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Bicuspid aortic valve morphology and its association with aortic diameter: an echocardiographic study

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Abstract

Background: Bicuspid aortic valve (BAV) is strongly associated with aortopathy. Previous studies have suggested that various types of bicuspid aortic valve morphology may differently affect the aortic dilatation.

Aim: To evaluate the impact of BAV cusp fusion morphology (type I — right-left coronary cusp fusion; type II — right-non-coronary cusp fusion) on the diameters of the aorta.

Methods: BAV morphology was evaluated retrospectively in a group of 67 consecutive patients with BAV. The control group comprised 1000 randomly selected patients with normal tricuspid aortic valve. Aortic dimensions and other echocardiographic parameters were obtained from the echocardiography database of our department. The diameters of aorta in both BAV subtypes were evaluated at the level of: annulus, the sinus of Valsalva, the sinotubular junction, and the ascending aorta and at the level of the ascending aorta in the control group.

Results: Patients with BAV were mainly male (78%), with a mean age of 55.3 ± 16.7 years. The dominant morphology of BAV in the study group was type I (n = 46; 69%). It was associated with increased aortic dimension in comparison to type II BAVs at the level of the sinuses of Valsalva (38.4 ± 5.2 vs. 34.0 ± 4.6 mm, p = 0.002), the sinotubular junction (33.1 ± 5.8 vs. 29.6 ± 5.0 mm, p = 0.035), and the ascending aorta (41.6 ± 7.1 vs. 36.6 ± 6.1 mm, p = 0.006). Indexed aortic diameter was also increased in type I BAV at the level of sinuses of Valsalva (19.6 ± 2.7 vs. 18.1 ± 1.6 mm/m^2, p = 0.008) and the ascending aorta (21.3 ± 3.4 vs. 19.3 ± 3.4 mm/m^2, p = 0.048). The dimensions of the ascending aorta exceeding the upper normal range limit based on control-group measurements (44.3 mm) were observed more frequently in type I than in type II (33% vs. 10%, p = 0.044). Aortic regurgitation (moderate or severe) occurred in similar percentages of both BAV subtypes (type I: 37% vs. type II: 33%, p = 0.774). There were also no significant differences in aortic valve area (2.2 ± 1.1 vs. 2.0 ± 1.4 cm^2, p = 0.163), indexed aortic valve area (1.1 ± 0.6 vs. 1.0 ± 0.6, p = 0.337), peak transvalvular gradient (35.3 ± 20.5 vs. 39.1 ± 28.9 mm Hg, p = 0.862), and mean gradient (18.6 ± 12.3 vs. 22.7 ± 18.2 mm Hg, p = 0.571) and left ventricular ejection fraction (51.8 ± 11.6 vs. 51.8 ± 12.2%, p = 0.978) between type I and type II BAV groups.

Conclusions: Type I BAV cusp fusion morphology is more commonly associated with dilatation of the aorta than type II, especially at the level of the sinus of Valsalva and the ascending aorta.

Key words: bicuspid aortic valve, aorta, aortic aneurysm, pathological dilatation, echocardiography

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INTRODUCTION

Bicuspid aortic valve (BAV) is the most common congenital heart defect in the adult population, observed in 1.3% of the population worldwide [1]. There are numerous complications recognised to be associated with the BAV, including aortic stenosis (AS), regurgitation (AR), infective endocarditis, and pathologies of the thoracic aorta [1]. It has been estimated that patients with BAV are more likely to be affected by dilatation of the proximal aorta [1, 2]. Individuals with BAV are not just at higher risk of aortic dilatation, but also the most feared complications — aortic dissection and rupture [3].

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The most common BAV fusion pattern is type I — fusion of the right and left coronary cusps, followed by type II — fusion of the right and noncoronary cusps. The least common pattern — type III — involves fusion of the left and noncoronary cusps [1, 4].

The prevalence of bicuspid aortic dilatation reported by other authors ranges from 20% to 84% [1, 2, 5–8]. Previous evidence suggests that various BAV types, distinguished by the morphology of the valve cusp fusion, may carry different relationships with aortic dilatation; however, the published literature is incoherent in this regard. Several studies have demonstrated increased aortic dimension in type I BAV, some others with type II BAV, and some showed no association.

