

Original Article

A normal and particularly small (<35 mm) left atrial size measured during echocardiography suggests low likelihood of moderate or severe left ventricular systolic dysfunction

Mohammad Reza Movahed^{1,2}, Arman Soltani Moghadam¹

¹University of Arizona Sarver Heart Center, Tucson, AZ, USA; ²University of Arizona College of Medicine, Phoenix, AZ, USA

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Abstract: Introduction: The left atrium (LA) size can change due to cardiac pathologies like heart failure and aging. While the link between LA enlargement and left ventricular (LV) dysfunction is acknowledged, this study aims to assess the negative predictive value of normal LA size concerning the severity of LV systolic function in a large cohort undergoing diagnostic echocardiography. Methods: This retrospective cohort study, conducted at the University of California, Irvine Medical Center from 1984 to 1998, aimed to elucidate the negative predictive value of normal LA size measured by M-mode and two-dimensional echocardiography in a large cohort undergoing diagnostic assessment. Results: In the analysis of 22,390 echocardiograms, 55.1% exhibited normal LA size (<40 mm), while 44.9% showed abnormal LA size (≥40 mm). Within the normal LA size group, only 2.4% demonstrated abnormal LV systolic function, with 1.1% mildly depressed, 0.7% moderately depressed, and 0.6% severely depressed LV function. The negative predictive value of normal LA size for abnormal LV systolic function was calculated at 97.5%, rising to 99.3% and 99.4% for moderate or severely decreased LV systolic function, respectively. In patients with small LA size (<35 mm), moderate to severely depressed LV systolic function was observed in only 0.8%, with severe LV systolic dysfunction in 0.3%, yielding an overall prevalence of 1.5% for all systolic dysfunction in the small LA size group. Conclusion: Our findings underscore the clinical significance of normal LA size as a reliable indicator of preserved LV function.

Keywords: Left atrial size, left ventricular systolic function, left atrial enlargement, echocardiography, reduced ejection fraction, left ventricular systolic dysfunction, systolic heart failure

Introduction

The left atrium (LA) serves a critical role in performing a spectrum of functions, encompassing its function as a reservoir during left ventricular (LV) systole, a conduit that transfers blood from the pulmonary system to the LV during early diastole, and its active contractile function that augments LV filling in late diastole [1-3]. LA size can increase due to volume and/or pressure overload, usually caused by heart failure, aging, and many other cardiac disorders [4-7]. Consequently, LA enlargement has been associated with a myriad of cardiovascular diseases, stroke, atrial fibrillation, and increased mortality in the general population [8, 9].

LV systolic function is an essential manifestation of overall cardiac performance [10]. Appraisal of left ventricular function has emerged as a fundamental aspect of patient assessment, management, and clinical diagnosis. Reduced left ventricular function is an important marker of prognosis and response to guidelines-based medical therapy [11]. It is noteworthy that diminished LV systolic and diastolic functions commonly coincide with LA enlargement [12-15]. Nonetheless, whether decreased LV systolic function can be reliably excluded in patients exhibiting normal LA size remains an area of uncertainty. Hence, the objective of this study was to assess the negative predictive value of a normal LA size (measured by M-mode and two-dimensional echo-

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cardiography in parasternal long-axis view) concerning the severity of LV systolic function within a large cohort undergoing diagnostic echocardiography.

Methods

This retrospective cohort study was conducted from 1984 to 1998 at the University of California, Irvine Medical Center. We analyzed 21,785 echocardiograms (with documented LA size), which were ordered by clinicians for various medical reasons. Our database contained all echocardiograms, including repeat echocardiograms, in the same patients at different times for different reasons. This study was approved by the institutional review board of the University of California, Irvine.

Echocardiography

All echocardiograms were performed by expert echocardiographers. LA size was assessed by M-mode and two-dimensional echocardiography in an anteroposterior position in a parasternal long-axis view [16, 17]. Values less than 40 mm were considered normal, while LA enlargement was defined as LA size equal to or more than 40 mm. LA size < 35 mm defined as a small LA size.

LV function was assessed using available EF measurements and visual estimation based on the echo quality. The severity of LV dysfunction was reported based on Echocardiographic measurement of left ventricular ejection fraction and visual estimation by a reading board-certified cardiologist. Groups with different Ejection fractions were coded as normal (EF>50%), mildly reduced (EF 45-50%), moderately reduced (EF 35-45%), and severely reduced left ventricular function (EF<35%).

Statistical analysis

The statistical analysis was conducted using the SPSS statistical software. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population, including mean age, gender distribution, and prevalence of abnormal left atrial (LA) size and left ventricular (LV) systolic dysfunction. The prevalence of abnormal LA size (≥ 40 mm), normal LA size (<40 mm) and small LA size (<35 mm) was calculated, along with the corresponding percentages. Additionally, the preva-

lence of LV systolic dysfunction, categorized as mild, moderate, and severe, was determined within the normal LA size group. Negative predictive values (NPVs) were calculated to assess the ability of normal LA size to exclude abnormal LV systolic function, including moderate and severe dysfunction. Subgroup analyses were performed to evaluate the prevalence of LV systolic dysfunction among patients with small LA size (<35 mm). The gender disparity in the prevalence of abnormal LA size and LV systolic dysfunction was also explored. *P* values less than 0.05 were considered significant.

