ISSN: 2834-5274

Research Article

Journal of Surgery Care

Determinants of Left Atrial Size in Hypertensive Patients: A Cross-Sectional Study

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Submitted: 2025, Jul 22; **Accepted:** 2025, Aug 28; **Published:** 2025, Sep 15

Citation: Wei, W., Jiahuan, R., Ying, W., Haibo, C. (2025). Determinants of Left Atrial Size in Hypertensive Patients: A Cross-Sectional Study. *J Surg Care, 4*(3), 01-05.

Abstract

This study examined 251 hypertensive patients to identify the factors influencing left atrial size. Duration of hypertension, age, left ventricular hypertrophy, atrial fibrillation, and left ventricular diastolic dysfunction were significant predictors ($P < 0.05$), whereas CAD (Coronary Heart Disease) and hypertension grade were not ($P > 0.05$). Early intervention in these factors may improve the cardiovascular outcomes.

Background: *Hypertension is a common health issue in China that affects a large proportion of the population. The adverse effects of hypertension on cardiac target organs, particularly through changes in the left atrial size, have been widely recognized. Left atrial enlargement is closely associated with multiple cardiovascular complications, including heart failure and stroke. Therefore, identifying the factors influencing left atrial size is crucial for early intervention and improving cardiovascular outcomes in patients with hypertension.*

Objective: *To investigate the factors related of left atrial size in hypertensive patients.*

Methods: *This retrospective study analyzed 251 hypertensive patients admitted to the Second People's Hospital of Shenzhen between August 2023 and September 2024. The factors examined included age, sex, duration of hypertension, hypertension grade, coronary artery disease (CAD), left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and atrial fibrillation (AF). A multivariate linear regression model was used to assess the correlations with left atrial size.*

Results: *Multiple regression analysis revealed that left atrial size was significantly correlated with the duration of hypertension, age, left ventricular (or septal) hypertrophy, atrial fibrillation, and left ventricular diastolic dysfunction ($P < 0.05$). No significant correlation was found with coronary artery disease ($P > 0.05$) or hypertension grade ($P > 0.05$).*

Conclusion: *The duration of hypertension, age, left ventricular (or septal) hypertrophy, atrial fibrillation, and left ventricular diastolic dysfunction are significant predictors of left atrial size in hypertensive patients. These findings highlight the importance of early intervention and management of these factors to improve cardiovascular outcomes.*

Keywords: Hypertension, Left Atrial Size, Atrial Fibrillation, Left Ventricular Diastolic Dysfunction

1. Introduction

Multiple factors can cause left atrial enlargement,a chronic sign of elevated left atrial pressure. There are few studies on the relationship between left atrial enlargement and other target organ damage in patients with essential hypertension; therefore, this study aimed to investigate the correlation between left atrial size and other changes in the heart in patients with hypertension.

2. Data and Methods

2.1. Study Subjects

According to the previous relevant literature data, the standard deviation is expected to be 28 mm, a two-sided test is required, α is 0.05 and the allowable error is 5 mm. According to the following formula, calculate the sample size. A sample size of N=139 was obtained. Considering 5% invalid data, at least 147 cases must be included as the study object. Collected Inpatient with hypertension were enrolled from August 2023 to September 24 251 patients at Shenzhen Second People's Hospital. The exposure factors for left atrial size: age (Age), sex (Sex), duration of hypertension (grade 1, 2, 3, 4, and 5), hypertension grade (grades 1, 2, and 3), coronary heart disease (CAD), left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and atrial fibrillation (AF).

The inclusion criteria were as follows: diagnosis of essential hypertension and heart rate <100 beats/min. The exclusion criteria were as follows: left ventricular ejection fraction <50%, significant valvular disease (moderate or greater valvular regurgitation or stenosis), history of myocardial infarction, dilated cardiomyopathy, hypertrophic myocardial disease,severe systemic disease, cardiac surgery, and cardiac implants.122 (48.6%) were male and 129 (51.4%) females, age distribution was 31-91 years old (mean 63.53 years old). There were 77 cases (30.7%) of grade 1 hypertension, 90 cases (35.9%) of grade 2 hypertension and 84 cases (33.5%) of grade 3 hypertension.All the patients underwent routine medical history collection and cardiac ultrasound examination.