The purpose of our study was to evaluate the impact of BAV cusp fusion morphology on the diameters of the aorta at the level of: annulus, sinus of Valsalva, sinotubular junction, and ascending aorta.

METHODS

Study population

Sixty-seven consecutive patients with BAV identified in transthoracic (TTE) or transoesophageal (TEE) echocardiographic examination were included in the study. Patients with evidence of previous aortic root surgery, aortic valvuloplasty, or complex congenital heart disease were excluded. For patients with serial echocardiographic studies in the database, only the most recent study was selected for further analysis.

Control group

The control group was composed of 1000 patients with normal tricuspid aortic valve, randomly selected from the echocardiography database. Exclusion criteria were the same as in the study group: evidence of previous aortic root surgery, aortic valvuloplasty, or complex congenital heart disease. The control group was only used to establish a cut-off for pathologic dilatation of proximal ascending aorta (measured 1–2 cm distal to the sinotubular junction) — defined as the mean + two standard deviations (SDs) of ascending aorta dimension in the control group.

Estimation of the upper limit diameter of aorta

To establish the upper limit diameters of aorta we applied the regression equation published by Campens et al. [9] (considering age, body surface area [BSA], and sex of patient) derived from the reference healthy population.

Echocardiographic analysis

Measurements of the aorta were obtained from the parasternal long axis view. Diameters of aorta were obtained at levels of: aortic annulus, sinus of Valsalva, sinotubular junction, and proximal ascending aorta. The diameter of the proximal ascending aorta was measured 1 cm above the sinotubular junction. All the measurements were obtained in end-diastole, from inner edge to inner edge as recommended by published guidelines [10, 11].

Assessment of BAV morphology was performed on TTE cine loops recorded from the parasternal short axis view. The diagnosis of BAV was confirmed only when two valve cusps were identified in both systole and diastole forming an oval-shaped orifice. The following qualification of BAV was applied: type I — right and left coronary cusp fusion; type II — right and noncoronary cusp fusion; and type III — noncoronary to left cusp fusion.

In the case of ambiguous TTE imaging, TEE loops were assessed (available in 24/67 patients). If assessment of BAV morphology was limited by suboptimal image quality, previous serial studies were used.

Aortic valve area (AVA) was calculated by application of the continuity equation. Aortic valve stenosis was classified as severe (AVA < 1.0 cm^2), moderate (AVA 1.0–1.5 cm^2), or mild (AVA > 1.5 cm^2). AR was assessed by colour Doppler in parasternal long-axis and five-chamber views. According to the European Association of Echocardiography recommendations AR was graded as mild, moderate, or severe [12, 13].

Statistical analysis

Categorical variables were presented as percentages. Continuous variables were reported as mean with SD. Intergroup differences for continuous variables (aortic dimensions, age, BSA etc.) were analysed with the Student-t test for independent variables or with the Mann-Whitney's U test, depending on the variable distribution. The categorical variable analysis was performed with the χ^2 test, the χ^2 test with Yates's correction, or Fisher exact probability test. P-values less than 0.05 were considered statistically significant.

The statistical analysis was carried out by using MedCalc version 12.2.1.0 and STATISTICA version 10.0.

RESULTS

Baseline characteristics

A total of 67 patients with BAV were identified and included into the study (mean age 55 ± 17 years). The dominant type of BAV was type I (n = 46; 69%), and type II BAV was present in 21 (31%) patients. Type III BAV morphology, because of its rarity, was excluded from the study (recorded in three patients). The majority of BAV patients were men (n = 53; 78%). Patients with type I BAVs were more likely to be men and were taller compared with those with type II BAVs. There was a trend for older age of individuals with type II BAV.

Detailed basic clinical characteristics of study patients are presented in Table 1.

