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Original Article

Echocardiographic Evaluation of Aortic Elasticity Parameters in Obesity-Prone Young Adults

Obeziteye Yatkın Genç Erişkinlerde Aort Elastisite Parametrelerinin Ekokardiyografik Değerlendirilmesi

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ABSTRACT

Aim: Arterial stiffness reflects the viscoelastic properties of the vessel wall. In this study, we aimed to evaluate the relationship between aortic strain, elasticity, stiffness, and left ventricle functions in obese and obesity-prone young adults.

Material and Methods: The participants were classified as obese, overweight, normal-weight, and underweight, according to the BMI. There were 28 underweight, 84 normal weight, 89 overweight, and 22 obese individuals. Physical examinations, findings and medical history of patients were recorded. Left and right ventricle functions were evaluated with 2D transthoracic echocardiography. Parameters of aortic elasticity including aortic strain, elasticity, and stiffness index were calculated according to the predefined formula.

Results: Baseline clinical and demographic findings were similar, except age and weight. In the comparison of echocardiographic measurements, left ventricular end-systolic and end-diastolic diameters, interventricular septum and posterior wall diastolic diameters, left atrial diameter, left ventricular mass and mass index were significantly higher between groups as consistent with the increase in BMI, mitral early diastolic filling velocities, mitral early and late diastolic filling velocity ratio and mitral lateral early diastolic relaxation were significantly lower between groups as conversely with the increase in BMI ($p < 0.05$, for all). Statistically significant differences were observed between groups regarding aortic strain, elasticity, and stiffness values. Aortic stiffness were significantly higher between groups as consistent with the increase in BMI, aortic strain and elasticity were significantly lower between groups as conversely with the increase in BMI ($p < 0.05$, for all). BMI, systolic blood pressure, pulse pressure, and myocardial performance index (MPI) were found as independent variables affecting the aortic stiffness index (β).

Conclusion: Aortic stiffness index (β), which might have a prognostic value in determining the risk of future CV disease, tends to be increased in obese and obesity-prone young adults, and correlated with the increase in BMI, systolic blood pressure, and left ventricle MPI.

Keywords: aortic elasticity properties, obesity, young adults

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ÖZ

Amaç: Arter sertliği damar duvarının viskoelastik özelliklerini yansıtır. Bu çalışmada obez ve obeziteye yatkın genç erişkinlerde aort strain, elastikiyet, sertlik ve sol ventrikül fonksiyonları arasındaki ilişkiyi değerlendirmeyi amaçladık.

Gereç ve Yöntemler: Katılımcılar VKİ'ye göre obez, fazla kilolu, normal kilolu ve zayıf olarak sınıflandırıldı. 28 zayıf, 84 normal, 89 fazla kilolu ve 22 obez birey vardı. Hastaların fizik muayeneleri, bulguları ve tıbbi öyküleri kaydedildi. Sol ve sağ ventrikül fonksiyonları 2D transtorasik ekokardiyografi ile değerlendirildi. Aortik strain, elastikiyet ve sertlik indeksini içeren aort elastikiyet parametreleri, önceden tanımlanmış formüle göre hesaplandı.

Bulgular: Temel klinik ve demografik bulgular, yaş ve ağırlık dışında benzerdi. Ekokardiyografik ölçümlerin karşılaştırılmasında, sol ventrikül sistol sonu ve diyastol sonu çapları, interventriküler septum ve arka duvar diyastol çapları, sol atriyum çapı, sol ventrikül kitle ve kitle indeksi, VKİ'deki artışla uyumlu olarak gruplar arasında anlamlı olarak yüksekti, mitral erken diyastolik dolum hızları, mitral erken ve geç diyastolik dolum hızı oranı ve mitral lateral erken diyastolik gevşeme, VKİ'deki artışın tersine, gruplar arasında anlamlı olarak daha düşüktü (tümü için $p < 0.05$). Aortik strain, elastikiyet ve sertlik değerleri açısından gruplar arasında istatistiksel olarak anlamlı farklılıklar gözlendi. Aortik sertlik, VKİ'deki artışla uyumlu olarak gruplar arasında anlamlı olarak daha yüksekti, aort strain ve elastikiyeti, VKİ'deki artışa zıt olarak gruplar arasında anlamlı olarak daha düşüktü (tümü için $p < 0.05$). VKİ, sistolik kan basıncı, nabız basıncı ve miyokardiyal performans indeksi (MPI), aort sertliği indeksini (β) etkileyen bağımsız değişkenler olarak bulundu.

