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ORIGINAL ARTICLE

Correlation Between Body Mass Index and Echocardiographic Findings in Overweight Patients Compared to Normal-Weight Patients

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ABSTRACT

Background: Being overweight is the main risk factor for many chronic disorders, especially cardiovascular diseases. Hypertension is the first reaction of the heart to overburdens imposed by obesity or overweightness. In this study, we evaluated the correlation between body mass index (BMI) and echocardiographic findings in overweight patients compared to normal-weight patients. **Methods:** This historical cohort study was conducted on 60 patients divided into two groups of 30 based on their measured weight: group 1 had a BMI of 20-25 kg/m^2 and was the control; group 2 had a BMI of >25-30 kg/m^2. Demographic and clinical data, as well as echocardiographic results, were recorded for all patients. **Results:** The mean age of patients in the control group (41.06 ± 12.82 years) and the overweight group (46.84 ± 12.61 years) was not significantly different (P = 0.067). Systolic blood pressure (P = 0.003) and pulse rate (P = 0.028) were significantly higher in the overweight group. Ejection fraction (P = 0.036); end-systolic (P < 0.001) and end-diastolic (P < 0.001) left ventricular dimensions; and left ventricular mass index (P = 0.005) were significantly higher in the control group. **Conclusion:** Overweightness due to anatomical remodeling can cause diastolic heart failure in the left ventricle. According to the relatively poor prognosis of treatment features in patients with probable risk factors for heart failure, such as diabetes, hypertension, and ischemic heart disease, we recommend considering overweightness as a strong prognostic factor for heart failure.

INTRODUCTION

Overweightness is a common condition and is a primary risk factor for many chronic disorders. The principal cause of death for people who are overweight and obese is cardiovascular disease; stroke and renal failure are also common in obese people (1-3).

When someone is overweight or obese, their ventricular wall can be overburdened with pressure, which can lead to hypertrophy as a compensatory mechanism. Hypertrophy, regardless of the cause, can lead to cardiac muscle stiffness and elevated metabolic requirements, resulting in cardiac output being limited in times of physical stress (4,5). The first heart reaction to obesity- or overweightness-related overburdening is hypertension, which is characterized by increased ventricular wall thickness. This can result in dysfunction of this cavity and symptoms of heart failure. Left ventricular hypertrophy (LVH) can be diagnosed most sensitively and accurately with chest X-ray (6). Diagnosis by echocardiography is based on direct observation of the heart and measurement of the parameters necessary for calculating the left ventricular mass and the index of left ventricular function (7).

LVH is an important risk factor for cardiovascular diseases. Given the increasing prevalence of cardiovascular diseases, current research in this area has been shifting away from treatment to prevention, and studies on preventive cardiology are much more significant than other types of studies. Accordingly, in our study we evaluated the correlation between body mass index (BMI) and echocardiographic findings in overweight patients compared to normal-weight patients.

METHODS

In this retrospective, historical cohort study, patients were divided into two groups based on the independent variable of

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BMI: group 1 had a BMI of 20-25 kg/m^2 and was the control; group 2 had a BMI of >25-30 kg/m^2. Statistical consultation determined that the sample size should be at least 60 patients in two groups of 30 (normal weight and overweight).

Exclusion criteria were age over 60 years, BMI greater than 30 or less than 20 (5), diabetes (6), intermittent smoking and alcohol use (7), periodic or regular physical isometric exercise (8), history of antihypertensive drugs (9), congestive heart failure, kidney failure, pregnancy, abnormal echocardiogram at rest, positive exercise test, and heart valve lesions.

All echocardiographs were performed by a skilled technician using General Electric Vivid-3 echocardiography. Definitions of left ventricular echocardiography parameters, including ejection fraction, fractional shortening, and left ventricular relative wall thickness (10), were taken from the guidelines of the American Society of Echocardiography (11).

RESULTS

Demographic and hemodynamic variables in the two groups are presented in Table 1. We observed that heart rate and systolic blood pressure were significantly higher in overweight patients. The height of the patients was not significantly different between the two groups; weight was the only reason for differences in BMI.

Comparison of echocardiographic findings in the two groups showed that interventricular septum and posterior wall of the left ventricle in both end-systolic and end-diastolic dimensions were not significantly different between the two groups; however, ejection fraction, left ventricular thickness, and left ventricular mass index were significantly lower in the overweight group than in the control group (Table 2).

As shown in Table 3, no significant differences in Doppler echocardiographic findings were observed between the two groups.

