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Morphometric Analysis and the Model for Predicting the Height of the Sinuses of Valsalva Depending on Anthropometric and Age Parameters in Men with Severe Aortic Stenosis

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ABSTRACT

Introduction: severe aortic stenosis still remains a widespread form of valvular heart disease. Transcatheter aortic valve replacement requires morphometric analysis of the aortic root. The aim of the study is to conduct a morphometric analysis of the height of the sinuses of Valsalva in men with severe aortic stenosis and to test predictive modeling of the height of the Valsalva sinuses based on anthropometric and age differences.

Methods and Methods: the study involved Computed tomography angiography images of male patients with severe aortic stenosis. Patients were divided into Group 1 (height up to 1.7 m) and Group 2 (taller than 1.71 m).

Results: the height of the left aortic sinus in men with severe aortic stenosis was 19.62 ± 2.45 mm in the Group 1, and 21.80 ± 1.76 mm in the Group 2 (p = 0.02); the height of the left coronary artery ostium was 10.97 ± 2.00 mm against 12.93 ± 1.27 mm (p = 0.007). The difference between the value of the height of the right aortic sinus was 8.02% higher in men from Group 2 (21.95 ± 1.31 mm) than in men from Group 1 (20.32 ± 2.40 mm), p = 0.04. No significant connection was found with BMI and age. BSA correlated with the height of the posterior aortic sinus and the left aortic sinus.

Conclusion: in men with severe aortic stenosis, anthropometric peculiarities affect the morphometric parameters of the aorta. The credibility of the logistic model used for predicting the height of the posterior aortic sinus and left coronary artery ostium was verified.

Keywords: Anatomy; Sinuses of Valsalva; Aortic root; Computed tomography; Measurements.

Introduction

Severe aortic stenosis still remains a widespread form of valvular heart disease[1]. Innovative cardiac techniques, such as transcatheter aortic valve replacement (TAVI), require morphometric analysis of the aortic root[2,3] annulus, sinus of Valsalva, and ascending aorta.\n\nResults\nThe study population comprised 80 men and 97 women (age: 82 ± 6 years. Aortic root is a complex and interconnected structure. Some components of the aortic root are posterior (noncoronary) sinuses, as well as the right and left coronary sinuses of Valsalva. Within the norm, the right coronary artery and the left coronary artery arise from the coronary sinuses[4]. Precise evaluation of the height of the Valsalva sinuses and the coronary ostia is necessary when planning endovascular interventions, predicting and preventing complications[5,6].

Morphometric analysis of the aortic root allows to estimate the height of the aortic sinuses and the height of the coronary ostia using specific measurements. Computed Tomography (CT) is a gold standard for assessing aortic root[7] and conducting appropriate assessments.

The aim of the study is to conduct a morphometric analysis of the height of the Valsalva sinuses in men with severe aortic stenosis and to test predictive modeling of the height of the Valsalva sinuses based on anthropometric and age differences.

Materials and Methods

Patients Population.

The study included patients of the cardiac surgery department with severe aortic stenosis who underwent computed tomography of the aortic root. The Heart Team established the “aortic stenosis” diagnosis according to the 2020 American College of Cardiology/American Heart Association (ACC/AHA) Guidelines[8]. The study involved 25 male patients with severe asymptomatic (Stage C1, C2) and symptomatic (Stage D1, D2, D3) aortic stenosis. Patients were divided into two groups: Group 1 – short (shorter than 1.7 m) and Group 2 – tall (taller than 1.71 m). Data on age, height, weight, body mass index (BMI), and body surface area (BSA) were obtained. The study was approved by the Local Bioethics Commission (# 10, December 20, 2021). The patients gave written informed consent.

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Study objective

The study objectives were to describe the morphometric anatomy of the height of the sinuses of Valsalva and the height of the coronary ostia in male with severe aortic stenosis. Patients with severe aortic stenosis might be considered as candidates to the aortic valve surgery or endovascular procedure. In both cases the precise assessment of the artic root is valuable. According to the results obtained, predictive modeling of the height of the Valsalva sinuses depending on anthropometric and age differences in men with severe aortic stenosis was performed.

Imaging Techniques

Computed tomography of the aorta with contrast enhancement (or computed tomography angiography, CTA). The examination was performed on 64 multidetector CT scanner LightSpeed VCT XT (General Electric, USA) with a scan type – helical 0.4 s; thick speed 3.75; interval 3.75 mm; tube voltage 80-120 kV and tube current (in mA) was adjusted to the patient size. CT examination was conveyed with ECG gating to follow a cardiac circle (Cardiac gating or ECG gated angiography in CT). Contrast material was Ultravist 470 (Bayer Healthcare, Germany) of 80-110 ml with the flow rate of 4 ml/s.

