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ORIGINAL RESEARCH

A STUDY TO FIND OUT THE CO-RELATION OF FINDINGS OF X-RAY, ECG AND ECHOCARDIOGRAPHY IN CARDIAC AND NON-CARDIAC DISEASES

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Abstract

Introduction: Detection of left atrial enlargement or its progression is frequently important in clinical medicine.A Chest X- Ray and ECG assessment of left atrial enlargement is a non-invasive and universally available method. Echocardiography has proven to be a valuable non-invasive tool for quantitatively assessing left atrial size. The present study is an attempt to detect left atrial enlargement in suspected cardiac patients and its correlation with X-Ray, E.C.G and Echocardiography.

Materials and Method: The presentstudy was conducted among 70 patients having left atrial enlargement. Data thus collected was studied and positive predictive index was determined and attempt was also made to find out prognostic index by size of the left atrium and other findings.Chest X ray PA view and Right lateral view, ECG and Echocardiographywas conducted.

Results: 2D-Echocardiography was able to detect all 70 cases of left atrial enlargement and was able to categorize them into mild, moderate and severe left atrial enlargement. But ECG was able to predict left atrial enlargement in only 45.71% of cases, where as X-ray was able to predict in only 27.14%.

Conclusion: 2D-Echo is simple, non invasive technique to detect left atrial enlargement from mild to severe grade and can provide a timely clue in preventing complications. ECHO was found to be more specific and sensitive then ECG and X-Ray, ECG was found to have more positive predictive value then X-Ray.

Keywords: Left atrial enlargement, ECHO, ECG, X-Ray

Introduction

Left atrial enlargement is an important pathologic change in many forms of heart disease.[1] Detection of left atrial enlargement or its progression is frequently important in clinical medicine.[2] There is growing recognition of the importance of left atrial enlargement and its association with increased morbidity and mortality in patients with cardiovascular diseases.[3]

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Several classic signs define left atrial enlargement. The first is dilatation of the left atrial appendage, seen as a focal convexity where there is normally a concavity between the left main pulmonary artery and the left border of the left ventricle on the frontal view. Second, because of its location, as the left atrium enlarges, it elevates the left main stem bronchus. In doing so it widens the angle of the carina. Third, as the left atrium enlarges posteriorly, it may cause focal bowing of the middle to low thoracic aorta towards the left. This bowing is distinguishable from the tortuosity seen with progressive atherosclerosis, which involves the descending thoracic aorta in its upper portion or diffusely. Fourth, with marked left atrial enlargement a double density can be seen on the frontal view because the left atrium projects laterally towards the right and posteriorly.[4]

A Chest X- Ray and ECG assessment of left atrial enlargement is a non-invasive and universally available method. Echocardiography has proven to be a valuable non-invasive tool for quantitatively assessing left atrial size. The present study is an attempt to detect left atrial enlargement in suspected cardiac patients and its correlation with X-Ray, E.C.G and Echocardiography in all patients attending medicine dept. of Medical College And Hospital.

Materials and Method

The present prospective clinical study was carried among 200 patients attending medicine department and clinically suspected of cardiac disease were evaluated and out of which 70 patients having left atrial enlargement were included in the study over a period of 18 months amongst those attending the Medicine outdoor and indoor department of Rohilkhand Medical College and Hospital, Bareilly. All patients were examined in detail and their findings were recorded in a specially devised proforma.

Data thus collected was studied and positive predictive index was determined and attempt was also made to find out prognostic index by size of the left atrium and other findings.

These patients, were selected after informed consent for the purpose of study during the study period. All Individuals aged 15 years or above coming to RMCH having either Rheumatic Fever and/or Rheumatic heart disease (Determined by Jones Criteria) and all patients having cardiac symptoms and attending the medicine department of R.M.C.H will be included in the study. All individuals less than 15 years of age were excluded.All individuals suspected of cardiac diseases were studied but not having left atrial enlargement as determined by echocardiography (as per guidelines of American society of echocardiography in conjunction with European association of echocardiography) was excluded.Any patient having congenital heart disease was excluded.

Laboratory investigations i.e., Hb, TLC, DLC, ESR, CRP, blood sugar random, serum creatinine, blood urea was conducted.

Chest X ray PA view and Right lateral view was conducted and described as presence of double density sign, convex left atrial appendage, oblique measurement of greater than 7 cm as measured from the mid point of left main bronchus to the right border of the left atrium (this sign requires double density sign to be present), splaying of the carina with increase of tracheal bifurcation angle of more than 90 degrees, posterior displacement of left main bronchus (walking man sign) on lateral radiography and or hesitancy in the passage of the barium (at the left atrial level) on lateral radiography.

