

# A Study of Co-Relation Between ECG and X-Ray in Left Atrial Enlargement

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## ABSTRACT

**Introduction:** Left atrial enlargement is an important pathological change in many form of heart diseases. In this context, this study was undertaken with the aim to find the positive predictive index of x-ray and ecg and to find out the better modality for the diagnosis of left atrial enlargement.

**Material and Method:** A prospective study of 18 months was undertaken from November 2013 to august 2015 in the department of General Medicine, in Rohilkhand Medical College And Hospital, Bareilly, U.P. 200 suspected cardiac patients were evaluated and those who were not having left atrial enlargement were excluded from the study thus, 70 patients of 15 years or above with left atrial enlargement were studied using X-ray and ECG.

**Results:** This study was carried out on 70 selected patients who underwent echocardiography and had left atrial enlargement. In the present study, age of the patients ranged from 15 years to 90 years (mean age of  $49.7 \pm 17.64$  years). In this study, maximum patients were of 41-50 years (n=19) and minimum patients were in age group 15 – 20 years (n=4). In this present study, 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.

**Conclusion:** ECG had better positive predictive index than X-Ray. In rural region where echocardiography is not available ECG can be used to predict left atrial enlargement.

**Keywords:** Co-Relation Between ECG, Atrial Enlargement

## INTRODUCTION

Detection of left atrial enlargement or its progression is important in clinical medicine as left atrial enlargement is a significant pathologic change in many heart diseases like mitral / aortic/ combined valvular lesions, Hypertension, Ischemic heart disease, mitral valve prolapse, cardiomyopathies, congenital heart diseases and pericardial effusion.<sup>1</sup> The left atrium is affected directly by increased left ventricular diastolic pressure, increased resistance across the mitral valve, or left ventricular volume overload.<sup>2</sup>

Left atrial dilatation could progress as a consequence of continued hemodynamic burden, decreased atrial systole or both and lead to recurrent/intermittent and chronic atrial fibrillation.<sup>3</sup> An increase in left atrial size in the presence of atrial fibrillation has been independently associated with an increased risk of stroke as well as increased mortality.<sup>4</sup> Assessment of left atrial enlargement by Chest X- Ray and ECG are non-invasive and universally available methods. Echocardiography has proven to be a valuable non-invasive tool for quantitative assessment of left atrial size, however it is not widely available in general practice. The present study

was an attempt to find the positive predictive index of X-ray and ECG in predicting Left atrial enlargement. Objectives of the study were to find out the enlargement of left atrial by X-Ray and E.C.G and to find out the better modality for predicting left atrial enlargement.

## MATERIAL AND METHODS

A prospective clinical study for 18 months was conducted amongst the patients attending the Medicine outdoor and indoor department a teaching hospital at north India. Approval was taken from ethical committee and informed and written consent was taken from patients for the purpose of study. 70 patients, 15 years or older, having left atrial enlargement on echocardiography were included in the study and classified in mild moderate and severe enlargement (table 1) and The chest X-Ray and ECG finding of these patients were studied in detail.

Data thus collected was studied and positive predictive index of ECG and X-Ray chest was determined and graded with the help of echocardiography.

Table-1 American society of echocardiography in conjunction with European association of echocardiography has given guidelines for left atrial enlargement.<sup>5</sup>

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

## STATISTICAL ANALYSIS

SPSS version 21 was used to generate tables. Descriptive statistics were used to infer results

## RESULTS

The study was carried out on 70 selected patients with left atrial enlargement.

### Age and sex wise distribution of cases

In the present study age of the patients ranged from 15 years to 90 years. With a mean age of  $49.7 \pm 17.64$  years. There were 33 (47.14%) males and 37 (52.86%) females with female-male ratio being 1.12:1.

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**How to cite this article:** Nikhil Saxena, Seema Seth, Malini Kulshreshtha, Darshan Mehra, K.K. Dwivedi. A study of co-relation between ECG and X-Ray in left atrial enlargement. International Journal of Contemporary Medical Research 2016;3(3):682-684.

ECG Findings	Number of cases (n=70)	Percentage
Double Peaked P wave (Notched) In lead II >0.04 sec	3	4.29%
P wave duration >0.11 sec in lead II	17	24.29%
Negative P terminal force > 1mm	21	30%
Morris Index more than 0.03 mm/sec	19	27.14%
Macruz Index more than 1.6	17	24.29%
Varying R-R interval	11	15.71%
Absent P wave	5	7.14%

**Table-1:** Analysis of eeg in patients with left atrial enlargement

In this study of 70 patients, negative P terminal force >1 mm was seen in 21 (30%) patients. 'P' wave duration >0.11 sec in lead II was seen in 17 (24.29%) patients. Morris index more than 0.03 mm/sec was seen in 19 (27.14%) patients, Macruz Index more than 1.6 was seen in 24.29% of patients. Double peaked 'P' wave (notched) in lead II >0.04 sec was seen in 3 (4.29%) patient. Varying R-R interval was seen in 11(8.33%) patients, among those 5 (7.14%) had absent P wave. Thus negative P terminal force more than 1mm had the best positive predictive value in this study 30%.

In this study of 70 patients, chest X-ray showed convexity of left atrial appendage was seen in 22 (31.43%) of patients, double density sign was seen in 18 (25.71%) of patients, splaying of carina (angle being more than 90°) was seen in 13 (18.57%) of patients, Oblique Measurement Of Greater Than 7cm Measured From Mid-point Of Left Main Bronchus To The Right Border Of Left Atrium (This Requires Double Density Sign) was seen in 7 (10%) of patients, walking man sign was seen in 18 (25.71%) of patients, Indentation Of Oesophagus Upon Barium Swallow In Right Lateral View was seen in 9 (12.86%) of patients. Thus convexity of left atrial appendage had best positive predictive value in this study (31.43%).

