



## A correlation study for detection of Left Atrial Enlargement of patients with cardiac and non cardiac disease: A hospital based study

Author

**Dr. Taskeen Ahmad Reza**

Assistant Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India

Corresponding Author

**Dr. Taskeen Ahmad Reza**

Assistant Professor, Department of Medicine, Katihar Medical College, Katihar, Bihar, India

Ph: +91 9431472939, Email: [taskeenarezakmc@gmail.com](mailto:taskeenarezakmc@gmail.com)

### Abstract

**Objective:** *Our study was to detect the prevalence and correlation of echocardiography and ECG finding of left atrial enlargement of patients with cardiac and non cardiac disease.*

**Methodology:** *A total of 75 patients were included on the basis of inclusion criteria. A detail assessment was taken to all patients. A standard 12 lead ECG was recorded and Echocardiography was performed in all the cases. Left atrial size was measured by 2D echo guided M-mode echocardiography.*

**Results:** *Data was analyzed by using MS-Office software.*

**Conclusions:** *Patients with RHD with mitral and aortic valve disease, hypertension, atrial fibrillation and IHD were more associated to left atrial enlargement (LAE). 2 D echocardiography was able to categorize LAE into mild, moderate and severe. ECG was only able to predict LAE. Hence echocardiography is superior than electrocardiography for detection of LAE.*

**Keywords:** *Left atrial enlargement, echocardiography, electrocardiography.*

### Introduction

Detection of left atrial enlargement or its progression is frequently important in clinical medicine<sup>[1]</sup>. Left atrium is affected directly by increased ventricular filling pressure, increased resistance across mitral valve or volume overload.<sup>[2]</sup> Left atrial enlargement is an important pathologic change in many forms of heart disease<sup>[3]</sup>.

Left atrial enlargement is an important pathologic change in many forms of heart disease.<sup>[3]</sup> detection of left atrial enlargement or its progression is frequently important in clinical

medicine.<sup>[1]</sup> There is growing recognition of the importance of left atrial enlargement and its association with increased morbidity and mortality in patients with cardiovascular disease<sup>[4]</sup>. The left atrium is affected directly by increased ventricular filling pressure, increased resistance across the mitral valve, or volume overload<sup>[2]</sup>. Left atrial enlargement occurs in various conditions like mitral valve disease, aortic valve disease, combined valvular lesions. Hypertension, ischemic heart disease, mitral valve prolapsed, cardiomyopathies, congenital heart disease, and pericardial effusion<sup>[2]</sup>. Left atrial enlargement

can be mild, moderate or severe depending on the extent of the underlying condition. Although other factors may contribute, left atrium size has been found to be a predictor of mortality due to both cardiovascular issues as well as all-cause mortality. Current research suggests that left atrium size as measured by an echo-cardiograph may have prognostic implications for preclinical cardiovascular disease. However, studies that have found LAE to be a predictor for mortality recognize the need for more standardized left atrium measurements than those found in an echo-cardiogram.<sup>[17]</sup>

Many numbers of studies has shown that a chronic hemodynamic burden initially produces atrial dilatation and structural damage to atrial wall; this in turn increases likelihood of the development of atrial fibrillation. Once atrial fibrillation is present, atrial dilatation could progress a consequence of continued hemodynamic burden, the less of atrial systole or both.<sup>[6]</sup> Left atrial enlargement has been found to be a significant predictor of recurrent and chronic atrial fibrillation<sup>[7]</sup>. ECG assessment of left atrial enlargement is a noninvasive and universally available method<sup>[8]</sup>. Echocardiography has proven to be a valuable non-invasive tool for quantitatively assessing left atrial size<sup>[6]</sup>. Aim of this study was to detect the left atrial enlargement by echocardiography and ECG correlation in cardiac and noncardiac diseases patients.

### Materials and Methods

Data was collected using random sampling method on the basis of inclusion and exclusion criteria, with irrespective of sex in OPD or the ward, of department of Medicine, Katihar Medical College, Katihar, Bihar during period of January 2017 to June 2017.