2.2. Study Methods

All participants recorded their Age Sex, duration of hypertension (HT) (grade 1, 2, 3, 4, 5), grade of hypertension (HT grade) (grade 1, 2, 3), coronary artery disease (CAD), left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and atrial fibrillation (AF). The course of hypertension is divided into 1 to 5 grades, i.e. grade 1 if less than 1 year, grade 2 for 1 to 5 years, grade 3 for 5 to 10 years, grade 4 if the course of hypertension is more than 10 years and less than 20 years,grade 5 for ≥20 years. Transthoracic echocardiography (TTE) was PHILIPS in all patients (a IE300) color cardiac ultrasound instrument, a with probe frequency of 2.5–5 MHz. The left ventricular posterior wall (or interventricular septum) of the selected patient was measured, peak E and A velocities were measured, and E/A value and LA size were calculated. Left ventricular (or interventricular septum) hypertrophy was defined as a left ventricular (or interventricular septum) thickness of≥ 11 mm. The end-diastolic LA anteroposterior diameter was measured as the LA size. Basic characteristics of the study population are shown in the following Table 1.

Characteristic	Total Population	Male	Female	P-value
Age (years)	63.45±11.18	60.61±11.84	66.29±10.52	0.000
LA (mm)	32.63±4.49	32.80±4.30	32.45±4.67	0.543
HT grade (n, %)				
grade 1		40 (51.9)	37(48.1)	0.711
grade 2		41 (45.6)	49(54.4)	
grade 3		41(48.8)	43(51.2)	
Duration of Hypertension (n, %)				
grade 1		25 (50.0)	25 (50.0)	0.744
grade 2		34 (51.5)	32 (48.5)	
grade 3		16 (45.7)	19 (54.3)	
grade 4		27 (52.9)	24 (47.1)	
grade 5		20 (40.8)	29 (59.2)	
CAD (n , %)				
No		65 (45.1)	79 (54.9)	0.202
Yes		57 (53.3)	50 (46.7)	
AF (n , %)				
No		106 (48.0)	115 (52.0)	0.581
Yes		16 (53.3)	14 (46.7)	
IVS or LVPW Hypertrophy (n, %)				
No		83 (42.3)	113 (57.7)	0.000
Yes		39 (70.9)	16 (29.1)	

Left ventricular diastolic dysfunction (n, %)				
No		11 (52.4)	10 (47.6)	
Yes		111 (48.3)	119 (51.7)	0.718

Table 1: Basic Characteristics

2.3. Statistical Methods

The data were analyzed using SPSS 25.0 statistical software, and the measurement data were expressed as mean ± standard deviation (x±s). ANOVA was used for intergroup comparisons. Multiple linear regression analysis was used to determine the relationship between each variable and the dependent variable. Statistical significance was set at $P \leq 0.05$.

3. Results

Multiple linear regression analysis of LA size, including age (Age), sex (Sex), duration of hypertension (Grade 1, 2, 3, 4, 5), hypertension grade (Grade 1, 2, 3), coronary heart disease (CAD), left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and atrial fibrillation (AF) independent variables. The analysis results are shown in the following (Table 2).