Data Analysis

CT images were post-processed at a dedicated CT workstation (General Electric, USA). The aortic root morphology was analyzed in the native (non-contrast phase), arterial and venous phases (after using contrast medium); axial cross-sections and multiplanar reformation. After the identification of the aortic root[2] annulus, sinus of Valsalva, and ascending aorta.\n\nResults\nThe study population comprised 80 men and 97 women (age: 82 ± 6 years, the evaluation was performed according to the Guidelines[7]. The height of the right coronary, left coronary and posterior sinuses of Valsalva, as well as the height of the right coronary artery (RCA) and the left coronary artery (LCA) orifices were measured.

Statistical Analysis

Continuous measures are presented in mean ± standard deviation (M ± SD). Comparison of the height of the sinuses of Valsalva and the height of the coronary ostia between the two groups was carried out with Student's *t* test. P-value of < 0.05 was considered significant. Correlation between variables was performed with Pearson's linear correlation method (r); multifactor regression analysis was calculated with Fisher test. To confirm the correctness of the developed model, the Durbin-Watson autocorrelation criterion was calculated. The statistical analysis was performed with SPSS (version 22.0, IBM Corp., Armonk, NY, USA).

Results

A total of 25 males with the severe aortic stenosis were included into the study. The mean age of patients was 58.48 ± 13.93 years. The results showed that the average height of the three aortic sinuses was almost at the same level (Table 1). While analyzing anthropometric data of men with severe aortic stenosis, it was noted that their height ranged from 1.60 m to 1.79 m, so the patients were divided into two groups by height: Group 1 (less than 1.7 m, average age 62, 46 ± 12.88 years, n = 13) and Group 2 (more than 1.71 m, average age 54.17 ± 14.28 years, n = 12). Comparison of the aortic root parameters based on the CT assessment in these groups showed significantly higher indicators of all studied vessels in men of the Group 2 than in men of Group 1 (Table 2).

Table 1. The average height of the sinuses of Valsalva and the height of the coronary ostia in men with severe aortic stenosis based on the CT results (M ± SD, mm).

Parameters	Male patients with severe aortic stenosis (n = 25)
Height of the posterior aortic sinus	21.95 ± 1.59
Height of the left aortic sinus	20.66 ± 2.38
Height of the right aortic sinus	21.10 ± 2.09
Height of the left coronary artery ostium, lower edge	11.91 ± 1.94
Height of the right coronary artery ostium, lower edge	12.71 ± 2.30
Height of the left coronary artery ostium, upper edge	16.78 ± 2.67
Height of the right coronary artery ostium, upper edge	17.01 ± 2.80

Table 2. Distribution of the aortic root parameters based on the CT results in two groups of men with severe aortic stenosis divided by height (M ± SD, mm).

Parameters	Group 1 (< 1.7 m) n = 13	Group 2 (> 1.71 m) n = 12	p
Height of the posterior sinus	21.46 ± 1.41	22.48 ± 1.67	0.12
Height of the left coronary sinus	19.62 ± 2.45	2.80 ± 1.76	0.02
Height of the right coronary sinus	20.32 ± 2.40	21.95 ± 1.31	0.04
Height of the left coronary ostium, lower edge	10.97 ± 2.00	12.93 ± 1.27	0.007
Height of the right coronary ostium, lower edge	12.4 ± 2.62	13.04 ± 1.95	0.49
Height of the left coronary ostium, upper edge	15.52 ± 2.15	18.14 ± 2.58	0.012
Height of the right coronary ostium, lower edge	16.69 ± 3.19	17.35 ± 2.41	0.56

A significant difference in these groups was proved based on the left side parameters of the aortic root: the height of the left aortic sinus – by 11.11% (21.80 ± 1.76 mm in men with severe aortic stenosis from Group 2, against 19.62 ± 2.45 mm in men from Group 1, p = 0.02), the height of the left coronary artery ostium – by 17.85% (12.93 ± 1.27 mm against 10.97 ± 2.00 mm, p = 0.007), the upper edge of the left coronary artery ostium – by 16.88% (18.14 ± 2.58 mm against 15.52 ± 2.15 mm, p = 0.012) respectively. There was also a significant difference between the value of the height of the right aortic sinus in the studied groups of men with severe aortic stenosis. This indicator was 8.02% higher in men from Group 2 (21.95 ± 1.31 mm) than in men from Group 1 (20.32 ± 2.40 mm), p = 0.04.