Echocardiographic characteristics

The prevalence of haemodynamically significant valvular disease in our study group was moderate, with 7.4% (5 of 67 patients) with severe AS and 35% (24 of 67 patients) with

Table 1. Basic clinical characteristics of study patients

Variable	Overall (n = 67)	Type I BAV (n = 46)	Type II BAV (n = 21)	P
Age [years]	55.3 ± 16.7	52.7 ± 14.6	60.9 ± 19.7	0.061
Man	53 (78%)	40 (87%)	13 (62%)	0.044
Weight [kg]	78.4 ± 12.2	80.0 ± 11.6	75.0 ± 13.0	0.128
Height [cm]	171.5 ± 9.1	173.5 ± 7.7	167.4 ± 10.7	0.010
Body mass index [kg/m^2]	26.6 ± 3.3	26.6 ± 3.5	26.7 ± 3.0	0.911
Body surface area [m^2]	1.94 ± 0.19	1.97 ± 0.17	1.89 ± 0.21	0.063

BAV — bicuspid aortic valve; p-values calculated for differences between type I and type II BAV

Table 2. Echocardiographic characteristics of study patients

Variable	Overall (n = 67)	Type I BAV (n = 46)	Type II BAV (n = 21)	P
Aortic regurgitation:				
Mild	36 (53.7%)	25 (54.3%)	11 (52.4%)	0.804
Moderate	23 (34.3%)	16 (28.1%)	7 (33.3%)	
Severe	1 (1.5%)	1 (2.2%)	0 (0.0%)	
AVA [cm^2]	2.16 ± 1.17	2.24 ± 1.08	2.01 ± 1.37	0.163
Indexed AVA [cm^2/m^2]	1.10 ± 0.56	1.13 ± 0.56	1.04 ± 0.63	0.337
Aortic stenosis:				
Mild (AVA > 1.5 cm^2)	19 (28.3%)	14 (30.4%)	5 (23.8%)	0.429
Moderate (AVA 1.0–1.5 cm^2)	17 (25.4%)	9 (19.6)	8 (38.1%)	
Severe (AVA < 1.0 cm^2)	5 (7.4%)	3 (6.5%)	2 (9.5%)	
Indexed AVA < 0.6 cm^2/m^2	10 (17%)	5 (13%)	5 (26%)	0.365
Peak transvalvular gradient [mm Hg]	36.5 ± 23.4	35.3 ± 20.5	39.1 ± 28.9	0.862
Mean transvalvular gradient [mm Hg]	20.0 ± 14.5	18.6 ± 12.3	22.7 ± 18.2	0.571
Left ventricular ejection fraction [%]	51.8 ± 11.7	51.8 ± 11.6	51.8 ± 12.2	0.978

Means with standard deviation or number of observations with percentage; p-values were calculated for differences between type I BAV vs. type II BAV; BAV — bicuspid aortic valve; AVA — aortic valve area

at least moderate AR. There were no significant differences between the two subtypes of BAV in severity of AS, even if the transvalvular pressure gradients, AVA (indexed and non-indexed), or percentage of individuals with severe AS (< 1.0 cm^2) were compared. Detailed echocardiographic characteristics of different BAVs groups are presented in Table 2.

Aortic dimensions

Patients with type I BAV had significantly larger dimensions at all levels except for the aortic annulus (Table 3). After indexation to BSA only the diameter of the sinus of Valsalva (19.6 ± 2.7 vs. 18.1 ± 1.6 mm/m^2, p = 0.008) and the ascending aorta (21.1 ± 3.5 vs. 19.1 ± 3.2 mm/m^2, p = 0.027) appeared to be significantly higher in the type I BAV group (Table 3).

The cut-off point for pathologic dilatation of the ascending aorta was defined as the mean + two SDs of its dimension in the control group, and was 44.3 mm. It was observed in every fourth patient (25.4%), and its prevalence was almost three-fold higher in the type I BAV group in comparison to the type II BAV group (32.6% vs. 9.5%, p = 0.044).

In both groups pathologic dilatation of ascending aorta was observed significantly more often than in controls (1.9%) (Table 4). Eight (11.9%) patients had aortic diameter at a level greater than 50 mm — defined as severe aortic dilatation. The prevalence of this condition did not differ significantly between BAV groups (15.2% vs. 4.8%, p = 0.269). The majority of these patients (seven of eight; 88%) had ascending artic dimension > 50 mm.

After calculation of the upper limit diameters for normal ascending aorta using the regression equation published by Campens et al. [9], we found that the pathologically dilated ascending aorta was present in every second patient with BAV (56.7%) and significantly more often in individuals with type I BAV (67.4% vs. 33.3%, p = 0.009).