Sonuç: Gelecekteki kardiyovasküler hastalık riskini belirlemede prognostik bir değeri olabilecek aort sertliği indeksi (β), obez ve obeziteye yatkın genç erişkinlerde artma eğilimindedir ve VKİ, sistolik kan basıncı ve sol ventrikül MPI ile korele olduğu gözlenmiştir.

Anahtar kelimeler: Aortun elastikiyet özellikleri, obezite, genç erişkinler

Introduction

Obesity is an important health problem that can affect all systems, including the cardiovascular(CV) and endocrine systems, even leading to death (1). In obese patients, the total blood volume increases to supply the blood circulation of the increased adipose tissue. Sodium retention due to leptin, atrial natriuretic peptide, renin-angiotensin produced by adipocytes, and the sympathetic nervous system stimulated by hyperinsulinemia, disrupts the body's fluid balance. The increase in circulating volume load affects the systolic and diastolic functions of the heart(2, 3).

The contribution of obesity or regional adiposity in CV risk estimation has always been a matter of debate (4-8). There is a consensus about that the increased CV risk is not only due to obesity and its severity, but also to the influence of the patient's risk factor profile among obese individuals. Subsequent studies have clearly demonstrated that obesity is an important independent determinant of CV risk and/or mortality in both genders (9-11). In addition, weight gain after the young adulthood has been reported to be associated with an increased risk of CV disease in both sexes. This cannot be attributed to baseline weight or the presence of risk factors because of subsequent weight gain. That is why fighting obesity appears to be a recommended goal in the primary prevention of CV disease in addition to the well-defined risk factors (5).

Arterial stiffness is a term used to describe the viscoelastic properties of the vessel wall. The effects of chronic inflammation, oxidative stress, production of free radicals, and neuroendocrine and genetic changes on the arterial wall may cause arterial stiffness and decreased vascular compliance, and it is associated with the physiopathogenesis of vascular aging (12). The role of aortic elasticity parameters in the development of atherosclerosis and in the early detection of atherosclerosis-related mortality and morbidity cannot be denied. Increased arterial stiffness has a significant impact on pulse pressure (the difference between systolic and diastolic blood pressure), wave reflections, kidney function, and above all CV risk (13). The increase in aortic stiffness causes increased cardiac workload and decreased coronary artery perfusion pressure, which can lead to microvascular cardiac ischemia. On the other hand, decreased arterial stiffness was found to be associated with increased survival (14). In previous studies, it has been shown that obesity causes an increase in aortic stiffness in children and adults, regardless of age, ethnicity, and blood pressure (15).

In our study, we aimed to evaluate the relationship between aortic strain, aortic elasticity, aortic stiffness, and left ventricular functions in obese and obesity-prone asymptomatic young adults without any comorbidities.

Materials and Methods

Study population

The study population is consisted of participants admitted to the cardiology outpatient clinic and had echocardiography between January 2014 and April 2016. Individuals with a normotensive course and not using any medication were included in the evaluation. A total of 223 participants under the age of 40 without any additional disease and/or risk factors were included in the study. Among the participants, 104 (46.6%) were male with a mean age of 27.67 ± 6.25 years, and 119 (53.4%) were female with a mean age of 28.32 ± 6.61 years. Detailed medical history of all individuals was taken, physical examinations were performed, and their biochemical parameters were evaluated. Those with coronary artery disease, hypertension, diabetes mellitus, hyperlipidemia, heart failure, cardiomyopathy, heart valve disease, pulmonary hypertension, renal failure, hematological and inflammatory disorders were excluded. All individuals were informed in detail about the investigational nature of the study and gave written informed consent to participate.