This prospective correlation study was conducted on 75 patients aged between 14-80yrs with clinically suspected left atrial enlargement. The attendant of entire subject/patients signed an informed consent approved by institutional ethical committee of Katihar Medical College, Katihar,

Bihar, India was sought. LAE has close relationship with atrial fibrillation, systemic thromboembolism events and heart failure.<sup>[3]</sup> ECG assessment of left atrial enlargement is a noninvasive and universally available method.<sup>[8]</sup> ECG analysis for left atrial enlargement includes configuration, amplitude and duration P wave<sup>[9]</sup>. Echocardiography LA dimension is the best noninvasive test of left atrial size<sup>[10]</sup>.

Inclusion criteria of this study was Rheumatic mitral and aortic valvular diseases, Isolated aortic valve diseases, Hypertension, Coronary artery diseases (IHD), Mitral valve prolapsed, Cardiomyopathy, Thyrotoxicosis, Atrial fibrillation. Exclusion criteria was patients with Age < 14 years, pericardial effusion, Chronic obstructive pulmonary diseases (COPD), Chest trauma

### Methods

A detail assessment was taken to all patients. It includes detailed history, thorough general physical examination, systemic examination and investigations like 12 lead ECG and echocardiography. Patients having P wave ECG changes in lead II and V<sub>1</sub> submitted for echocardiography evaluation over a period for 6 months.

### Electrocardiogram

A standard 12 lead ECG was recorded in all patients and was analyzed for evidence of left atrial enlargement and/or AF.

### Echocardiography

Echocardiography was performed in all the cases. Left atrial size was measured by 2D echo guided M-mode echocardiography. Measurements were obtained as per the recommendations of American society of echocardiography. Left atrium was measured at end systole in parasternal long axis as a maximum distance between the anterior margin of posterior aortic root echo and the anterior margin of a posterior wall of left atrial echo at the aortic valve levels.

### Statistical analysis

Simple analysis method was taken to analyzed the data with the help of MS-Office soft ware.

**Observations**

This study was carried out on 75 patients with left atrial enlargement OPD and ward of department of Medicine, Katihar Medical College, Katihar, Bihar, India.

In the present study, age of the patients were taken from 17 years to 80 years. There were 45 males and 30 females. In age group of 14-20 years, 2(4.44%) were male and 2(6.66%) females. In age group of 21-30 years, 4(8.89%) were males and 2(6.66%) females. In age group of 31-40 years, 5(11.11%) were males and 5(16.66%) females. In age group of 41-50 years, 11(24.44%) were males and 11(36.66%) females. In age group of 51-60 years 11(24.44%) were males and 02(6.66%) females. Above of age 60 years, 12(26.67%) were males and 08(26.66%) females.

In this study, 21(28%) cases were with rheumatic mitral and valvular disease. 14(18.66%) cases were with hypertension. 10(13.33%) cases were with ischemic heart disease (IHD). 8(10.66%) cases were with isolated aortic valve disease. 2(2.66%) cases were with mitral valve prolapsed. 4(5.33%) cases were with cardiomyopathies. 2(2.66%) cases were with thyrotoxicosis. And 14(18.66%) cases were with atrial fibrillation with or without rheumatic heart disease (RHD).

In this study, 41(54.66%) patients were symptoms with breathlessness. 24(32%) patients were with symptoms of chest pain. 13(17.33%) patients were with symptoms of cough. 23(30.66%) patients were with palpitation. 18(24%) patients were with symptoms of swelling of lower limbs. 16(21.33%) patients were with symptoms of easy fatigability. 5(6.66%) patients were history of neurological deficits. 5(6.66%) patients were with symptoms of hemoptysis. And 10(13.33%) patients were with symptoms of syncope.

In the present study, 40 (53.33%) patients had left atrial size in the range 39 to 45 mm followed by 17(22.66%) patients in the range of 46 to 50 mm, 08 (10.66%) patients in the range 51-55mm, 06(8%) patients in 56-60 mm and 4(5.33%) in the range  $\geq 61$ mm. In the study, LA size varied from 40mm to 76mm.