Coefficient [a]						
Model		**Unnormalized Factor**		**Normalizatio Factor**	**t**	**Significance**
		B	**Standard Error Beta**	**Beta**		
	(constant)	23.127	1.513		15.284	.000
	Sex (1 male,2 female)	-.492	.495	-.055	-.993	.322
	Age	.084	.025	.217	3.348	.001
	HT grade	.082	.297	.015	.277	.782
	HT course	.674	.186	.215	3.616	.000
	CAD (0 no,1 yes)	.308	.498	.034	.619	.537
	AF (0 no,1 yes)	3.764	.756	.273	4.979	.000
	IVS or LVPW hypertrophy (0 no,1 yes)	1.762	.592	.163	2.976	.003
	Left ventricular diastolic dysfunction (0 no,1 yes)	1.918	.875	.119	2.193	.029
a. Dependent variable:LA						

Table 2: Related Factors of Left Atrial Size

4. Discussion

Multivariate logistic regression analysis showed that the left atrial size of patients with hypertension was positively related to the duration of hypertension, age, hypertrophy of the left ventricular septum or left ventricular (or septal) hypertrophy,atrial fibrillation,and left ventricular diastolic dysfunction. There was no correlation between left atrial size and CAD ($p=0.537$) ($p>0.05$), suggesting that coronary heart disease was not a factor affecting left atrial size in hypertensive patients. There was no significant difference between the left atrial size and HTN grade ($p=0.782$) ($p>0.05$).

Left atrial enlargement is a change in the shape and function of the heart caused by hypertension itself, and its mechanism is still unclear due to the impact of some factors of target organs in patients with hypertension; however, Galderisi et al. used ambulatory blood pressure monitoring to find that nocturnal mean diastolic blood pressure was independently associated with left atrial enlargement [1]. Hypertension is a risk factor for left atrial enlargement [2]. Even mild HT appears to be associated with the presence of reduced early diastolic filling, and left atrial size in hypertensive patients is associated with decreased left ventricular diastolic function (DD) ($p<0.05$), which leads to an increase in late left ventricular diastolic filling due to active atrial contraction, which may be the mechanism of the increase in LA size [3].

The results showed that the size of the left atrium increased with age. Due to the pathological changes in the left ventricular structure caused by cardiac pressure overload in patients with high blood pressure, the end-diastolic volume increases and diastolic function decreases, thereby affecting the size of the left atrium. The change in the size of the left atrium can be used as a sensitive predictor of the change in left ventricular preload and diastolic function [4,5]. There was a significant difference between the left

atrial size and the duration of hypertension ($P < 0.001$). The value of the partial regression coefficient B was 0.678, indicating that the average change in left atrial size was 0.678, and the left atrial size was positively correlated with the course of hypertension.

The correlation between left atrial size and left ventricular hypertrophy (or ventricular septal hypertrophy) in hypertensive patients was statistically significant ($P<0.05$). The value of the partial regression coefficient B was 1.762, indicating that the variable of left ventricular hypertrophy (or ventricular septal hypertrophy) changed from 0 to 1, Left atrial size increased by 1.762 mm, that is, LA increased by 1.762 mm compared with patients without left ventricular hypertrophy (or ventricular septal hypertrophy). LA size was statistically associated with atrial fibrillation in hypertensive patients ($P<0.001$), with a partial regression coefficient (B) of 3.764. LA increased by 3.764 mm in patients with atrial fibrillation compared with patients without atrial fibrillation, which was a risk factor for LA.

LA enlargement is a common early sign of hypertensive heart disease. The longer the history of hypertension, the greater the incidence of atrial fibrillation in patients with ventricular septal hypertrophy, which is a risk factor for the onset of atrial fibrillation [6]. Early control of blood pressure and the use of drugs that inhibit myocardial remodeling have important significance in improving the prognosis of patients (reducing the incidence of stroke, heart failure, etc) [7-10]. In patients with HT, the incidence of paroxysmal AF is related to LA size. In patients with HT, and LA size may be a useful surrogate marker for monitoring the effect of medication and the development of AF [11,12].

Studies have demonstrated that left atrial enlargement is an independent risk factor for the first cardiovascular event, including atrial fibrillation, myocardial infarction, stroke, congestive heart failure, and sudden death [13]. Early detection of hypertension, routine monitoring of left atrial size, and timely and effective treatment may delay the process of left atrial enlargement, thereby reducing the incidence of severe adverse events of cardiovascular and cerebrovascular diseases [14,15].