Anthropometric measurements

The study groups were determined according to the body mass index, the most common anthropometric parameter; as underweight (BMI<20kg/m2), normal weight (BMI 20-25 kg/m2), overweight (25-30 kg/m2), and obese (BMI<30 kg). There were 28 underweight, 84 normal weight, 89 overweight, and 22 obese individuals.

Echocardiography

Transthoracic echocardiography was performed using a Vivid S5 ultrasound system (GE Medical Systems Ultrasound & Primary Care Diagnostics, USA) with a 2.5 MHz phased-array transducer in the left lateral decubitus position at the end of the expiration, following rest for 10 minutes. Standard left and right ventricular echocardiography measurements were obtained according to the current recommendation guidelines of the American Society of Echocardiography. Peak early (E) and atrial (A) flow velocities (cm/s), E/A ratio, deceleration time (DT) (ms) of LV diastolic filling were taken by pulse wave Doppler in apical four-chamber view. Measurements were repeated at 3 consecutive cardiac cycles and the averaged value was used for analysis. All data were stored digitally and analyzed offline. Two separate investigators blinded to each other's results and patients' clinical data analyzed all measurements.

Aortic systolic and diastolic diameters (AoD) were measured by M-mode echocardiography of ascending aorta obtained at 3 cm above the aortic valve from a parasternal long- axis view. Simultaneously, blood pressure measurements were obtained using an aneroid sphygmomanometer on brachial artery.

Aortic strain is defined as the percentage change of the ascending aorta, aortic distensibility index is defined as the relative change in diameter (or area) for a given pressure change and, aortic stiffness index (β) is defined as the ratio of ln systolic/diastolic pressures to relative change in diameter. Aortic strain (AS), aortic distensibility (DIS), and aortic stiffness index (SI) were calculated using the following previously described formulas(16):

- Aortic strain (%) = 100 × (AoS−AoD)/AoD
- Aortic distensibility index (cm-2dyn-110-6) = [2 x (Aos - Aod) / Aod x (SBP - DBP)]
- Aortic stiffness index (β) = ln (SBP/DBP)/[(Aos - Aod)/Aod)]
- LV Mass (g) (deverux) = 0.8{1.04[([LVEDD + IVSd +PWd]3 - LVEDD3)]} + 0.6
- Relative Wall Thickness: (2xPWd) /LVIDd

Statistical analysis

Data analysis was performed with SPSS (Statistical Package for Social Sciences) 20.0 package program. Continuous variables are expressed as mean ± standard deviation (SD) and categorical variables as percentages. The distribution of continuous variables was evaluated with the Kolmogorov-Smirnow test. One-way ANOVA test (one-way analysis of variance) was used for comparisons between groups and Tukey was used as post-hoc test to delineate pair-wise differences. Chi-square test was used to compare categorical variables. Pearson coefficient was used to perform analysis of univariate correlation. Following univariate correlations, a multivariate linear regression model with backward selection process was applied to identify independent predictors affecting the aortic stiffness index. A P-value of $p < 0.05$with a confidence interval of 95% were accepted statistically significant.

Results

Among the participants, 104 (46.6%) were male with a mean age of 27.67 ± 6.25 years, and 119 (53.4%) were female with a mean age of 28.32 ± 6.61 years. Baseline demographic and clinical characteristics as well as risk factors were similar in the three groups, except for age and BMI. Heart rate, systolic, and diastolic blood pressure values were within normal limits compatible with age, and no statistically significant difference was observed between the groups (Table 1). When the biochemical parameters of the groups were compared, the fasting blood glucose, creatinine, hemoglobin, hematocrit, low-density lipoprotein (LDL), high-density lipoprotein (HDL), total cholesterol, triglyceride, and glomerular filtration rate (e-GFR) values were statistically significantly different, with an increasing from the underweight group to the obese group, compatible with BMI values ($p < 0.05$, for all).