In this study, least number of patients was in the age group of 14-20 years (6 patients). Among them 02(33.33%) had mild, 04(66.66%) had moderate LAE. 7 patients were in age group of 21-30 years. Among them 04(57.14%) had mild, 1(14.28%) had moderate and 2(28.57%) had severe LAE. 9 patients were in age group of 31-40 years. Among them 05(55.55%) had mild, 3(33.33%) had moderate and 1(11.11%) had severe LAE. 24 patients were of 41-50 years age group. Among them 08(33.33%) had mild, 8(33.33%) had moderate and also 8(33.33%) had severe LAE. 13 patients were of 51-60 years age group. Among them 06(46.15%) had mild, 2(15.38%) had moderate and 5(38.46%) had severe LAE. 16 patients were of Age above than 60 years. Among them 8(50%) had mild, 6(37.5%) had moderate and 2(12.5%) had severe LAE.

In this study 45 patients were male. Among them 24(53.33%) had mild, 10(22.22%) had moderate and 11(24.48%) had severe left atrial enlargement. 30 patients were females. Among them 08(26.66%) had mild 14(46.66%) had moderate and 08(26.66%) had severe left atrial enlargement. In this study of total 75 patients. LAE was seen in 22 patients of RHD with mitral and aortic valve disease. Among them 15(68.18%) had mild, 05(22.72%) had moderate and 02(9.1%) had severe LAE. 15 patients were seen with hypertension. Among them 7(46.66%) patients had mild, 5(33.33%) had moderate and 3(20%) had severe LAE. 11 patients were seen with IHD. Among them 4(36.36%) patients had mild, 7(63.63%) had moderate LAE. 6 patients were seen with isolated aortic valve disease. Among them 3(50%) patients had mild, 2(33.33%) had moderate and 1(16.67%) had severe LAE. 14 patients were seen with AF. Among them 1(7.14%) patients had mild, 3(21.43.33%) had moderate and 10(71.43%) had severe LAE. 3(100%) patients with cardiomyopathies were seen with LAE. 2 patients were seen with thyrotoxicosis. Among them 1(50%) patients had

mild, 1(50%) had moderate LAE. 2(100) patients with mitral valve prolapsed were seen mild LAE.

In this present study, out of 13 patients of AF all 13 (100%) had shown ECG characteristics of AF like absent P wave and varying RR interval. P duration in lead II > 0.11 seconds was seen in 45(82.46%) patients. Morris and Macruz index characteristics were seen in 39(77.12%) of patients each. P wave notch duration > 0.04 seconds was seen also in 39(77.12%) of patients.

In this study ECG predicted overall 76 % positivity in LAE. But when AF alone was considered, 100 % ECG features of AF were seen. ECG positivity were seen in 100% in AF and cardiomyopathy followed by 72.72% in RHD with mitral and aortic valve disease, followed by hypertension(69.23%), isolated aortic valve disease (71.42%). IHD, MVP and thyrotoxicosis had shown 50% positive prediction. Sensitivity of ECG for detecting LAE-100%. But specificity - 75%.

Positive correlation between ECG and Echo in relation to disease findings: In this study, Echo

was able to identify all 75(100%) patients of LAE, where as ECG detected only 55(76%) patients of LAE.

ECG wise prediction of LAE in Echo graded LAE: In this study, out of 75 patients, ECG detected LAE in 18(90.71%) of severe, 1(78.26%) of moderate and 18(56.25%) of mild LAE patients. This is significant difference of ECG +ve and -ve prediction of patients with LAE.

Relation between LA size and congestive cardiac failure: Out of 75 patients, 30(40%) of patients shown features of CCF. Among them 14(46.67%) were severe LAE, 9(30%) were moderate LAE and 7(23.33%) were mild LAE.

In this study of 75, 10 patients with neurological deficits were LAE. Among them 3(30%) patients had moderate and 7(70%) had severe LAE.

In this present study, out of 75 patients, mortality was seen in 9(12%) patients. Among them 07(77.77%) were with severe LAE and 2(22%) were with moderate LAE.

