-ray Diagnosis of Cardiomegaly at an Academic Hospital in Zambia

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ABSTRACT

Background: Cardiomegaly is the most diagnosed condition on Chest X-ray (CXR) at the study site. However, little is found on the association between cardiomegaly and echocardiography (ECHO) findings at this site. The main objective of this study was to establish whether there is an association between cardiomegaly diagnosed on a CXR and ECHO findings of the same patient.

Methods and Materials: This retrospective study involved the retrieving of data from files of 124 patients who had cardiomegaly diagnosed on CXR and had undergone an ECHO examination. The study sought to establish whether there is an association between cardiomegaly diagnosed on a CXR and ECHO findings of the same patients.

Results: There was a positive association between cardiomegaly diagnosed on CXR and ECHO findings and the association was significant at 5%. In addition, there was also a strong association between age and cardiomegaly and the association was also significant at 5%. The Chi-square results at 5% level of significance showed that there is not enough evidence to suggest an association between gender and cardiomegaly. Therefore, both women and men have an equal chance of acquiring cardiomegaly. Left Ventricular Diastolic Dysfunction was the most prevalent condition, having been seen in more than 50% of patients. Most of the conditions identified in patients were very severe. In addition, 70% of these patients had a raised blood pressure with 43% having severely raised blood pressure.The test results also showed that 66% of patients in the sample had increased blood flow on Doppler measured at certain points of the heart with 6% of the patients having severely increased blood flow. Patients with increased blood flow showed an increase in blood pressure with those with severe increased blood flow showing a strong positive association with severe high blood pressure.

Conclusion: These findings show that there is a strong association between cardiomegaly diagnosed on CXR to ECHO findings of the same patient. Therefore, echocardiography should be done on all patients diagnosed with cardiomegaly on CXR. In addition, priority should be given to elderly patients (65 years and above) as most of these had both severe cardiomegaly and one or more cardiovascular diseases.

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INTRODUCTION

Cardiovascular diseases are very often accompanied by an enlarged heart and these diseases are the world's leading cause of death[1]. Common causes of an enlarged heart are heart failure, heart muscle disease (cardiomyopathy), coronary heart disease, high blood pressure, congenital heart disease, heart valve disease, thyroid disease and obesity[2].Many scholars have ranked cardiomegaly as the most prominent diagnosis on CXR and ECHO examinations[2,3,4,5].

Estimates show that 17 million people (31%) die annually from cardiovascular diseases, globally.[1] In America, it is estimated that about 5 million Americans have symptomatic heart failure, but it has been estimated that 50 million Americans account for the American Heart Association–American College of Cardiology definitions of heart failure[6]. In Zambia, cardiovascular diseases are among the top ten causes of death. Thus, stroke is the fifth leading cause of death in Zambia while ischemic heart disease is the eighth[7]. These diseases account for 4.3% and 2.6% of the total deaths recorded respectively, in Zambia[8]. It should be noted that the total prevalence of cardiovascular diseases in Zambia is 8%[9].

In 2015 it was estimated that 16.7% of CXR done at the study site, were diagnosed with cardiomegaly but it is however unclear as to what the association is between cardiomegaly and ECHO findings of the same patient at this site[10]. This study was designed to investigate the association between cardiomegaly diagnosed on CXR and the ECHO findings of the same patients, since no such study has ever been done in Zambia.

METHODS

Study Population

The study population included 124 adult male and female patients who were diagnosed with cardiomegaly on a CXR and had ECHO examinations at the research site. The files used in this study, were for patients aged from 18 to 80 years old. All patients who meet the inclusion criteria from 30th August, 2017, dating backwards, formed the sample until the target was reached.

Study design

This study was a quantitative, retrospective, descriptive study that was carried out at a single site.

Research Site

The study was undertaken at Levy Mwanawasa hospital, in Lusaka, Zambia. Prior, no such formal study had ever been done at this hospital or in Zambia.