Table 1. Patients Characteristics						
	All patient (n=223)	BMI < 20 kg/m^2 (n=28)	BMI 20-25 kg/m^2 (n=84)	BMI 25-30 kg/m^2 (n=89)	BMI > 30 kg/m^2 (n=22)	P Value
Age (year)	27.67 ± 6.25	25.64 ± 6.33	26.21 ± 6.00	28.88 ± 6.19	30.90 ± 5.20	0.001
Men (n, %)	104 (46.6)	3 (10.7)	36 (42.9)	51 (57.3)	14 (63.6)	< 0.001
BMI (kg/m2)	24.90 ± 4.30	19.05 ± 0.56	22.21 ± 1.60	27.26 ± 1.37	33.11 ± 2.98	< 0.001
Smoke (n, %)	70 (31.4)	5 (7.1)	26 (31)	29 (32.6)	10 (45.5)	0.215
SBP (mmHg)	111.88 ± 11.60	109.25 ± 13.31	111.61 ± 10.93	111.66 ± 10.73	117.18 ± 14.24	0.106
DBP (mmHg)	70.12 ± 8.99	67.14 ± 7.30	69.47 ± 8.49	70.76 ± 9.45	73.81 ± 9.51	0.052
PP (mmHg)	41.76 ± 9.17	42.10 ± 10.02	42.14 ± 8.23	40.89 ± 8.88	43.36 ± 12.46	0.653
Heart rate (beat/min)	72.42 ± 12.36	71.03 ± 12.96	70.41 ± 9.74	74.35 ± 14.43	74.04 ± 10.66	0.163

BMI: body mass index; SBP: systolic blood pressure; DBP: diastolic blood pressure; PP: pulse pressure

Interventricular septum end-diastolic measurement, left ventricular posterior wall end-diastolic measurement, left ventricular end-systolic and end-diastolic diameters, left atrial diameter and aortic annulus diameter were found to increase from underweight group to obese group, with a statistically significant difference. There was no difference between the groups in terms of ejection fraction and fractional shortening. Left ventricular mass and left ventricular mass index showed statistically significant changes, increasing from underweight group to the obese group. No statistical significance was found in terms of relative wall thickness. A statistically significant decrease was found in mitral E velocity measured with pulse wave doppler, compatible with BMI values. Although an increase was observed in mitral A wave velocity, it was not statistically significant. A statistically significant decrease was found in the mitral E/A ratio. A significant decrease was detected in the mitral E' velocity measured with tissue Doppler, compatible with BMI values. Also, the myocardial performance index (MPI), which allows us to evaluate the left ventricular systolic and diastolic functions globally, showed statistically significant differences between the groups, compatible with BMI values (Table 2).

Table 2. Conventional Echocardiographic Parameters						
	All patient (n=223)	BMI < 20 kg/m^2 (n=28)	BMI 20-25 kg/m^2 (n=84)	BMI 25-30 kg/m^2 (n=89)	BMI > 30 kg/m^2 (n=22)	P Value
LA (mm)	33.24 ± 3.84	29.92 ± 3.83	32.04 ± 3.21	34.42 ± 3.27	37.27 ± 2.91	< 0.001
Aortic annulus (mm)	19.71 ± 1.97	18.03 ± 1.52	19.29 ± 1.70	20.24 ± 1.90	21.31 ± 1.78	< 0.001
IVSd (mm)	8.57 ± 1.43	7.39 ± 1.28	8.36 ± 1.22	8.82 ± 1.32	9.86 ± 1.48	< 0.001
LVIDd (mm)	47.39 ± 5.27	43.64 ± 3.34	46.47 ± 5.26	48.76 ± 5.25	50.09 ± 4.08	< 0.001
LVIDs (mm)	29.12 ± 4.14	26.35 ± 2.87	28.55 ± 4.06	30.19 ± 4.13	30.45 ± 3.96	< 0.001
LVPWd (mm)	7.92 ± 1.46	7.14 ± 1.35	7.78 ± 1.38	8.00 ± 1.34	9.13 ± 1.64	< 0.001
LVEF (%)	68.73 ± 5.54	70.28 ± 4.66	68.72 ± 4.95	68.12 ± 5.81	69.27 ± 7.27	0.324
FS (%)	38.58 ± 4.63	39.71 ± 3.87	38.45 ± 4.06	38.16 ± 4.82	39.36 ± 6.44	0.382
LVM (g)	132.49 ± 43.25	96.45 ± 27.71	124.12 ± 37.72	141.51 ± 39.67	173.88 ± 49.23	< 0.001
LVMI (g/m2)	53.73 ± 14.32	43.95 ± 11.61	52.23 ± 13.71	55.77 ± 13.60	63.66 ± 14.84	< 0.001
RWT	0.33 ± 0.05	0.32 ± 0.05	0.33 ± 0.05	0.33 ± 0.05	0.36 ± 0.05	0.091
Mitral E (cm/sec)	85.99 ± 16.81	92.18 ± 14.56	89.32 ± 17.00	82.00 ± 16.93	81.55 ± 13.73	0.003
Mitral A (cm/sec)	59.00 ± 12.02	56.14 ± 10.63	58.45 ± 13.07	59.53 ± 11.77	62.64 ± 9.92	0.269
Mitral E/A oranı	1.50 ± 0.37	1.67 ± 0.30	1.57 ± 0.36	1.42 ± 0.40	1.31 ± 0.20	< 0.001
Mitral lateral E' (cm/sec)	18.64 ± 4.03	19.96 ± 3.44	19.46 ± .3.94	17.85 ± 4.08	17.00 ± 3.89	0.003
Mitral E/E' ratio	4.74 ± 1.06	4.70 ± 0.87	4.73 ± 1.13	4.71 ± 1.01	4.98 ± 1.21	0.755
MPI	0.46 ± 0.11	0.41 ± 0.10	0.45 ± 0.10	0.48 ± 0.12	0.47 ± 0.11	0.044