**Table.1.** ECG and Echo correlation of patient's with different conditions

Conditions	ECG			ECHO			Total	
	+ve prediction	-ve prediction	% of positivity	+ve prediction	-ve prediction	% of positivity	No	%
RHD with mitral & aortic valve disease	16	6	72.72	22	0	100	22	100
Hypertension	9	4	69.23	13	0	100	13	100
IHD	5	4	55.59	9	0	100	9	100
Isolated aortic valve disease	5	2	71.42	7	0	100	7	100
Atrial fibrillation	16	0	100	16	0	100	16	100
Cardiomyopathy	4	0	100	4	0	100	4	100
Thyrotoxicosis	1	1	50	2	0	100	2	100
Mitral valve prolapsed	1	1	50	2	0	100	2	100
Total	57	18	76	75	0	100	75	100

## Discussion

Enlargement of the left atrium is well known as one of the earliest manifestations of rheumatic mitral valvular dysfunction. On rare occasions this chamber may become enormous, expanding to the right and posteriorly to form a huge sac that encroaches upon adjacent structures and may eventually rest against the right chest wall. The

clinical course of patients who develop such extreme left atrial enlargement is remarkably uniform, and the diagnosis can be suspected from the presence of a number of characteristic symptoms and signs. <sup>[5]</sup>

In our study age of patients ranged from 17 years to 90 years. There were 45(60)% males and 30(40%) females with a ration 1.5:1 showing male

preponderance. Wagner Ad et al.<sup>[16]</sup> in their study involving 339 patients, 58.99% were females and 41.01% were males. In a study by Levy et al.<sup>[33]</sup> F:M was 1.3:1. So this study is comparable to Levy et al study.<sup>[12]</sup>

Rheumatic mitral and aortic valve disease was the most common cause of left atrial enlargement accounting for 28% in this study. Next in this order were atrial fibrillation and hypertension 18.66%, IHD 13.33%, isolated aortic valve diseases 10.66%, cardiomyopathies 05.33%, MVP and thyrotoxicosis each accounting for 2.66%. Hamid Ikram et al.<sup>[1]</sup> found rheumatic mitral and aortic disease as the most common cause of left atrial enlargement (48.64%), next in this order was hypertension (7.08%).

In this study, left atrial size was varied from 40 mm to 76 mm. AF was more common (53.33%) when left atrial enlargement was 39-45 mm. Kulkarni AG et al.<sup>[11]</sup> has shown in their study 97.14% of population had LA size > 40mm. In a study by Levy et al.<sup>[12]</sup> patients with AF had left atrial size of 43.8±8.6mm. The findings of present study are comparable to the above mentioned studies.

In this study, out of 22(29.33%) rheumatic mitral and aortic valve disease patients, 68.18% of them were with mild LAE with mean left atrial size 44.75mm. 18.66% patients were of atrial fibrillation, among them 71.43% had severe LAE with mean left atrial size 58mm. 14.66% patients were of IHD, among them 63.63% had moderate LAE with mean left atrial size of 44.62mm. There were 20% patients of hypertension, of them 46.66% were mild LAE with mean LA size of 40.72mm. 4% were of cardiomyopathy, All of them were of severe left atrial enlargement with a mean LA size of 56.33mm. 2.66% cases were of thyrotoxicosis, of the 50% each of mild and moderate LAE with a mean LA size 42mm. 8% were of isolated aortic valve disease of which 50% were mild LAE with mean LA size 44.83mm. 2.66% patients were of mitral valve prolapsed, all of them were of mild left atrial enlargement with mean LA size of 43mm. In

study of Levy et al.<sup>[12]</sup> Cardiomyopathy accounted for 5.06% of cases with a mean LA size of 43.8±8.6 mm. Coronary artery disease accounted for 16.3% of patients with mean left atrial size of 43.8±8.6mm. Hypertensive heart disease accounted for 21.44% patients with a mean LA size of 43.8±8.6mm.