Clinical and echocardiographic characteristics of individuals with pathologic dilatation of ascending aorta are presented in Table 5.

Table 3. Aortic dimensions in different bicuspid aortic valve (BAVs) morphology types

Dimension	Overall (n = 67)	Type I BAV (n = 46)	Type II BAV (n = 21)	P
Non-indexed [mm]				
Annulus	25.2 ± 4.0 (61)	25.8 ± 3.9 (41)	23.8 ± 3.9 (20)	0.103
Sinuses of Valsalva	37.1 ± 5.4 (67)	38.4 ± 5.2 (46)	34.0 ± 4.6 (21)	0.002
Sinotubular junction	32.0 ± 5.7 (61)	33.1 ± 5.8 (42)	29.6 ± 5.0 (19)	0.035
Ascending aorta	39.6 ± 7.4 (67)	41.4 ± 7.2 (46)	35.8 ± 6.3 (21)	0.002
Indexed [mm/m^2]				
Annulus	13.0 ± 2.0	13.1 ± 2.0	12.8 ± 1.9	0.515
Sinuses of Valsalva	19.1 ± 2.5	19.6 ± 2.7	18.1 ± 1.6	0.008
Sinotubular junction	16.5 ± 2.7	16.9 ± 2.8	15.8 ± 2.3	0.149
Ascending aorta	20.5 ± 3.5	21.1 ± 3.5	19.1 ± 3.2	0.027

Means ± standard deviation (number of patients with data available for analysis); p-values were calculated for differences between type I BAV vs. type II BAV; indexation was made to body surface area

Table 4. Prevalence of pathologic aortic dilatation at the level of ascending aorta in bicuspid aortic valve (BAV) subtypes

Pathologic aortic dilatation	Overall (n = 67)	Type I BAV (n = 46)	Type II BAV (n = 21)	Controls (n = 1000)	P†
Ascending aorta > 44.3 mm (mean + 2 SD of controls)[1]	17 (25.4%)	15 (32.6%)‡	2 (9.5%)‡	19 (1.9%)	0.044
Diameter larger than upper limit for normal ascending aorta[2]	38 (56.7%)	31 (67.4%)‡	7 (33.3%)‡	103 (10.3%)	0.009
Diameter at any level > 50 mm	8 (11.9%)	7 (15.2%)	1 (4.8%)	–	0.269

[1]Cut-point value (44.3 mm) for diameter of ascending aorta was obtained from 1000 individuals in the control group with normal tricuspid aortic valve and defined as mean + two standard deviation (SD); [2]Upper limit diameters for normal ascending aorta was calculated using regression equation published by Campens et al. [17] (considering gender, age, and body surface area); †p-values for differences between type I and II BAV; ‡p < 0.05 vs. controls

Table 5. Characteristics of patients with pathologic dilatation of ascending aorta (greater than mean + two standard deviation dimension of the control group)

Variable	Dilatation of the ascending aorta (n = 17)	No dilatation of the ascending aorta (n = 50)	P
Type I BAV	15 (88%)	31 (62%)	0.044
Age [years]	58.9 ± 13.2	54.0 ± 17.7	0.295
Man	16 (94%)	37 (74%)	0.096
Weight [kg]	85.2 ± 10.3	76.0 ± 12.0	0.102
Height [cm]	175.1 ± 6.2	170.3 ± 9.7	0.061
Body mass index [kg/m^2]	27.7 ± 2.5	26.2 ± 3.5	0.097
Body surface area [m^2]	2.05 ± 0.15	1.91 ± 0.19	0.010
Aortic regurgitation (moderate or severe)	7 (41%)	17 (34%)	0.594
AVA [cm^2]	2.31 ± 1.21	2.11 ± 1.17	0.512
Indexed AVA [cm^2/m^2]	1.13 ± 0.62	1.09 ± 0.56	0.828
AVA < 1.0 cm^2	2 (12%)	3 (6%)	0.595
Indexed AVA < 0.6/m^2	3 (19%)	7 (17%)	1.000
Peak transvalvular gradient [mm Hg]	40.8 ± 23.0	35.5 ± 23.6	0.460
Mean transvalvular gradient [mm Hg]	23.1 ± 14.3	19.2 ± 14.6	0.337
Left ventricular ejection fraction [%]	48.8 ± 10.8	52.9 ± 11.9	0.063