Results

A total of 22,390 echocardiograms were included in the analysis, revealing that 9,072 exhibited abnormal left atrial size (≥ 40 mm), while 12,318 (55.1%) demonstrated normal LA size (<40 mm). The mean age of the study population was 51.4 years (SD=18.53), with 11,076 male and 12,680 female participants. Normal LA size was observed in 12,583 (57.8%) patients, among whom only 304 (2.4%) had abnormal LV systolic function, comprising 140 (1.1%) with mildly depressed LV function, 92 (0.7%) with moderately depressed LV function, and 72 (0.6%) with severely depressed LV function within the normal LA size group. The negative predictive value of a normal LA size for abnormal LV systolic function was calculated to be 97.5%. For patients with moderate or severely decreased LV systolic function, the negative predictive value of a normal LA size was found to be 99.3% and 99.4%, respectively. Moreover, among patients with small LA size (<35 mm), the prevalence of moderate to severely depressed LV systolic function was 0.8%, with severe LV systolic dysfunction observed in 0.3% of the low LA size group. The overall prevalence of all systolic dysfunction in the small LA size group was 1.5% (**Figures 1-3**).

Discussion

In this retrospective cohort study of 21,785 patients undergoing echocardiography, the calculated negative predictive value for normal LA size in association with abnormal LV systolic function was 97.5%. When considering moderate or severely decreased LV systolic function, a normal LA size demonstrated negative predictive values of 99.3% and 99.4%, respectively. This means that a normal LA size is highly

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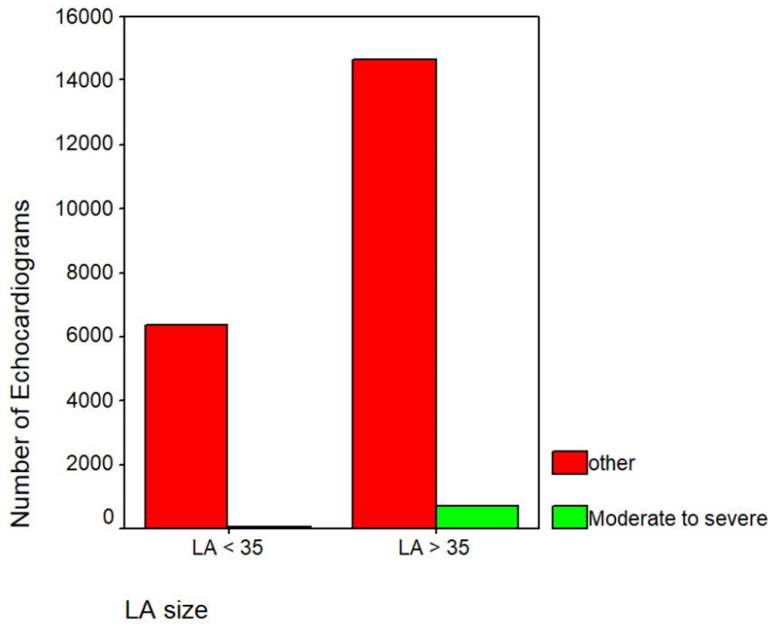


Figure 1. Prevalence of moderate to severely depressed LV function based on LA size (≥ 35 vs. < 35).

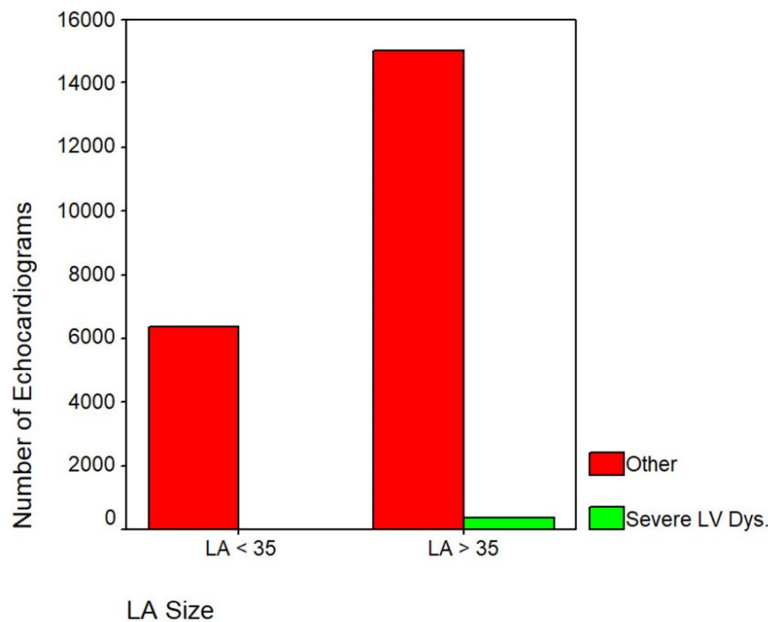


Figure 2. Prevalence of severely reduced LV function based on LA size (≥ 35 vs. < 35).

predictive of the absence of severe LV dysfunction. Additionally, in cases of small LA size (less than 35 mm), the prevalence of any LV systolic dysfunction was very low at 1.5%. Furthermore, in the overall cohort, LA enlargement and LV systolic dysfunction were more prevalent in male participants.