Howad DC et al.<sup>[1]</sup> IHD patients accounted for 23 % cases of atrial fibrillation with mean left atrial size of 47±8mm. In a study Papazolgloue NM et al.<sup>[13]</sup> hypertension accounted for 22% of patients. Cardiomyopathy accounted for 11% of cases. In a study by Iwasaki T et al.<sup>[14]</sup> of thyrotoxicosis patients, mean age was 54.1±8.2 years with mean LA size of 42.8±3.6mm. In a study by Owen R Brown et al.<sup>[15]</sup> isolated aortic valve disease formed 23.52% of cases. In a study by Raul Chirife et al.<sup>[2]</sup> mitral valve prolapsed formed 10.41% of cases of left atrial enlargement.

In this present study, out of 13 patients of AF all 13 (100%) had shown ECG characteristics of AF like absent P wave and varying RR interval. P duration in lead II > 0.11 seconds was seen in 45(82.46%) patients. Morris and Macruz index characteristics were seen in 39(77.12%) of patients each. P wave notch duration > 0.04 seconds was seen also in 39(77.12%) of patients.

In this study ECG predicted overall 76 % positivity in LAE. But when AF alone was considered, 100 % ECG features of AF were seen. ECG positivity were seen in 100% in AF and cardiomyopathy followed by 72.72% in RHD with mitral and aortic valve disease, followed by hypertension(69.23%), isolated aortic valve disease (71.42%). IHD had 55.59%, MVP and thyrotoxicosis had shown 50% positive prediction. Positive correlation between ECG and Echo in relation to disease findings: In this study, Echo was able to identify all 75(100%) patients of LAE, where as ECG detected only 57(76%) patients of LAE.

ECG wise prediction of LAE in Echo graded LAE: In this study, out of 75 patients, ECG detected LAE in 18(90.71%) of severe, 1(78.26%) of moderate and 18 (56.25%) of mild LAE

patients. This is significant difference of ECG +ve and -ve prediction of patients with LAE.

In a study by Raul Chirife et al<sup>[2]</sup> shown ECG positivity of 89%, when p wave duration was considered alone, 83% when Morris index considered alone and 89% when Marcuz index alone was considered. Alan D Waggoner et al<sup>[16]</sup> over all ECG predictability of left atrial enlargement was 80%. And showed 100% positivity when LA size >50 mm, 70.83% positivity when LA size was 46 to 50mm and 56.41% when LA size was 41 to 45mm. So our study is comparable to these studies.

In this study, out of 75 patients, 10 patients with neurological deficits were LAE. Among them 7(70%) had severe LAE. Mortality was seen in 9(12%) patients. Among them mortality 07(77.77%) were with severe LAE.

So that echo was found to be more specific investigation to detect LAE compared to ECG. Echo was non invasive simple technique to detect positive LAE than ECG. As LA enlarged from mild to severe grade, ECG predictability of LAE was also increased (90.71% in severe LAE group). In the study it was found that complications of LAE like CCF, AF, Embolic stroke and mortality were increased as size of LA increased. Thus early detection of LAE using ECHO and ECG will help in reducing further complications.

### Future Research

Science is dynamic and there is always a scope of improvement and change in time to come ahead. With progressive aim to move ahead we aspire to achieve highly accurate and reliable results. Thus every study leaves back scopes for other researcher to do something more advanced and varied in order to touch the height of perfection. This study examined only 75 subjects (45 males and 30 females), future researchers can expand the study by including more number of subjects so as to make generalization of the results and practice, further studies with a larger sample size and in multiple centers are required. Thus it could be applied to real life situation.

### Limitation

There were several limitations like, the sample size was small, and it was a hospital-based study, the prevalence of exposure and outcome variables may be different from a community setting.

### Conclusion

This study concluded that patients with rheumatic heart disease with mitral and aortic valve disease, hypertension, atrial fibrillation and ischemic heart disease were more prevalence to left atrial enlargement (LAE). 2 D echocardiography was able to categorize LAE into mild, moderate and severe. ECG was only able to predict LAE, it could not categorize LAE. So that 2 D echo is superior to ECG. Congestive cardiac failure, atrial fibrillation, neurological deficits (stroke) and mortality were associated with severity of LAE. So that, early detection of LAE is need for appropriate management and prevention of complications.