Given the significant differences in height in the studied men with severe aortic stenosis, it was considered appropriate to conduct Pearson's correlation analysis between anthropometric parametres and morphometric data. Significant correlations between the height and left side parameters of the aortic root were observed: positive moderate correlation with the height of the left aortic sinus (r = + 0.42, p = 0.04), the height of the left coronary artery ostium (r = + 0.49, p = 0.014), and the upper edge of the left coronary artery ostium (r = + 0.55, p = 0.004) (Table 3, Fig. 1, Fig. 2).

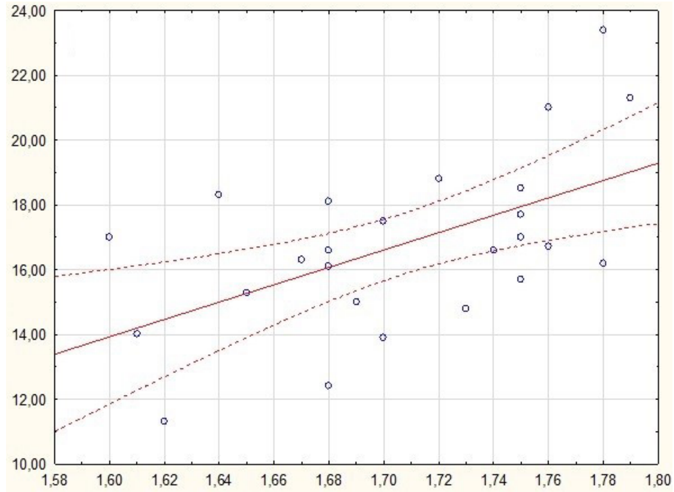

Figure 1. Correlation between the height (X axis) and the parameters of the upper edge of the coronary artery (Y axis) in men with severe aortic stenosis: r = 0.5538; p = 0.0041

Table 3. Data on the correlation (r) between the aortic root parameters, age and anthropometric parameters in men with severe aortic stenosis.

Parameters		Posterior SoV	Left SoV	Right SoV	LCAl	RCAl	LCAu	RCAu
Age	r	0.09	0.05	0.01	0.10	-0.09	-0.06	-0.06
	p	0.66	0.81	0.94	0.62	0.68	0.78	0.78
Height	r	0.34	0.42	0.29	0.49	0.22	0.55	0.14
	p	0.10	0.04	0.15	0.014	0.30	0.004	0.50
Weight	r	0.50	0.36	0.28	0.13	-0.10	0.18	-0.12
	p	0.012	0.08	0.17	0.53	0.62	0.38	0.57
BMI	r	0.38	0.23	0.19	-0.02	-0.19	0.01	-0.17
	p	0.06	0.26	0.36	0.91	0.37	0.95	0.42
BSA	r	0.49	0.40	0.29	0.18	-0.07	0.26	-0.09
	p	0.012	0.046	0.16	0.38	0.75	0.21	0.66
Posterior SoV	r		0.53	0.57	0.38	0.14	0.31	0.12
	p		0.006	0.003	0.06	0.51	0.13	0.58
Left SoV	r	0.53		0.69	0.58	0.24	0.61	0.40
	p	0.006		0.0001	0.002	0.24	0.001	0.046
Right SoV	r	0.57	0.69		0.58	0.56	0.53	0.71
	p	0.003	0.0001		0.002	0.004	0.007	0.0001
LCAl	r	0.38	0.58	0.58		0.27	0.89	0.35
	p	0.06	0.002	0.002		0.19	<0.0001	0.09
RCAl	r	0.14	0.24	0.56	0.27		0.23	0.88
	p	0.51	0.24	0.004	0.19		0.27	<0.0001
LCAu	r	0.31	0.61	0.53	0.89	0.23		0.32
	p	0.13	0.001	0.007	<0.0001	0.27		0.11
RCAu	r	0.12	0.40	0.71	0.35	0.88	0.32	
	p	0.58	0.046	0.0001	0.09	<0.0001	0.11	

Notes: Posterior SoV - Height of the posterior sinus; Left SoV - Height of the left coronary sinus; Right SoV - Height of the right coronary sinus; LCAl – Height of the left coronary ostium, lower edge; RCAl - Height of the right coronary ostium, lower edge; LCAu - Height of the left coronary ostium, upper edge; RCAu - Height of the rigft coronary ostium, upper edge.