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ECG was conducted and described as increased duration (more than 0.11 sec) of P wave in Limb lead II, notching of the P wave with increased distance between two notch (more than 0.04 sec), increased terminal negative deflection in P wave in chest lead V1 (more than 1 mm in depth), Morris Index is more than 0.03 mmsec,and or Macruz Index more than 1.6. Another investigations done in selected cases were MRI- Brain screening, TSH, T3, T4 for patients suspected to be having hyperthyroidism and ASO titers.

Echocardiography was conducted (American society of echocardiography in conjunction with European association of echocardiography guidelines for left atrial enlargement)[5] and is described as given in table 1.

Table 1: Echocardiography reference range

LA Diameter (cms)	Reference Range	Mild	Moderate	Severe
Male	3.0-4.0	4.1-4.6	4.7-5.2	=>5.2
Female	2.7-3.8	3.9-4.2	4.3-4.6	=>4.7

Results

Table 2: X-RAY, ECG AND ECHO prediction of left atrial enlargement in different condtions and it's co-relation

Conditions	X-RAY prediction of left atrial enlargement			ECG prediction of left atrial enlargement			ECHO prediction of left atrial enlargement			Total	
	Positive prediction	Negative prediction	Positivity %	Poisitive Prediction	Negative Prediction	Positivity %	Positive Prediction	Negative Prediction	Positivity %	No	%
RHD	11	12	47.83 %	10	13	43.48 %	23	0	100%	23	32.85%
HTN	0	3	0%	1	2	25.00 %	3	0	100%	3	4.29 %
IHD	5	13	27.78 %	7	11	38.89 %	18	0	100%	18	25.71%
A.F	1	0	100%	0	1	0.00%	1	0	100%	1	1.43 %
CARDIOMYO-PATHIES	2	13	13.33 %	4	11	26.67 %	15	0	100%	15	21.43%
Thyrotoxicosis	0	6	0%	6	0	100%	6	0	100%	6	8.57 %
Anemia	0	3	0%	3	0	100%	3	0	100%	3	4.29 %
Peripartum-	0	1	0%	1	0	100%	1	0	100%	1	1.43 %

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Cardiomyopathy											
TOTAL	19	51	27.14 %	32	38	45.71 %	70	0	100%	70	100 %

r =0.940, t = 4.764, P =0.0176(significant)

In this study, Echo was able to identify all 70 (100%) cases of left atrial enlargement. Whereas ECG detected 32 (45.71%) patients of left atrial enlargement. X-RAY detected left atrial enlargement in 19 (27.14%) of cases only (table 2, figure 1).

Figure 1: X-RAY, ECG AND ECHO prediction of left atrial enlargement in different condtions and it's co-relation

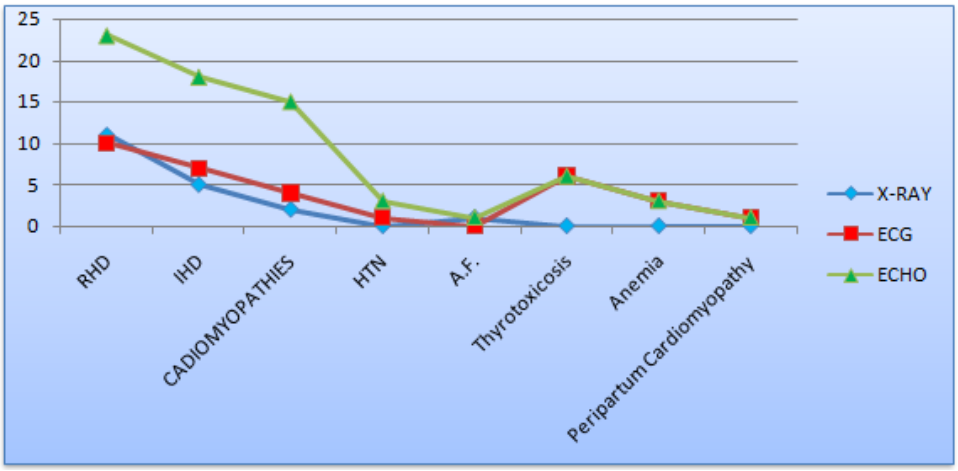

Table 3: X-RAY AND ECG wise prediction of LAE in echo graded LAE

LAE (BY ECHO)	ECG				X-RAY				TOTAL	
	Positive prediction	%	Negative prediction	%	Positive prediction	%	Negative prediction	%	No.	%
Mild	18	46.15 %	21	53.85 %	3	7.69 %	36	92.31%	39	55.71 %
Moderate	4	30.77 %	9	69.23 %	5	38.46%	8	61.54%	13	18.57 %
Severe	10	55.56 %	8	44.44 %	11	61.11%	7	38.89%	18	25.71 %
Total	32	45.71 %	38	54.29 %	19	27.14%	51	72.86%	70	100%

X^2=5.2126, P = 0.022424 (Significant)

In this study out of 70 patients, ECG positively predicted 10 (55.56%) patients with severe enlargement, 4 (30.77%), with moderate enlargement and 18 (46.15%) with mild enlargement (table 3).