BAV — bicuspid aortic valve; AVA — aortic valve area

Table 6. Correlations coefficients of different indexed aortic dimensions, aortic valve area (AVA), and patient age in the study group

	Type of BAV	Aortic diameter (all dimensions indexed to BSA)				Aortic valve			
		Annulus	Sinus of Valsalva	Sinotubular junction	Ascending aorta	AVA (indexed)	Transvalvular pressure gradient PG	Transvalvular pressure gradient MG	V_{max}
Age	Type I	0.29	0.48*	0.38*	0.42*	–0.41*	0.23	0.26	0.29
	Type II	–0.42	–0.12	0.03	0.48	–0.69*	0.49*	0.48*	0.60*

*$p < 0.05$; BAV — bicuspid aortic valve; BSA — body surface area; PG — peak transvalvular pressure gradient; MG — mean transvalvular pressure gradient; V_{max} — aortic valve peak velocity

Morphology of the aorta

We observed two different phenotypes of aortic dilatation. In type A the aortic diameter at the level of the sinuses of Valsalva was larger than the ascending aorta, and in type B the ascending aortic diameter exceeded that measured in the sinuses of Valsalva. Among patients with type I BAV, types A and B were observed in 35% and 65%, respectively. Although the A pattern was observed more frequent in the individuals with type II BAV (38% vs. 35%), this difference was statistically non-significant ($p = 0.793$).

Age vs. aortic dilatation and aortic valve haemodynamics

Detailed analysis of BAV subtypes has shown that in type II BAV the age of patient correlated negatively with indexed AVA ($r_{II\ AVA\ vs.\ age} = -0.69$; $r_{I\ AVA\ vs.\ age} = -0.41$); however, there were no significant differences in these correlation coefficients between BAV subgroups ($p > 0.05$). Moreover, in individuals with type II BAV significant correlations of age with peak and mean transvalvular pressure gradients, and maximum aortic flow velocity were observed (Table 6).

There was a positive correlation between patients' age and the diameter of the aorta only in type I BAV, where it correlated positively with all aortic diameters except the annulus. However, only the difference of correlation coefficients between type I and type II BAV at the level of the sinuses of Valsalva was statistically relevant ($p = 0.022$). Other differences of correlation coefficients appeared to be non-significant (Table 6).

DISCUSSION

The results of our study confirm that the morphologic subtype of BAV is associated with different aortic dilatation. Previously reported prevalence and degree of dilatation of the ascending aorta in patients with BAV varies widely due to heterogeneous study populations, assessment techniques, and defined aortic size thresholds [1]. However, it has been widely proven by many authors that all the segments of the ascending aorta in individuals with BAV are larger than in those with normal tricuspid AV [1, 5]. Beroukhim et al. [14] also proved that aortic dilatation begins in early childhood and that children born with BAV have larger dimensions in all measured regions of the aorta, especially at the level of ascending aorta.

The pathogenesis of BAV and coexisting pathologies is still unclear. The two main theories explaining the pathogenesis of aortopathy in patients with BAV are present in literature: the genetic [15, 16] and the haemodynamic theory [17].

The haemodynamic theory is supported by the observation that even in normal-functioning BAV, abnormal transvalvular-flow patterns can be observed. They lead to regional wall shear stress and are predicted largely by the BAV morphology [1, 17–19]. Hope et al. [19], using cardiovascular magnetic resonance, demonstrated the differences in ascending aortic flow directions between type I and type II BAV. Type I BAV produced a helical jet flow directed toward the right anterior wall of the aorta (which is opposite to the physiological direction) and type II BAV — toward the posterior aorta. Increased regional wall shear stress in different places of the aorta and dictated by the morphology of BAV might be essential for the different pattern of aortic dilatation [19]. Cotrufo et al. [20] demonstrated an asymmetric histological pattern of BAV aortopathy. They showed an asymmetric spatial pattern of smooth muscle cell changes and extracellular matrix proteins expression in the convexity versus concavity of BAV individuals' aorta and tricuspid aortic valve vs. BAV stenosis [21].