DISCUSSION

Being overweight is the main risk factor for many chronic disorders, especially cardiovascular diseases (12). Obesity-related cardiovascular diseases often result in heart failure and become more common with increasing age (13). However, heart failure is mainly a diastolic disorder and has a strong association with anatomical remodeling of the left ventricle and its valves (12). Apart from age, history of diabetes mellitus, female sex, history of hypertension, and obesity are among the most common risk factors for left ventricular diastolic dysfunction (14). Although recent studies have identified obesity as the primary risk factor for left ventricular remodeling, preventive cardiology has an important role to play in reducing the risk of heart disease. From this perspective, overweightness, not obesity, is considered a warning for patients at risk (15,16). In this study, we examined overweight people in comparison to normal-weight people from this perspective.

Table 1. Evaluation of the demographic factors affecting the left ventricular parameters in the two groups

Demographic variables	Normal-weight group (BMI = 20-25 kg/m^2)	Overweight group (BMI = >25-30 kg/m^2)	P value
Age (years)	41.06±12.82	46.84±12.61	0.067
Heart rate (bpm)	79.34±9.25	84.13±7.93	0.028
Systolic blood pressure (mmHg)	125.66±16.75	137.10±14.31	0.003
Diastolic blood pressure (mmHg)	83.00±14.41	87.36±9.77	0.142
Height (cm)	162.96±8.51	161.18±11.33	0.476
Weight (kg)	61.60±7.23	73.76±11.1	<0.001
BMI (kg/m^2)	23.14±1.43	28.28±2.14	<0.001

BMI: Body mass index

Table 2. Evaluation of the left ventricular echocardiographic findings in the two groups

Demographic variables	Stages	Normal-weight group (BMI = 20-25 kg/m^2)	Overweight group (BMI = >25-30 kg/m^2)	P value
Interventricular septum thickness (mm)	End-diastolic	16.01±3.23	15.86±3.86	0.865
	End-systolic	10.79±2.94	10.37±2.38	0.520
Posterior wall thickness (mm)	End-diastolic	15.58±2.56	15.89±2.84	0.635
	End-systolic	11.43±2.1	11.69±3.03	0.690
Ejection fraction		61.50±5.43	57.63±8.6	0.036
Fractional shortening		32.17±9.75	29.68±9.13	0.282
	End-diastolic	38.84±6.08	32.13±5.78	<0.001
	End-systolic	32.47±6.66	26.3±5.31	<0.001
Mass index (g/m^2)		53.25±8.64	49.45±8.88	0.005

Table 3. Evaluation of Doppler echocardiographic findings for mitral valve in the two groups

Findings	Normal-weight group (BMI = 20-25 kg/m^2)	Overweight group (BMI = >25-30 kg/m^2)	P value
E (cm/s)	90.7±19.47	86.6±20.81	0.410
A (cm/s)	81.86±17.27	84.18±22.76	0.646
E/A	1.15±0.34	1.08±0.32	0.357
PHT (ms)	71.66±21.76	64.81±20.73	0.190

E: Peak velocity during early filling; A: Peak velocity during atrial contraction; PHT: Pressure half-time

We found that end-systolic and end-diastolic left ventricular dimensions were significantly lower in overweight patients than in normal-weight patients. Redfield et al. (17) found significant effects of overweightness on the left ventricular size. However, in their study, only patients with a BMI greater than 30 kg/m^2 were selected, and overweight and obese patients were not included.

Decreased left ventricular size, except for the reduction of end-systolic and end-diastolic dimensions, is also measured using a more precise indicator called the left ventricular mass index. In our study, the left ventricular mass index in overweight patients was lower than the left ventricular mass index in normal-weight patients. Considering the significant difference in systolic blood pressure between the two groups and regarding the interval between the incidence of blood pressure in patients, the difference in left ventricular mass index between the two groups can be interpreted well. In a similar study, Yu et al. (18) reported that the left ventricular mass index and the ejection fraction in obese patients were lower than in normal-weight patients, which is completely in line with the results of our study. This finding suggests the need for preventive cardiologic strategies in overweight patients.

CONCLUSION

A significant correlation exists between overweightness and left ventricular anatomical remodeling, which can accelerate the onset of left ventricular diastolic dysfunction. Considering the relatively poor prognosis of patients with left ventricular diastolic dysfunction, and that these patients are often treated only symptomatically, we recommend that, to prevent heart failure, further complications, and subsequent disabilities, overweightness factors— such as diabetes, high blood pressure, and ischemic heart disease—be regarded seriously in patients with possible risk factors for cardiovascular diseases. Therefore, not only patients at risk, but also middle-aged populations, should undergo necessary diet and lifestyle modifications and get regular physical isometric exercises to lose weight and prevent possible complications of heart failure. Additional comprehensive studies with larger sample sizes and that consider other potential risk factors are needed to verify or modify the findings of this and similar studies.