Data collection

Patients' files were randomlyretrieved and the necessary data was got from these files. Data Results for CXR and ECHO were in the form of reports. The results of the CXR and ECHO were entered on data collection sheets. The data collection sheets used for the study had the following sections:

i. Patients demographic information: age and gender
ii. Chest x-ray:
    a. Cardiac thoracic ratio (CTR)
    b. Any lung disease
iii. Echocardiography:
    a. Left and right ventricle
    b. Left and right atrium
    c. Aortic valve (size, systolic and diastolic function)
    d. Inter-ventricular septum (thickness measured in cm)
    e. Poster wall of left ventricle (thickness measured in cm)
    f. Mitral valve (regurgitation)
    g. Ejection Fraction (normal: 50-70%)
    h. Pericardial effusion
    i. Color Doppler
iv. Blood pressure parameters (mm/Hg)

Data Analysis

The data was captured on a data spread sheet. The data was quality controlled, assured and analysed using SPSS version 24.Descriptive statistics (mean, median, percentages, and standard deviation) were used for prevalence in age, gender, pathological conditions.

Inferential statistics were also used with a level of statistical significance set at $p<0.05$.

Spearman's correlation test was conducted to assess the relationship between the CXR findings, the ECHO findings and the BP. Chi-squared test was also used to assess whether there is a significant difference between 2 sets of variables e.g. males and cardiomegaly[11].

RESULTS

Gender characteristics

From the data collected, 84 were females and 40 were males; representing a distribution of 68% for women and 32% for men as depicted in the frequency table 1 below.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	40	32.0	32.3	32.3
	Female	84	67.2	67.7	100.0
	Total	124	99.2	100.0	
Missing	System	1	.8		
Total		125	100.0		

Frequency Distribution Table 1: Table showing frequency distribution by sex.

Patients' Age Distribution

	Sample	124
Mean		56.78
Median		63.00
Mode		80
Std. Deviation		18.382
Variance		337.912
Range		62
Minimum		18
Maximum		80

Frequency Distribution Table 2:Table showing frequency distribution by Age.

The results in the table above show some critical characteristics of the patients in the sample in terms of their age. Firstly, the results show the mean age of about 57 years, indicating the average age of the participants. In addition, the median age was 63 years indicating that there is an equal probability that if the sample was halved, 50% would fall above and the other 50% below. This also implies that the population was not young. The age of highest frequency in this study was 80 years, being the mode. The smallest age from the participants was 18 years and the oldest was 80 years, giving the range of 62. The Standard deviation and the variance show how patients' age deviated from the mean and one another respectively.

Cardiomegaly

	CARDIOMEGALY			
AGE RANGE	Minimal	Moderate	Severe	Total
Less than 35	8	9	3	20
35-45	1	13	6	20
46-54	3	2	7	12
55-64	2	9	6	17
65-74	3	2	14	19
75+	1	5	30	36
Total	18	40	66	124

Frequency Distribution Table 3: Table showing frequency distribution of cardiomegaly by age.

Table 4 above is a cross tabulation of the cardiomegaly condition and the age of the patients. Notably, as the age of the patients increase, the severity of the condition also worsens. Specifically, more patient from the young age group (<35) were found to have minimal cardiomegaly while more (30) in the older ages (>75) were found to have the severe condition. Thus there is a positive and strong correlation between the condition and age.

Distribution According to Normal and Abnormal ECHO Findings in Cardiomegaly

		Frequency	Percent	Valid Percent	Cumulative Percent
Yes	15	12.0	12.1	12.1	
Not normal	109	87.2	87.9	100.0	
Total	124	99.2	100.0		
System	1	.8			
Total		125	100.0		

Frequency Distribution Table 4: Table showing frequency distribution of normal and abnormal ECHO findings in cardiomegaly.

The frequency table above shows that 88% of patients with cardiomegaly had an abnormal ECH0

finding while 12% showed normal ECHO reading. This means that 88% of patients with cardiomegaly diagnosed on chest X-ray had one or more cardiovascular diseases accompanying the cardiomegaly.