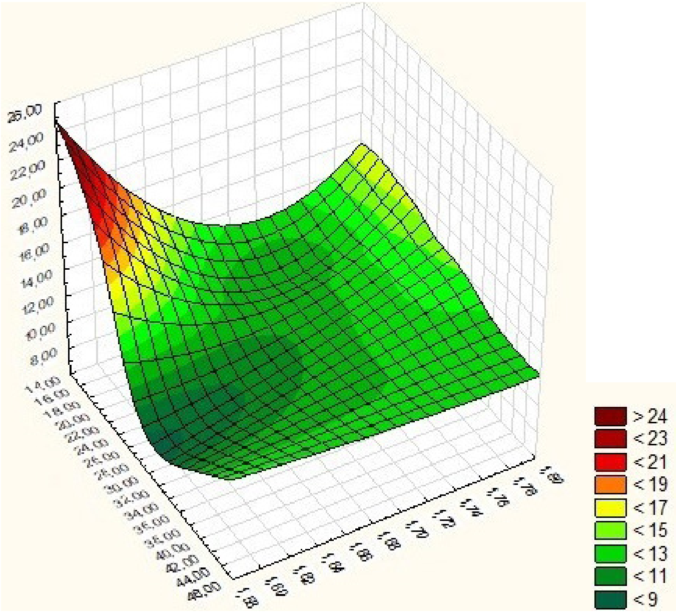

Figure 2. Correlation between height (X axis), BMI (Y axis) and the height of the left coronary artery (Z axis) in men with severe aortic stenosis

The results of correlation analysis of the morphometric parameters and weight showed a positive moderate correlation of weight only with the height of the posterior aortic sinus (r = + 0.50, p = 0.012) (Fig. 3). There was no significant correlation of the morphometric parameters on BMI (p > 0.05). However, there was a positive moderate correlation between BSA and the height of the posterior sinus of Valsalva (r = + 0.49, p = 0.012) and the left coronary sinus (r = + 0.40, p = 0.046).

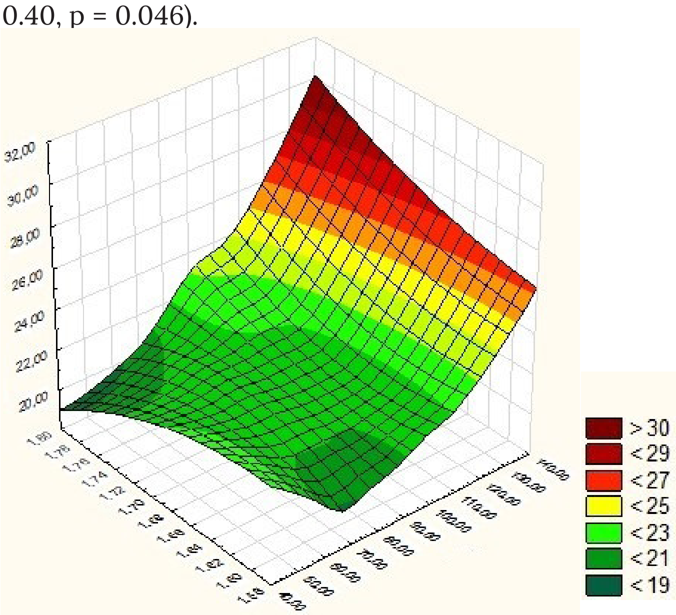

Figure 3. Correlation between height (Y axis), weight (X axis) and the height of the posterior aortic sinus (Z axis) in men with severe aortic stenos.

Assessing the correlations between the values of the parameters of the studied structures, it was found that the height of the right coronary sinus was directly dependent on all other morphometric parameters: r = from + 0.51 to + 0.71 with p < 0.001, which indicates an increase in all studied parameters of the aortic root with the increasing height of the right coronary sinus.

The value of the height of the left coronary sinus also positively correlated with almost all other parameters (except for the height of the right coronary artery): the correlation coefficient ranged from + 0.40 to + 0.69 with p < 0.05.

In addition to the aforementioned dependencies, other indicators of the aortic root parameters had the following positive strong correlation: the height of the left coronary artery ostium and the upper edge of the left coronary artery ostium (r = + 0.89, p < 0.0001), the height of the right coronary artery ostium with the upper edge of the right coronary artery ostium (r = + 0.88, p < 0.0001).