In this study out of 70 patients, ECG positively predicted in 10 (55.56%) patients with severe enlargement, in 4 (30.77%) patients, with moderate enlargement and in 18 (46.15%) patients with mild enlargement. 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. 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 even the presence of mild left atrial enlargement.

## DISCUSSION

This study was carried out on 70 randomly selected patients who underwent echocardiography and had left atrial enlargement. In the present study, age of the patients ranged from 15 years to 90 years ( mean age of  $49.7 \pm 17.64$  years). In this study, maximum patients were of 41-50 years (n=19) and minimum patients were in age group 15 – 20 years(n=4). There were 33 (47.14%) males and 37 (52.86%) females with female-male ratio being 1.12:1. Waggoner A.D. et al<sup>6</sup>

in their study involving 307 patients, 58.99% were female and 41.01% were males. In a study by Levy et al<sup>7</sup>, Female: Male ratio was 1.3:1. So our study is comparable to both the studies

In this present study, out of 5 patients of A.F. all 5 (100%) had shown ECG characteristics of A.F like absent 'P' wave and varying R-R interval (as shown in table no.1). Rajeev Bhardwaj<sup>6,3</sup> et al 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.

As shown in table number-1, negative P terminal force >1 mm was seen in 21 (30%) patients. 'P' wave duration >0.11 sec in lead II was seen in 17 (24.29%) patients. Morris index more than 0.03 mm/sec was seen in 19 (27.14%) patients, Macruz Index more than 1.6 was seen in 24.29% of patients. Double peaked 'P' wave (notched) in lead II >0.04 sec was seen in 3 (4.29%) patient. Varying R-R interval was seen in 11(8.33%) patients, among those 5 (7.14%) had absent P wave. Alan D Waggoner et al<sup>6</sup> (1976) compared ECG manifestation of left atrial enlargement and left atrial size by echocardiography in 307 patients in sinus rhythm. ECG criteria used were 'P' wave duration in lead II >0.11sec, ratio of duration of negative terminal 'P' in V1 to the PR segment => 1.0, negative 'P' terminal force in V1 > 0.03 sec. Echocardiographic diagnosis of left atrial enlargement was based on (1) Transverse dimension >4.0cm or (2) A ratio of transverse atrial to transverse aortic root dimension >1.17. They found the predictive index of ECG for left atrial enlargement was 63% overall. When they considered terminal 'P' force in V1 alone it was 56%. They concluded that using appropriate criteria, ECG appears to be reasonably specific but less sensitive indicator of left atrial dilatation. Kirubakaran Munuswamy et al and Martin A. Alpert et al<sup>9</sup> assessed the sensitivity and specificity of commonly used electrocardiographic criteria for left atrial (LA) enlargement.

As shown in table number - 2, chest X-ray showed convexity of left atrial appendage was seen in 22 (31.43%) of patients, double density sign was seen in 18 (25.71%) of patients, splaying of carina (angle being more than 90°) was seen in 13 (18.57%) of patients, Oblique Measurement Of Greater Than 7cm Measured From Mid-point Of Left Main Bronchus To The Right Border Of Left Atrium (This Requires Double Density Sign) was seen in 7 (10%) of patients, walking man sign was seen in 18 (25.71%) of patients, Indentation Of Oesophagus Upon Barium Swallow In Right Lateral View was seen in 9 (12.86%) of patients, S.J. Quinto<sup>8</sup> demonstrated in data from patients older than 18 years admitted to Steve Biko Academic Hospital during 2000–2003 who had both chest radiographs and cardiac ultrasound were included in this cross-sectional, retrospective analysis, the positive as well as negative predictive value were close to 50%. In this study as shown in table number -3, ECG positively predicted 10 (55.56%) patients with severe enlargement, 4 (30.77%), with moderate enlargement and 18 (46.15%) with mild enlargement. X-ray positively predicted in 11(61.11%) patients with severe enlargement, 5(38.46%) with moderate enlargement

X-Ray Findings	Number of cases (n=70)	Percentage
Convexity of Left Atrial Appendage	22	31.43%
Double Density Sign	18	25.71%
Splaying of Carina (Angle being more than 90°)	13	18.57%
Oblique Measurement of Greater Than 7cm Measured From Mid-point of Left Main Bronchus to The Right Border of Left Atrium (This Requires Double Density Sign)	7	10.00%
Walking Man Sign	18	25.71%
Hesitancy in the Passage of Barium in Oesophagus Upon Barium Swallow in Right Lateral View	9	12.86%

**Table-2:** Analysis of x-ray in patients with left atrial enlargement

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<sup>2</sup>=5.2126, P = 0.022424 (Significant)

**Table-3:** X-Ray and ECG wise prediction of LAE in echo graded LAE

and 3(7.69%) patients with mild enlargement. ECG positively predicted left atrial enlargement in 32 (45.71%) patients whereas X-Ray predicted positively in only 19 (27.14%) patients. Allan D. Waggoner<sup>6</sup> compared ECG in sinus rhythm with echocardiography in 307 patients and found that echocardiography had 100% positive predictive value whereas 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.

There is significant difference between ECG and X-Ray prediction of Left Atrial Enlargement, with ECG having better positive predictive value. In this study, mean age was 49.7 ± 17.64 years, mean left atrial size was 4.54cm.

## CONCLUSION

ECG had better positive predictive index than X-Ray. In rural region where echocardiography is not available ECG can be used to predict left atrial enlargement. Although ECG had positive predictive index of 45.71%, echocardiography still remains the investigation of choice for evaluating the left atrial enlargement if available.

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**Source of Support:** Nil; **Conflict of Interest:** None

**Submitted:** 15-12-2015; **Published online:** 04-02-2016