Common Diseases

DISEASE	PERCENT OF OCCURRENCE		
	Seen	Not seen	Total
Cardiomyopathy	16	84	100
Inter Ventricular Hypertrophy	23	77	100
Left Atrium Dilation	29	71	100
Left Ventricular Diastolic Dysfunction	71	29	100
Left Ventricular Dilation	21	79	100
Left Ventricular Hypertrophy	24	76	100
Left Ventricular Systolic Dysfunction	29	71	100
Pericardial Effusion	21	79	100
Pulmonary Hypertension	16	84	100
Right Atrium Dilation	25	75	100
Right Ventricular Dilation	18	82	100

Frequency Distribution Table 5: Table showing frequency distribution according to the common diseases found.

The above table displays some of the diseases which were common in the study. As the results above indicate, Left Ventricular Diastolic Dysfunction was the most common disease found in the participants. The results above show that left Ventricular Diastolic Dysfunction was found in more than half of the study participants (71%). Thus, Left Ventricular Diastolic Dysfunction was the overall most common disease among the patients. Other common diseases include Left Atrium Dilation and Left Ventricular Systolic Dysfunction, with 29% distribution each.

Patients' Blood Pressure

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	up to 120/60 - 80	37	29.6	29.8	29.8
	121-140/81-90	16	12.8	12.9	42.7
	141-159/91-99	18	14.4	14.5	57.3
	151 or more/100 or more	53	42.4	42.7	100.0
	Total	124	99.2	100.0	
Missing	System	1	.8		
Total		125	100.0		

Frequency Distribution Table 6: Table showing frequency distribution according to blood pressure.

After testing for blood pressure, the result indicates that 43% of the patients had severe blood pressure, 14% had moderate blood pressure while 13% had minimal. 30% of the sample had normal blood pressure, as the frequency distribution table above shows.

Doppler Test Results

Doppler Test outcome	Frequency	Percentage Distribution
Normal Blood Flow	27	22%
Increased Blood Flow	75	60%
Severely Increased Blood Flow	7	6%
Blood Flow not measured due to the absence of the A-wave	15	12%
Total	124	100%

Frequency Distribution Table 7: Table showing frequency distribution according to Doppler.

The test results show that 66% of patients in the sample had increased blood flow with the blood flow of 60% of the patients being increased and 6% of the patients being severely increased. On the other hand, 22% of patients showed normal blood flow after conducting a Doppler test. Patients with increased blood flow also showed an increased blood pressure with those with severe increased blood flow showing a strong positive association with severe high blood pressure. However, blood flow could not be measured on 12% of patients in the sample because of the absence of the A-wave.

DISCUSSION

The main objective of this study was to establish whether there is an association between the CXR reports of patients diagnosed with cardiomegaly to the ECHO reports of the same patients. Studies by different researchers have confirmed that cardiomegaly is very prominent around the world and CXRs and ECHO have been used to prove this fact. For example, according to a study conducted in Iraq from 2006 to 2007, 24.9% and 50.8% of patients had cardiomegaly on CXR and echocardiography respectively[2]. Other research estimates that cardiomegaly is found in 5-7% of chest x-ray film evaluations in tropical Africa[3]. In

addition, another research found that among adults with a mean age of about 50 years, cardiomegaly is a frequent cause of sudden cardiac death[5]. At the research site in Zambia, the prevalence of cardiomegaly was estimated to be at 16.7%, as shown by records from the X-ray department register[10].

The results in this study show that 53% of the respondents had severe cardiomegaly. 32% had moderate while 15% had minimal. Of all the patients with cardiomegaly on CXR, only 12% had normal ECHO findings while 88% had one or more cardiovascular disease accompanying the cardiomegaly.The study results also show that most conditions of cardiomegaly such as Cardiomyopathy (16% prevalence), Pulmonary Hypertension (16% prevalence) and Left Atrium Dilation (29% prevalence) were present and severe in patients. These findings are consistent but lower than the conclusions reached by other scholars who concluded that 21.76% patients in Nigeria who had cardiomegaly on a standard CXR also had severe cardiomypathy while figures from Senegal and Ivory Coast were lower than the research findings and ranged from 7.2 to 57%[3].