LA: left atrium; IVSd: interventricular septum diastolic; LVPWd: left ventricle posterior wall diastolic; LVIDd: left ventricular internal diameter diastolic; LVEF: left ventricle ejection fraction; FS: fractional shortening; LVM: left ventricle mass; LVMi: left ventricle mass index; RWT: relative wall thickness; MPI: myocardial performance index

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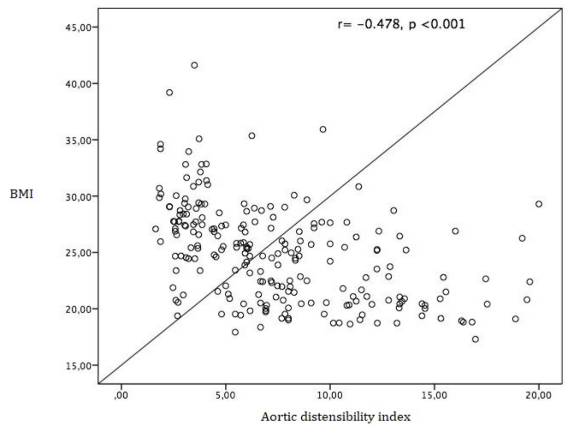
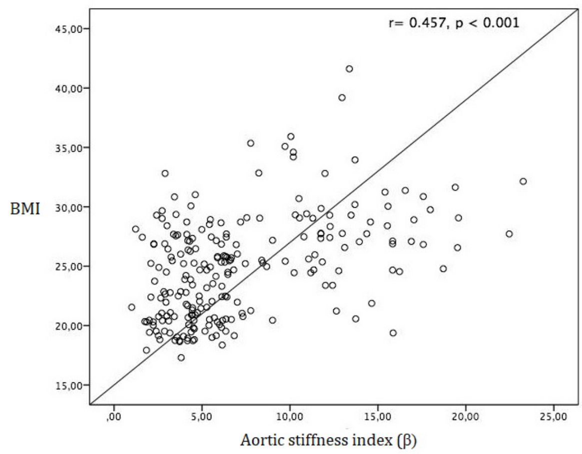
A significant increase was observed in ascending aortic systolic (Aos) and diastolic (Aod) measurements with obesity. There was no difference between the groups in terms of peak aortic velocity and aortic ejection time. aortic strain and aortic distensibility index showed. Significant decreases in aortic strain and aortic distensibility index was found, compatible with BMI values. On the other hand, the aortic stiffness index (β) showed a statistically significant increase in parallel with obesity (Table 3). In univariate correlation analysis, a negative correlation was observed between BMI and aortic strain (r=-0.491, p<0.001) and aortic distensibility index (r=-0.478, p<0.001), while a positive correlation was observed between BMI and aortic stiffness index (β) (r=0.457, p<0.001) (Figure 1A-C). Variables showing significant correlation with aortic stiffness index (β) in univariate analysis are summarized in Table 4. We performed a standard multivariate regression analysis using the backward method based on independent variables likely to affect aortic stiffness index (β). In multivariate linear regression analysis, significant independent factors affecting the aortic stiffness index (β) were found as BMI, SBP, PP, and left ventricular MPI (Table 4).