Study Limitations

Since the exclusion criteria of our study included a wide range of cardiac and non-cardiac diseases, the sampling time was longer than expected. Moreover, echocardiography required a longer duration than is normal for other patients. In addition to requiring more time, this raised the cost of echocardiography for each patient beyond the cost of a typical echocardiography.

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AUTHORS CONTRIBUTION

All authors contribute in this study equally

REFERENCES

1. Kasper D. Harrison's Principles of Internal Medicine. 16th ed. New York, NY: McGraw Hill; 2005. p. 1463-81.
2. Reichek N, Devereux RB. Left ventricular hypertrophy: relationship of anatomic, echocardiographic and electrocardiographic findings. Circulation 1981; 63(6): 1391-8.
3. Shulman NB, Ford CE, Hall WD, Blaufox MD, Simon D, Langford HG, et al. Prognostic value of serum creatinine and effect of treatment of hypertension on renal function. Results from the hypertension detection and follow-up program. The Hypertension Detection and Follow-up Program Cooperative Group. Hypertension 1989; 13(5 Suppl): I80-I93.
4. Recommendations for routine blood pressure measurement by indirect cuff sphygmomanometry. American Society of Hypertension. Am J Hypertens 1992; 5(4 Pt 1): 207-9.
5. Schuster I, Vinet A, Karpoff L, Startun A, Jourdan N, Dauzat M, et al. Diastolic dysfunction and intraventricular dyssynchrony are restored by low intensity exercise training in obese men. Obesity (Silver Spring) 2012; 20(1): 134-40.
6. Kim H, Yoon HJ, Park HS, Cho YK, Nam CW, Hur SH, et al. Usefulness of tissue Doppler imaging-myocardial performance index in the evaluation of diastolic dysfunction and heart failure with preserved ejection fraction. Clin Cardiol 2011; 34(8): 494-9.
7. Lakhani M, Fein S. Effects of obesity and subsequent weight reduction on left ventricular function. Cardiol Rev 2011; 19(1): 1-4.
8. Kasner M, Westermann D, Steendijk P, Gaub R,

Wilkenshoff U, Weitmann K, et al. Utility of Doppler echocardiography and tissue Doppler imaging in the estimation of diastolic function in heart failure with normal ejection fraction: a comparative Doppler-conductance catheterization study. Circulation 2007; 116(6): 637-47.
9. Tabata T, Oki T, Fukuda N, Iuchi A, Manabe K, Kageji Y, et al. Influence of left atrial pressure on left atrial appendage flow velocity patterns in patients in sinus rhythm. J Am Soc Echocardiogr 1996; 9(6): 857-64.
10. Aschenberg W, Schluter M, Kremer P, Schroder E, Siglow V, Bleifeld W. Transesophageal two-dimensional echocardiography for the detection of left atrial appendage thrombus. J Am Coll Cardiol 1986; 7(1): 163-6.
11. Pozzoli M, Febo O, Torbicki A, Tramarin R, Calsamiglia G, Cobelli F, et al. Left atrial appendage dysfunction: a cause of thrombosis? Evidence by transesophageal echocardiography-Doppler studies. J Am Soc Echocardiogr 1991; 4(5): 435-41.
12. Galinier M, Pathak A, Roncalli J, Massabuau P. Obesity and cardiac failure. Arch Mal Coeur Vaiss 2005; 98(1): 39-45. [In French].
13. Aljaroudi W, Alraies MC, Halley C, Rodriguez L, Grimm RA, Thomas JD, et al. Impact of progression of diastolic dysfunction on mortality in patients with normal ejection fraction. Circulation 2012; 125(6): 782-8.
14. Kazik A, Wilczek K, Polonski L. Management of diastolic heart failure. Cardiol J 2010; 17(6): 558-65.
15. Russo C, Jin Z, Homma S, Rundek T, Elkind MS, Sacco RL, et al. Effect of diabetes and hypertension on left ventricular diastolic function in a high-risk population without evidence of heart disease. Eur J Heart Fail 2010; 12(5): 454-61.
16. Langenberg C, Sharp SJ, Schulze MB, Rolandsson O, Overvad K, Forouhi NG, et al. Long-term risk of incident type 2 diabetes and measures of overall and regional obesity: the EPIC-InterAct case-cohort study. PLoS Med 2012; 9(6): e1001230.
17. Redfield MM, Jacobsen SJ, Burnett JC, Jr., Mahoney DW, Bailey KR, Rodeheffer RJ. Burden of systolic and diastolic ventricular dysfunction in the community: appreciating the scope of the heart failure epidemic. JAMA 2003; 289(2): 194-202.
18. Yu CM, Sanderson JE, Marwick TH, Oh JK. Tissue Doppler imaging a new prognosticator for cardiovascular diseases. J Am Coll Cardiol 2007; 49(19): 1903-14.