X-ray positively predicted in 11(61.11%) patients with severe enlargement, 5(38.46%) with moderate enlargement and 3(7.69%) patients with mild enlargement.

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ECG positively predicted left atrial enlargement in 32 (45.71%) patients whereas X-Ray predicted positively in only 19 (27.14%) patients.
There is significant difference between ECG and X-Ray prediction of Left Atrial Enlargement, with ECG having better positive predictive value.

Table 4: Relationship between left arial size and congestive heart failure

Congestive heart failure		Left atrial size									Total		
		Mild			Moderate			Severe					
		Number	%	Mean L.A. size	Number	%	Mean L.A. Size	Number	%	Mean L.A. Size	Number	%	Mean L.A. Size
Present	Male	16	53.33 %	4.24	3	37.50 %	4.80	5	50.00 %	5.44	24	50.00 %	4.83
	Female	14	46.67 %	4.20	5	62.50 %	4.42	5	50.00 %	6.08	24	50.00 %	4.90
	Total	30	76.92 %	4.22	8	61.54 %	4.61	10	55.56 %	5.76	48	68.57 %	4.86
Absent	Male	6	66.67 %	4.28	2	40.00 %	4.95	1	12.50 %	5.20	9	40.91 %	4.81
	Female	3	33.33 %	4.17	3	60.00 %	4.43	7	87.50 %	4.94	13	59.09 %	4.51
	Total	9	23.08 %	4.23	5	38.46 %	4.69	8	44.44 %	5.07	22	31.43 %	4.66
Total		39	55.71 %		13	18.57 %		18	25.71 %		70	100%	4.76
Mean L.A. size				4.23			4.65			5.42			

X^2= 4.267, P =.0389 (significant)

In this study of 70 patients, 48 (63.33%) patients showed features of congestive heart failure. Among them 30 (55.71%) had mild left atrial enlargement (16 male and 14 female), 8 had moderate left atrial enlargement (3 male and 5 female), 10 had severe left atrial enlargement (5 male and 5 female) (table 4).
Mean Left atrial size in patients having congestive heart failure is 4.86cm.
There is statistical co-relation of left atrial enlargement and congestive heart failure, out of 70 patients having left atrial enlargement 48 (68.57%) patients had congestive heart failure.

Discussion

In our study, X-ray positively predicted in 11(61.11%) patients with severe enlargement, 5(38.46%) with moderate enlargement and 3(7.69%) patients with mild enlargement. S. J. Quinto et al[6]demonstrated in data older than 18 years admitted to Steve Biko Academic

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Hospital during 2000-2003 who had both chest radiography and echocardiography included in this cross-sectional, retrospective analysis. Intra and Interobserver variability were determined using logistic regression (with left atrial enlargement determined by echocardiography), the positive predictive value was 48.7%, so the results of the above mentioned study is comparable to our study.

There is significant difference between ECG and X-Ray prediction of Left Atrial Enlargement, with ECG having better positive predictive value. ECG positively predicted left atrial enlargement in 32 (45.71%) patients whereas X-Ray predicted positively in only 19 (27.14%) patients.

In this study, Echo was able to identify all 70 (100%) cases of left atrial enlargement. Whereas ECG detected 32 (45.71%) patients of left atrial enlargement. X-RAY detected left atrial enlargement in 19 (27.14%) cases only, showing 2D-ECHO having the most positivity index (100%), followed by ECG (45.71%), followed by X-Ray (27.14%). Allan D. Waggoner[7]compared ECG in sinus rhythm with echocardiography in 307 patients and found that echocardiography had 100% positive predictive value where as electrocardiography had only 63% positive predictive index, the difference in the positive predictive index can be accounted by the smaller sample size in our study.