Table 3. Aortic Elasticity Parameters

	All patient (n=223)	BMI < 20 kg/m² (n=28)	BMI 20-25 kg/m² (n=84)	BMI 25-30 kg/m² (n=89)	BMI > 30 kg/m² (n=22)	P Value
Peak aortic velocity (m/sec)	1.17 ± 0.17	1.19 ± 0.15	1.16 ± 0.16	1.16 ± 0.17	1.18 ± 0.19	0.887
Aortik ejeksiyon zamanı (ms)	273.29 ± 24.38	281.92 ± 21.82	273.80 ± 20.50	272.37 ± 26.17	264.09 ± 30.78	0.077
Aos (mm)	28.44 ± 3.30	26.82 ± 2.73	27.55 ± 2.59	29.01 ± 3.31	31.59 ± 3.86	< 0.001
Aod (mm)	26.19 ± 3.71	23.96 ± 2.72	25.00 ± 2.78	27.02 ± 3.68	30.17 ± 4.13	< 0.001
Aortic strain (%)	9.04 ± 4.80	12.10 ± 3.71	10.52 ± 4.75	7.69 ± 4.39	4.96 ± 3.13	< 0.001
Aortic distensibility index (10-6 cm2 dyn-1)	7.47 ± 4.29	10.25 ± 4.40	8.75 ± 4.13	6.20 ± 3.81	4.16 ± 2.53	< 0.001
Aortic stiffness index (β)	7.18 ± 4.66	4.58 ± 2.58	5.85 ± 3.63	8.16 ± 4.90	11.61 ± 5.26	< 0.001

Aos : aortic systolic diameter; Aod: aortic diastolic diameter





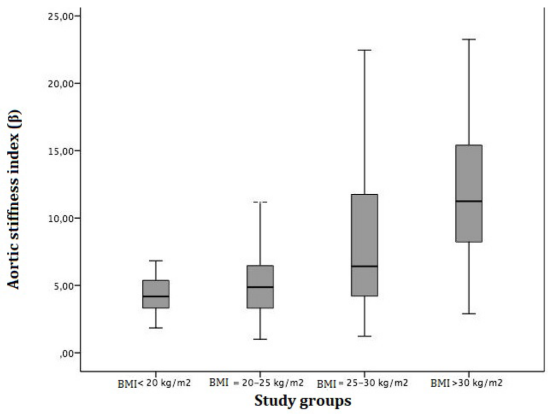


Figure 1. Univariate correlation analysis between BMI and aortic strain **(A),** BMI and aortic distensibility index **(B),** BMI and aortic stiffness index (β) **(C).**

Table 4. Multivariate linear regression analysis

	Multivariate analysis	
	Unstandardized Coefficients B (95% CI)	P value
BMI	0.537 [(0.378) – (0.696)]	< 0.001
SBP	-0.086 [(-0.167) – (-0.005)]	0.037
PP	0.230 [(0.133) – (0.327)]	0.018
MPI	6.805 [(0.133) – 0.327)]	< 0.001

In subgroup analyzes, a statistically significant difference was found between male and female gender independent of BMI in terms of aortic strain, aortic distensibility, and aortic stiffness index (β), (p<0.001). It was observed that the aortic stiffness index (β), was significantly higher in males. No significant difference was observed in terms of the aortic elasticity parameters according to the smoking status.