To the best of our knowledge, no studies have previously evaluated the negative predictive value of normal left atrial size in a large cohort of patients. In a study by Hambey et al. [12], the predictive value of an abnormal LA size in predicting low ejection fraction was estimated to be 75%, but this study was conducted in patients with coronary artery disease with only 100 participants that could consequently undermine the generalizability of their results.

The left atrium (LA) is representative of left ventricular filling pressures, and its function as a booster pump to the left ventricle becomes even more significant in the setting of LV dysfunction [18-20]. When pressures tend to elevate in the LV, the left atrium undergoes hypertrophy and remodeling as a response to trying to increase LV filling initially by the Frank-Starling mechanism. However, as the situation deteriorates, the left atrium becomes enlarged and stiff and cannot compensate for LV demands [21-24]. Enlargement of the LA, identified through echocardiography, has demonstrated prognostic significance in predicting adverse cardiovascular outcomes among individuals diagnosed with atrial fibrillation, cardiomyopathy, ischemic heart disease, valvular heart disease, and the general population [25-28]. In particular, in patients with HFrEF

(heart failure with reduced ejection fraction) and LV systolic dysfunction, the LA has a noticeable impact in the pathophysiology of the disease and even as a mediator to clinical decompensation due to the LA enlargement and remodeling and increased chance of atrial fibrillation [29-32].

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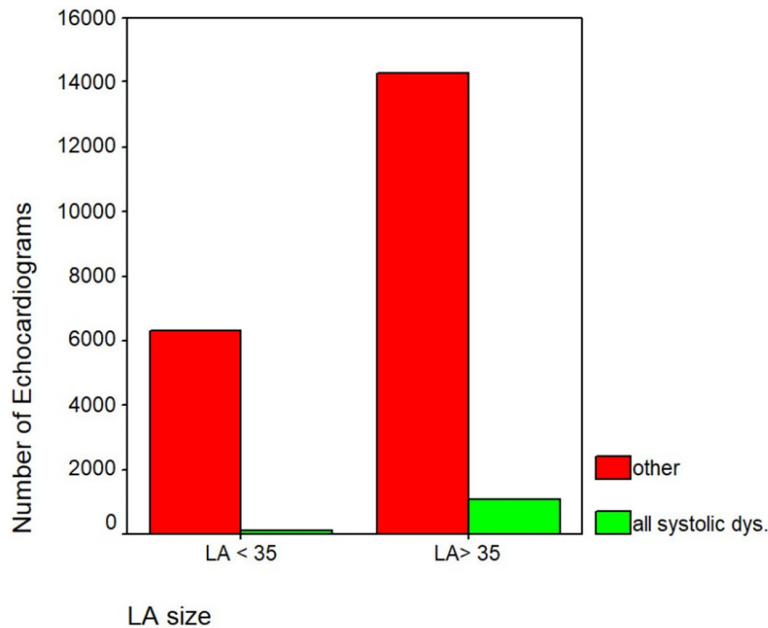


Figure 3. Prevalence of all systolic dysfunction depend on LAD size (≥ 35 vs. < 35).

A study by Rossi et al. found similar to our results correlation of left atrial size and structure with left ventricular dysfunction [33]. Furthermore, the correlation of left atrial size with higher mortality in patients with heart failure has been well documented, confirming the prognostic value of left atrial size [34]. In concordance with our study, an extensive review describes the pathophysiologic determinants and clinical implications of LA enlargement as an important clinical risk identifier and outcome [15]. Using a large number of patients with left atrial enlargement was a predictor of adverse cardiac outcomes confirming our results [35]. Normal LA size, as demonstrated in our study, has an interesting high negative predictive value in excluding LV systolic dysfunction. This highlights the importance of LA size in patient management and evaluation not only as a predictive value but also as an index for LV systolic function. Our study results suggest that healthcare providers must include LA size assessment in their evaluation of patients and consider it to be an essential component in patient management.

Conclusions

Our study revealed that a normal LA size has a high negative predictive value in excluding severe LV systolic dysfunction. This observation

underscores the importance of LA size assessment as a non-invasive tool for risk stratification in patients undergoing echocardiographic evaluation.

Limitations

In our study, it is important to note that the data analyzed were not derived from a normal population as the patients were referred for echocardiography for different medical conditions limiting our findings to a selective population. Additionally, many patients were represented multiple times within our database, potentially introducing a degree of data redundancy and influencing the overall statistical analyses. These

limitations underscore the need for further research utilizing more diverse and representative cohorts to validate our findings.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Mohammad Reza Movahed, Department of Medicine, University of Arizona Sarver Heart Center, 1501 N. Campbell Avenue, Tucson, AZ 85724, USA. Tel: 949-400-0091; E-mail: rmoval@aol.com

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