Rheumatic Heart Disease was the most common cause of left atrial enlargement accounting for 32.83% in this study with mean left atrial size of 5.42cm. Next in this order was Ischemic Heart Disease 25.71% with mean left atrial size of 4.58cm, followed by Cardiomyopathies 21.43% with mean left atrial size of 4.24cm, followed by Thyrotoxicosis 8.57% with mean left atrial size of 4.20cm, followed by Hypertension 4.29% with mean left atrial size of 4.27cm, followed by Anemia 4.29% with mean left atrial size of 4.20cm, followed by Atrial Fibrillation 1.43% with mean left atrial size of 4.20cm and Peripartum-Cardiomyopathy 1.43% with mean left atrial size of 4.20cm,the most common non cardiac cause of left atrial enlargement was Thyrotoxicosis 8.57% with mean left atrial size of 4.20cm, Hamid Ikram et al[2]found RHD (48.64%) as the most common cause of left atrial enlargement.In a study by Iwasaki T et al[8]of thyrotoxicosis patients, mean left atrial size was 4.28 cm. So our study is comparable to above mentioned studies.

Mean left atrial size in atrial fibrillation was 4.68 ±0.75 cm. Rajeev Bhardwaj et al[9] found Rheumatic Heart Disease as the most common cause of atrial fibrillation in India, in a study of 137 patients with atrial fibrillation 84 (61.31%) had RHD. Left Atrial size varied from 4.1 cm to 7.3 cm with a mean left atrial size of 4.66cm.Our study is comparable to the above mentioned study.

In this study of 70 patients Left atrial size varied from 4.1 – 7.3 cm with mean left atrial size of 4.54 cm. Mild left atrial enlargement was seen in 39 (55.71%) patients. Among them 10(25.64%) patients had IHD, 9 (23.08%) patients had Cardiomyopathies, 7 (17.95%)patients had RHD, 6 (15.39%) patients had Thyrotoxicosis, 3 (7.69%) patients had anemia, 2 (5.13%) patients had Hypertension, 1 (3.45%) patient had A.F. and 1 patient had Peripartum-Cardiomyopathy. Moderate left atrial enlargement was seen in 13 (18.57%) patients, among them 6 (46.15%) patients had Cardiomyopathies, 5 (38.47%) patients had RHD, 1 (7.69%) patient had IHD, and 1 (7.69%) patient had Hypertension. Severe left atrial enlargement was seen in 18 (25.72%) patients among them 11 (61.11%) patients had RHD and 7 (38.89%) patients had IHD.

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In this study of 70 patients, 48 (63.33%) patients showed features of congestive heart failure. Among them 30 had mild left atrial enlargement (16 male and 14 female), 8 had moderate left atrial enlargement (3 male and 5 female), 10 had severe left atrial enlargement (5 male and 5 female). Takemoto Y et al[10]conducted a prospective study on 1495 patients in olmsted county, Minnesota, residents aged more or equal to 65 years of age were referred for transthoracic echocardiography from 1990 to 1998, who were in sinus rhythm without a history of congestive heart failure and were followed in the medical record to 2003, of the 1495 patients identified, 1375 with ejection fraction more than or equal to 50% constituted the study population, 138 of whom developed congestive heart failure out of which 74 (76%) had ejection fractions remaining at or => 50%, they concluded that left atrial enlargement independently predicted the first congestive heart failure.

Mean Left atrial size in patients having congestive heart failure is 4.86cm in our study.There is statistical co-relation of left atrial enlargement and congestive heart failure, out of 70 patients having left atrial enlargement 48 (68.57%) patients had congestive heart failure. X^2= 4.267, P = 0.0389 (significant). KizerJR et al[11]investigated the prognostic value of left atrial diameter for incident cardiovascular events in 2804 American - Indians, during a median follow up of 7 years, 368 events occurred. Left atrium both as continuous and as a categorical variable, was significantly associated with incident cardiovascular events in unadjusted analyses. In multivariable analyses adjusted for age, sex, body mass index, hypertension, diabetes, total cholesterol, high density lipoprotein cholesterol , smoking, renal insufficiency, left ventricular hypertrophy, abnormal left ventricular systolic and diastolic function, mitral annular calcification, left atrial diameter (risk ratio 1.04/mm, 95%, P<0.002) remained independent predictor of first cardiovascular event.

Conclusion

2D-Echocardiography was found to be superior to electrocardiography and electrocardiography is superior to X-Ray in predicting left atrial enlargement. Left atrial enlargement was found to be associated with a significant number of patients with congestive heart failure, 63.33% patients with left atrial enlargement had congestive heart failure in this study, early recognition and prompt treatment could result in reduction in morbidity and mortality in these patients.

2D-ECHO was able to recognize left atrial enlargement in all cases. ECG was able to positively predict left atrial enlargement in 45.71% of cases, where as X-ray was able to predict in only 27.14%. ECG was able to show atrial fibrillation characteristic features in all cases of atrial fibrillation. Hence, 2D-Echo is simple, non invasive technique to detect left atrial enlargement from mild to severe grade and can provide a timely clue in preventing complications. ECHO was found to be more specific and sensitive then ECG and X-Ray, ECG was found to have more positive predictive value then X-Ray.

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