Our study shows that different patterns of BAV are associated with different size of aortic dilatation. However, both BAV subtypes had larger ascending aorta diameter than controls, and its pathologic dilatation at the level of ascending aorta was more often in both BAV subtypes, but type I BAV predisposed to greater dimensions at level of the sinuses of Valsalva and the ascending aorta in comparison to type II BAV. Although it has been proven that patients with type I BAV carry a higher risk of aortic dilatation [16, 22], Cecconi et al. [23] observed no significant difference between BAV subtypes in aortic dimensions. Additionally Khoo et al. [4] showed significantly larger indexed diameters only at the level of the sinuses of Valsalva in patients with type I BAV. In our study we also used the regression equation published by Campens et al. [9] to estimate the upper limit diameter for normal ascending aorta (considering gender, age, and BSA), which showed a more than two-times higher incidence of pathologically dilated ascending aorta in patients with type I BAV. That and our other previously mentioned findings support the thesis that type I BAV is associated with larger dimensions of the ascending aorta, excluding the annulus of AV as previously reported by other researchers [4, 24].

Previous studies have also shown that morphology of BAV is associated with different patterns and sites of aortic dilatation. Type I BAV predisposes to aortic root dilatation and asymmetric dilatation of the ascending aorta. Conversely, type II BAV more often lead to dilatation of the aortic arch [1]. These patterns are hypothesised to be the result of different directions of transvalvular blood flow in BAV subtypes [1, 4]. However, no significant differences in patterns of aortic dilatation were found in our study, with similar percentages of more proximal aortic dilatation pattern in both BAV subtypes. Therefore, it seems that further studies on larger BAV populations are needed to evaluate the real impact of BAV morphology on the pattern of aortic dilatation.

Interestingly, in our study the age of examined patients correlated significantly more with aortic diameter at the sinuses of Valsalva in type I than in type II BAV. These findings seem to be a surrogate marker of greater predisposition to aortic dilatation in time among patients with type I BAV. These results are consistent with those reported by other authors, where patients with type I BAV proved to be at increased risk of rapid aortic dilatation in time [8]. Moreover, Khoo et al. [4] showed type I BAV as only one independent predictor of proximal aortic dilatation. Interestingly, in an observational study performed by Detaint et al. [24] the rate of dilatation did not correlate with valve morphology, and progression of the aortic diameter was present only in 57% of BAV, although the baseline diameters of ascending aorta was significantly higher in type I BAV. These previously mentioned discrepancies suggest that other, still unknown environmental and genetic factors may play an essential role in progression of aortic dilatation.

Our studied population with relatively young individuals (mean age 55.3 years) and 1:3 female-to-male ratio is comparable with other previously reported representative BAV populations [4, 8, 16]. The frequency of pathologic dilatation (in 25% of all patients with BAV) was similar to reported estimates from necropsy and surgical series, where it ranged from 10% to 35% [25]. It was also concordant with the prevalence of pathologic dilatation of ascending aorta reported by other authors in performed echocardiographic studies [4, 8].

Limitations of the study

Our study has a number of imitations. The study population is relatively small, and was recruited from a tertiary-care referral centre database. Thus, our patients might have had more advanced aortopathy than patients in other studies, which could have led to overestimation of valvular lesion severity and aortic dimensions. This referral bias seems to be at least partially reduced by the fact that our hospital works without on-site cardiac surgery. Another limitation is the retrospective study character using data collected in a clinical database. Therefore, we could not correlate information about hypertension, blood pressure, and other comorbidities in our group, which could have influenced the aortic dimensions. Notably, some authors have suggested that differences in prevalence of aortopathy in patients with BAV persist even after adjusting for blood pressure, peak aortic-jet velocity, and left ventricular ejection time [8] and is also present in persons with normal-functioning BAV [14]. We realise that the exclusion of patients who have undergone surgery or aortic valvuloplasty might have led to underestimation of the incidence, size, and pattern of aortic dilatation; however, the presented diameters of aorta are relatively high compared to those shown in studies by other authors [4].

CONCLUSIONS

Our study confirmed that type I bicuspid aortic valve (fusion of the right and left-coronary cusp) is associated with increased diameter of aorta, especially at the level of the sinuses of Valsalva and the ascending aorta.