Discussion

This study clearly showed that aortic elasticity parameters, which are predictors of future CV disease, is statistically significantly increased in obese and obesity-prone young adults. Aortic strain and aortic elasticity decreased in line with BMI, while aortic stiffness index (β) increased. Although MPI, which shows the left ventricular global performance globally, was within normal limits, it showed a significant increase towards obesity. Also, a statistically significant and positive correlation was observed between MPI and aortic stiffness index (β). This finding suggests the increased left ventricular performance against relatively increased afterload, with increased aortic stiffness.

Recent studies have shown that there may be a relationship between loss of elasticity of the great arteries and CV diseases (17, 18). Aortic stiffness is an independent determinant of CV and all-cause mortality, independent of age, DM, and previous CV events (18). There are many techniques for the assessment of vascular disease and stiffness in the early stage, including pulse wave and direct measurements. Recent studies have shown that pulsatile changes in the diameter of the ascending aorta can be recorded indirectly by routine echocardiography. Aortic elasticity parameters are based on aortic diameters and data of blood pressure. These non-invasive measurements have been validated as predictors of aortic elasticity with a higher degree of accuracy than invasive measurements (19, 20). Our findings support that obesity causes changes in dimensions, as structural features of ascending aorta. In addition, the finding of a decrease in aortic elasticity and an increase in aortic stiffness, which is a functional vascular feature of the ascending aorta, is consistent with previous studies.

Left ventricular hypertrophy is the most important manifestation and independent predictor of preclinical heart disease in terms of all CV complications (21, 22). The pathophysiological mechanisms of the relationship between obesity and left ventricular hypertrophy have not yet been fully elucidated. Nevertheless, volume overload and pressure overload of obesity are associated with systemic hypertension, increased arterial stiffness, and sleep apnea syndrome (23). Normal values for left ventricular mass are < 294 g in men and < 198 g in women. In our study, baseline left ventricular mass and left ventricular mass index showed a statistically significant increases towards the obese group. This finding confirmed the hypothesis that arterial stiffness is the main determinant of left ventricular hypertrophy in obesity, in relation to all aortic elasticity parameters.

Arterial stiffness in a healthy woman tends to be lower than that of men until menopause, but it has been reported that the difference decreases if the woman does not take estrogen replacement in the postmenopausal period (24). However, it has been determined that the gender factor is more important in peripheral arteries than in the aorta (25). Rajkumar et al. showed that estrogen changes the vessel wall loading thickness by nitric oxide mediator and endothelium-dependent vasodilation (25). In addition, acute estrogen administration has been reported to improve aortic stiffness and reduce arterial wave reflection in postmenopausal women with or without coronary artery disease. In our study, independent of BMI, a statistically significant difference was found between male and female gender in subgroup analyses in terms of aortic strain, aortic distensibility, and aortic stiffness index (β), (p<0.001). It was observed that the aortic stiffness index was significantly higher in males.

In smoking addicts, smoking acutely decreases the elastic properties of the aorta (26). Another study investigated the acute effects of smoking on arterial stiffness in regular smokers reported that the dilatation ability of the carotid and brachial arteries decreased by 7% to 18% after acute smoking, however, there was no long-term baseline difference when compared to non-smokers (27). Stefanadias et al. (28) reported that smoking acutely and significantly reduced the ability of aortic dilatation. In our study, it was determined that smoking did not cause a statistically significant difference in aortic elasticity parameters.

To the best of our knowledge this is the first study investigating the relationship between aortic elasticity parameters in obesity prone young adults. The small sample size of the study is an important limitation of our study and decreases the statistical power. Therefore, our findings need to be supported by large-scale randomized studies.

Conclusion

Aortic stiffness index (β), which has prognostic value in determining the risk of CV disease, tends to be increased in obese and obesity-prone healthy young adults compared with normal-weight individuals. Besides, aortic stiffness index (β) correlates with BMI, SBP, and left ventricle MPI. We may conclude that the increased aortic stiffness index (β) in obese and obesity-prone young adults have a prognostic significance in terms of determining the risk of CV disease development, and thereby, obese, and obesity-prone young adults with higher aortic stiffness index (β) can be recommended to be followed closely. By improving this parameter as a treatment goal, a reduction in CV morbidity and mortality can be achieved.

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