### References

1. Hamid Ikram, Peri Derysdale, P J Bones, W Chan. The non- invasive recognition of left atrial enlargement; Comparison of electro and echocardiographic measurement. Post Graduate Medical Journal;1977 July; 53: 356-359.
2. Raul Chirife, Gilson S. Feitosa, William S. Frankl. Electrocardiographic detection of left atrial enlargement- correlation of P wave with left atrial dimension by echocardiography. British Heart Journal. 1975; 37: 1281-1285.
3. Hua Yang, Anna Woo, Daniel Monakier, Michal Jamorski, Keti Fedwick, Douglas Wigle et al. Enlarged left atrial volume in hypertrophic cardiomyopathy, a marker for disease severity. Journal of the American Society echocardiography. 2005 October; 18(10): 1074-1082.
4. Olivoho I, Cecchi F, Casey S A, Dolara A, Traverse JH, Maron BJ et al. Impact of

- atrial fibrillation on the clinical course of hypertrophic cardiomyopathy. *Circulation* 2001; 104: 2517-2524.
5. Roman W, Desanctis, David C, Dean and Edward, F Bland. Extreme left atrial enlargement- some characteristics features. *Circulation*. 1964 January; XXIX: 14-23.
  6. Water L Henry, Joel Marganroth, Alan S Pearl Man, Chester E Clark, David R Redwood, Samuel B Itscoitz et al. Relation between echocardiographically determined left atrial size and atrial fibrillation. *Circulation* 1976 February; 53(2): 273-279.
  7. Ratika Prakash, Martin S. Green, Charles R Kerr, Stuart J Connolly, George J Klein, Robert Sheldon et al. The association of left atrial size and occurrence of atrial fibrillation. A prospective cohort study from Canadian registry of atrial fibrillation. *American Heart Journal*. 2004 October; 148: 649-654.
  8. Kohsaka, Shun Sciacca, Robert R Sugioka et al. electrocardiographic left atrial abnormalities and risk of ischemic stroke. *American Heart Association*. 2005 November; 36(11): 2481-2483.
  9. Radi Macruz, Joseph K Perloff, Robert B. Case. A method for the electrocardiographic recognition of atrial enlargement. *Circulation* 1958 May; XVII: 882-889.
  10. Benedict A, Termini, Yu Chen Lee, Ballimone. Echocardiographic and electrocardiographic criteria for diagnosis left atrial enlargement. *Southern Medical Journal*. 1975 February; 68(2): 161-165.
  11. Kulkarni AG, Mulay DV, Jilla P. A study of relation between left atrial size and atrial fibrillation. *Journal of Associations of Physicians of India*. 2002; 50: 1555.
  12. Samuel Levy, Martin Marrek, Philippe Coumel, Lowis Guize Jean Lekieffre, Lowis Medvedowsky et al. characterization of different subjects of atrial fibrillation in general practice in France- The ALFA study. *Circulation* 1999 June; 99: 3028-3035.
  13. Papzoglou NM. Atrial fibrillation and mitral stenosis: *Circulation*. 1974; XLIX: 1009—1020.
  14. Psutomo Iwasaki, Motoji Naka, Kunihide Hiramatsu, Takashi Yamada, Akinoro Niwa Toru Aizawa et al. Echocardiographic studies on the relationship between atrial fibrillation and atrial enlargement in patients with hyperthyroidism of graves' disease. *Cardiology* 1989; 76: 10-17.
  15. Owen R Brown, Donald C Harrison, Richard L Popp. An improved method for electrocardiographic detection of left atrial enlargement. 1974 July; 50: 58-64.
  16. Alan D. Waggoner, Ajith V. Adyanthaya, Migvel A. Quinones, James K. Alexander. Left atrial enlargement- echocardiographic assessment of electrocardiographic criteria. *Circulation*. 1976 October; 54: 553-557.
  17. Patel DA, Lavie CJ, Milani RV, Shah S, Giliand Y (Winter 2009). Clinical Implications of Left Atrial Enlargement: A Review". *The Ochsner Journal*. 2009; 9 (4): 191–196.