5. Conclusion

The relationship between LA size and Age,Sex,duration of hypertension, grade of hypertension, CAD, left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and AF. Age, HT course, AF, left ventricular (or septal) hypertrophy, and left ventricular diastolic dysfunction could AFfect left atrial size in hypertensive patients, and left ventricular (or septal) hypertrophy and left ventricular diastolic dysfunction are predictive factors for LA enlargement. Strengthening the changes in the structure and function of cardiac ultrasound and standardizing blood pressure control may help reduce the incidence of LA enlargement.

Study Limitations

This study found that left ventricular (or septal) hypertrophy, left ventricular diastolic dysfunction, and AF may affect LA size of the left atrial. Many scholars believe that left atrial enlargement leads to an increased incidence of atrial fibrillation, but it is difficult to clarify the causal relationship between atrial fibrillation causing left atrial enlargement or left atrial enlargement leading to atrial fibrillation. Larger sample sizes and prospective randomized controlled trials are needed to demonstrate the sequence of cardiac structural changes in patients with hypertension.

The measurement data (left atrial anteroposterior diameter) in this study lacked accuracy. For example, the measurement of LA volume can more accurately assess the risk of patients with cardiovascular events than LA diameter. In an RCT study from the echocardiography laboratory of the Mayo Clinic, 423 patients were enrolled. LA volume was compared with LA area and LA anteroposterior (AP) diameter. LA volume is a better predictor of cardiovascular events, especially in patients with sinus rhythms. However, it is still unknown whether LA volume is superior to LA anteroposterior diameter in predicting the prognosis of hypertension in patients with atrial fibrillation [16].

Comprehensive Ethics Statement

The requirement for informed consent was waived by the Institutional Review Board due to the retrospective nature of the study and the use of deidentified patient data. This study was conducted in accordance with the ethical standards of the Declaration of Helsinki and its amendments.

Data Availability

The authors are unable or have chosen not to specify which data have been used.

Funding

This study was not supported by any institution or organization.

Author Contributions

Wen Wei designed research, data curation, analyzed data and edited the manuscript. Rao Jiahuan, Wang Ying: Conceptualization, Methodology and Software. Chen Haibo: Supervision, Writing-Reviewing and Editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

Acknowledgments

The authors thank Prof.Chen Hai Bo, from Shenzhen Second People's Hospital, for her administrative support throughout the project. Additionally, we are thankful to Rao Jia Huan,Wang Ying for their valuable insights and constructive feedback on the manuscript.

References

1. Nakagawa, N., & Hasebe, N. (2016). Left atrial enlargement and blood pressure variability in untreated hypertensive patients. *Hypertension Research, 39*(8), 581-582.
2. Sabo, S., Dalen, H., Nyberg, J., Grenne, B. L., Jakobsen,

E. O., Nes, B. M., ... & Letnes, J. M. (2024). Left atrial to ventricular volume ratio and relation to fitness, cardiovascular risk factors, and diastolic function in healthy individuals: the HUNT Study. *European Heart Journal-Imaging Methods and Practice, 2*(1), qyae028.