Our study also demonstrated that older patients are more at risk. Specifically, more patients from the young age group (<35) were found to have minimal cardiomegaly while more in the older ages (>75) were found to have the severe condition. The study also showed that the number of respondents increased as their age increases. Thus there is a positive and strong correlation between the condition and the age as the older the patients, the more the number of patients and the more severe was their cardiomegaly.

These findings are in conformity with other scholars who all agree that an enlarged heart size is an independent predictor of death, and an increased cardiothoracic ratio on CXR, irrespective of its etiology, is associated with poor prognosis in middle-aged patients. This issue is thus indicative of great importance and necessity of early diagnosis, especially in older patients[12, 13, 14].

There was no notable relationship between the condition and the sex of the respondents. For both minimal and severe categories, both males and females were seen to be at risk of acquiring cardiomegaly. That is, there is an equal chance that either females or males may have cardiomegaly. This was confirmed by the Chi-square results at 5% level of significance, whose p value was found to be 0.676.

The results from this study also showed that left Ventricular Diastolic Dysfunction was the most prevalent disease in patients with cardiomegaly. It was found in more than half of the study participants (71%). Other common diseases included Left Atrium Dilatation and Left Ventricular Systolic Dysfunction, with 29% distribution each, right atrium dilatation (25%), left ventricular hypertrophy (24%), inter ventricular hypertrophy (23%), and Left ventricular dilatation and pericardial effusion at 21% each.

This is in contrast to a study conducted on 170 patients, at the Madonna University Teaching Hospital in Nigeria. In his study, cardiomegaly was revealed by chest radiographs and patients then underwent echocardiography. Arterial hypertension was found to be most frequently associated with heart enlargement (39.4%), followed by dilated cardiomyopathy (21.76%), endomyocardial fibrosis (14.1%), valvular defects (9.4%) and cardiac enlargement (6.47%)[15].

In addition, this study also showed that 70 % of the respondents had increased blood pressure with 43% of the patients having severe blood pressure. The test results also showed that 66% of patients in the sample had increased blood flow on Doppler measured at certain points of the heart, with the blood flow of 6% of the patients being severely increased. Patients with increased blood flow showed an increase in blood pressure with those with severe increased blood flow showing a strong positive association with severe high blood pressure.

Limitations of the study

Being a retrospective study, there were challenges in accessing information that could have been relevant

to this study. This was due to the fact that the data used in this study could only be collected from patient's records as they appeared which in some cases could not be found or was incomplete. As such, no measurements of gradient of stenosis and for the aorta were available on the ECHO forms. In addition, the inferior vena cava (IVC), right atrium and right ventricle measurements were also not available as the doctor doing the ECHO examinations only mentioned whether the IVC was dilated or not without indicating the actual values. Furthermore, Doppler reports on ECHO were only indicating the E/A value without the actual velocity of the blood flow. In future it will be necessary to therefore carry out a longitudinal prospective study that will take into consideration the issues of quantification of all findings.

CONCLUSION

The researcher would like to recommend that cardiomegaly diagnosed on a chest X-ray should be considered as a strong indicator for cardiovascular diseases. Therefore, all patients diagnosed with cardiomegaly should be assessed further on ECHO, as this study has shown that there is a strong association between cardiomegaly diagnosed on a CXR and ECHO results.

It is also recommended that those from 65 years and above should be made aware that they are more at risk of cardiomegaly and thus cardiovascular diseases. Furthermore, it is recommended that more research be done on cardiovascular diseases like left Ventricular Diastolic Dysfunction, left Atrium Dilatation, left Ventricular Systolic Dysfunction and left Ventricular Hypertrophy, as these were found to be very common as well as severe in patients with cardiomegaly. More preventive measures against these diseases should also be put in place.

The researcher would also like to recommend that all patients with a raised BP should undergo a CXR and ECHO examination so as to assess for any other specific cardiovascular diseases like Cardiomyopathy, Left Atrium Dilatation, Left Ventricular Hypertrophy and Pericardial Effusion. These diseases were found to be very severe in patients with a raised BP in this research study.

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