Conflict of interest: *none declared*

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Morfologia dwupłatkowej zastawki aortalnej i jej związek z wymiarem aorty — badanie echokardiograficzne

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Streszczenie

Wstęp: Dwupłatkowa zastawka aortalna (BAV) jest powiązana z patologicznym poszerzeniem aorty wstępującej. Wcześniejsze wyniki badań sugerują, że różne typy morfologiczne BAV mogą odmiennie wpływać na wymiar aorty.

Cel: Celem pracy była ocena wpływu morfologii BAV (typ I — połączenie płatka prawowieńcowego i lewowieńcowego; typ II — połączenie płatka prawowieńcowego i bezwieńcowego) na wymiary aorty.

Metody: Morfologia zastawki aortalnej została poddana retrospektywnej ocenie w grupie 67 kolejnych pacjentów z BAV. Grupę kontrolną utworzyło 1000 losowo wybranych osób z prawidłowo funkcjonującą trójpłatkową zastawką aortalną. Wymiary aorty i pozostałe parametry echokardiograficzne zostały uzyskane na podstawie echokardiograficznej bazy danych Kliniki Kardiologii Uniwersytetu Medycznego w Łodzi. Wymiary aorty w obydwu podtypach morfologicznych BAV poddano ocenie na poziomie: pierścienia aortalnego, zatoki Valsalvy, połączenia opuszkowo-aortalnego i aorty wstępującej, a w przypadku grupy kontrolnej na poziomie aorty wstępującej.

Wyniki: Grupę pacjentów z BAV stanowili głównie mężczyźni (78%), a średni wiek w grupie badanej wyniósł 55,3 ± 16,7 roku. Dominującym typem morfologicznym BAV był typ I (n = 46; 69%). Był on związany z istotnie większym wymiarem aorty na poziomie zatoki Valsalvy (38,4 ± 5,2 *vs*. 34,0 ± 4,6 mm; p = 0,002), połączenia opuszkowo-aortalnego (33,1 ± 5,8 *vs*. 29,6 ± 5,0 mm; p = 0,035) oraz aorty wstępującej (41,6 ± 7,1 *vs*. 36,6 ± 6,1 mm; p = 0,006) w porównaniu z pacjentami z typem II BAV. U pacjentów z typem I BAV zaobserwowano również istotnie wyższe indeksowane (względem powierzchni ciała) wymiary aorty na poziomie zatoki Valsalvy (19,6 ± 2,7 *vs*. 18,1 ± 1,6 mm/m^2; p = 0,008) oraz aorty wstępującej (21,3 ± 3,4 *vs*. 19,3 ± 3,4 mm/m^2; p = 0,048). Wymiary aorty wstępującej przekraczające górną granicę normy (44,3 mm) zdefiniowaną na podstawie pomiarów w grupie kontrolnej (średnia + 2 SD), zanotowano istotnie częściej w przypadku typu I BAV (33% *vs*. 10%; p = 0,044). Niedomykalność aortalna (w stopniu przynajmniej umiarkowanym) występowała u podobnego odsetka pacjentów z BAV (typ I: 37% *vs*. typ II: 33%; p = 0,774). Nie zaobserwowano również istotnych różnic w polu zastawki aortalnej (2,2 ± 1,1 *vs*. 2,0 ± 1,4 cm^2; p = 0,163), indeksowanym polu zatawki aortalnej (1,1 ± 0,6 *vs*. 1,0 ± 0,6 cm^2/m^2; p = 0,337), wartościach szczytowego (35,3 ± 20,5 *vs*. 39,1 ± 28,9 mm Hg; p = 0,862) i średniego gradientu przezzastawkowego (18,6 ± 12,3 *vs*. 22,7 ± 18,2 mm Hg; p = 0,571) oraz frakcji wyrzutowej lewej komory (51,8 ± 11,6 *vs*. 51,8 ± 12,2%; p = 0,978) między pacjentami z typem I oraz II BAV.

Wnioski: Typ I BAV istotnie częściej wiąże się z poszerzeniem aorty, zwłaszcza na poziomie zatoki Valsalvy i aorty wstępującej.

Słowa kluczowe: dwupłatwkowa zastawka aortalna, aorta, echokardiografia, patologiczne poszerzenie, tętniak aorty

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