3. Robinson, S., Ring, L., Oxborough, D., Harkness, A., Bennett, S., Rana, B., ... & Smiseth, O. A. (2024). The assessment of left ventricular diastolic function: guidance and recommendations from the British Society of Echocardiography. *Echo Research & Practice, 11*(1), 16.
4. Cai, J., Liang, Z., Feng, W., & Long, H. (2023). Correlation between left atrial strain and left ventricular diastolic function in hypertensive patients. Zhong nan da xue xue bao. *Yi xue ban= Journal of Central South University. Medical Sciences, 48*(6), 846-851.
5. Dokainish, H., Nguyen, J. S., Sengupta, R., Pillai, M., Alam, M., Bobek, J., & Lakkis, N. (2010). Do additional echocardiographic variables increase the accuracy of E/e′ for predicting left ventricular filling pressure in normal ejection fraction? An echocardiographic and invasive hemodynamic study. *Journal of the American Society of Echocardiography, 23*(2), 156-161.
6. Uemura, K., Nishimori, M., Nagai, S., Takeuchi, M., Nishihara, Y., Todo, S., ... & Tanaka, H. (2023). Identification of factors associated with progression of left atrial enlargement in patients with atrial fibrillation. *Echocardiography, 40*(9), 976-982.
7. Girard, A. A., Denney, T. S., Gupta, H., Dell'Italia, L. J., Calhoun, D. A., Oparil, S., ... & Lloyd, S. G. (2024). Spironolactone improves left atrial function and atrioventricular coupling in patients with resistant hypertension. *The International Journal of Cardiovascular Imaging, 40*(3), 487-497.
8. El Hajjar, A. H., Dagher, L., Younes, H., Mekhael, M., Noujaim, C., Chouman, N., ... & Marrouche, N. (2024). History of stroke as a predictor of high left atrial fibrosis in patients with persistent atrial fibrillation—insight from the DECAAF II randomized trial. *Journal of Interventional Cardiac Electrophysiology, 67*(9), 2101-2109.
9. Place, F., Carpenter, H., Morrison, B. N., Chester, N., Cooper, R., Stansfield, B. N., ... & Oxborough, D. (2023). The impact of image and performance enhancing drugs on atrial structure and function in resistance trained individuals. *Echo Research & Practice, 10*(1), 19.
10. Yaghi, S., Moon, Y. P., Mora-McLaughlin, C., Willey, J. Z., Cheung, K., Di Tullio, M. R., ... & Elkind, M. S. (2015). Left atrial enlargement and stroke recurrence: the Northern Manhattan Stroke Study. *Stroke, 46*(6), 1488-1493.
11. Saadeh, R., Abu Jaber, B., Alzuqaili, T., Ghura, S., Al-Ajlouny, T., & Saadeh, A. M. (2024). The relationship of atrial fibrillation with left atrial size in patients with essential hypertension. *Scientific Reports, 14*(1), 1250.
12. Suh, I. W., Song, J. M., Lee, E. Y., Kang, S. H., Kim, M. J., Kim, J. J., ... & Song, J. K. (2008). Left atrial volume measured by real-time 3-dimensional echocardiography predicts clinical outcomes in patients with severe left ventricular dysfunction and in sinus rhythm. *Journal of the American Society of Echocardiography, 21*(5), 439-445.
13. Piotrowski, Grzegorz, Maciej Banach, Eva Gerdts, Dimitri P. Mikhailidis, Simon Hannam, Rafal Gawor, Arkadiusz Stasiak, Jacek Rysz, and Zenon Gawor. "Left atrial size in hypertension and stroke." *Journal of hypertension 29*, no. 10 (2011): 1988-1993.
14. Alosco, M. L., Gunstad, J., Jerskey, B. A., Clark, U. S., Hassenstab, J. J., Xu, X., ... & Sweet, L. H. (2013). Left atrial size is independently associated with cognitive function. *International journal of neuroscience, 123*(8), 544-552.
15. Wang, W., Zhang, M. J., Inciardi, R. M., Norby, F. L., Johansen, M. C., Parikh, R., ... & Chen, L. Y. (2022). Association of echocardiographic measures of left atrial function and size with incident dementia. *Jama, 327*(12), 1138-1148.
16. Tsang, T. S., Abhayaratna, W. P., Barnes, M. E., Miyasaka, Y., Gersh, B. J., Bailey, K. R., ... & Seward, J. B. (2006). Prediction of cardiovascular outcomes with left atrial size: is volume superior to area or diameter?. *Journal of the American College of Cardiology, 47*(5), 1018-1023.