Having performed correlation analysis which showed the significant connections between anthropometric data and morphometric parameters based on CT data, we were prompted to conduct the next stage of the study, namely multifactor regression analysis between independent (anthropometric parameters) and dependent (morphometric parameters) predictors. As a result of this analysis, a proven average effect of anthropometric parameters on the height of the aortic sinus was established: R = + 0.68, with p = 0.029 (according to Fisher) and standard error of estimation of 1.32. In 31.5% of cases, these independent predictors affected the height of the posterior sinus (adjusted coefficient of multiple determination R2adj = + 0.315). To form a model for predicting the height of the posterior aortic sinus depending on anthropometric and age parameters, β-coefficients, which are shown in Table 4, were derived.

Table 4. Results of the logistic regression calculations for predicting the height of the posterior aortic sinus in men with severe aortic stenosis.

Parameters	Designated reference	β- coefficients	p
Constant		76.2797	0.12
Age	A1	-0.0069	0.78
Height	A2	-15.8136	0.59
Weight	A3	0.7942	0.03
BMI	A4	-1.0984	0.14
BSA	A5	-31.1868	0.09

In the given model the value of the weight index (p = 0.03), which has a direct impact on the height of the posterior aortic sinus, is significant, while other indicators have the opposite effect. To confirm the correctness of the developed model, the Durbin-Watson autocorrelation criterion was calculated (it was 1.612). Its value does not exceed the norm of 1.5-2.5 and confirms the reliability of the model.

Thus, the linear equation of logistic regression concerning the predicted height of the posterior aortic sinus in men with severe aortic stenosis is as follows:

Height of the posterior sinus = $-0.0069^{x}A1 - 15.8136^{x}A2 + 0.7942^{x}A3 - 1.0984^{x}A4 - 31.1868^{x}A5 + 76.2797$.

It is estimated that the average predicted value of the height of the posterior aortic sinus is 21.95 ± 1.10 mm (minimum value – 21.06 mm, maximum value – 26.43 mm), which is exactly the same as the actual average value of 21.95 ± 1.59 mm. A graphical representation of the normal probability of the influence of independent predictors on the predicted value of the height of the posterior aortic sinus is shown in Figure 4.

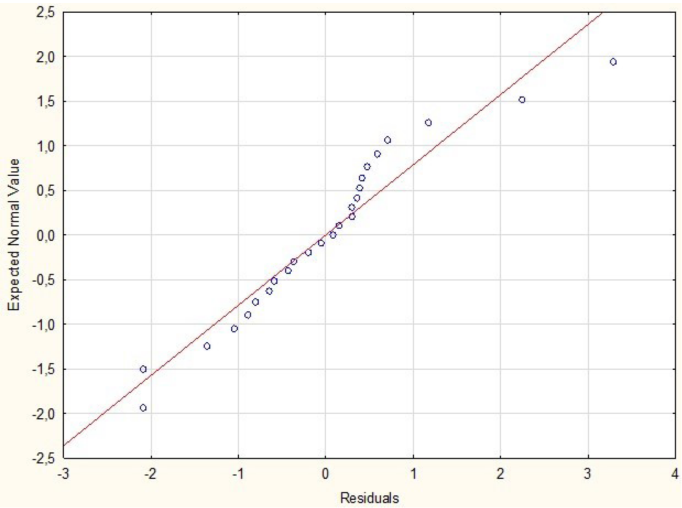

Figure 4. Normal probability of the predictors' influence on the predicted value of the height of the posterior aortic sinus in men with severe aortic stenosis
To establish the credibility of this logistic model, the calculations were made for two patients with different anthropometric and age parameters.

Example № 1. Patient № 1 in the database: male, 70 years old, height 1.70 m, weight 130 kg, BMI 42.45 kg/m2, BSA 2.51 m2. According to CT diagnostics, the height of the posterior aortic sinus was 26.7 mm. Having inserted the patient's data, we obtained a linear equation:

Height of the posterior sinus = $-0.0069x70 - 15.8136^{x}1.70 + 0.7942x130 - 1.0984^{x}42.45 - 31.1868^{x}2.51 + 76.2797 = 26.34$ mm

Thus, the predicte.d value differs only by 0.36 mm from the actual value obtained through CT diagnostics, which is much less than the margin of permissible error (5%).

Example № 2. Patient № 14 in the database: male, 50 years old, height 1.62 m, weight 80 kg, BMI 30.48 kg/m2, BSA 1.90 m2. According to CT diagnostics, the height of the posterior aortic sinus was 21.0 mm. Having inserted the patient's data, we obtained a linear equation:

Height of the posterior sinus = $-0.0069^{x}50 - 15.8136^{x}1.62 + 0.7942^{x}80 - 1.0984^{x}30.48 - 31.1868^{x}1.90 + 76.2797 = 21.19$ mm.

The predicted value differs by 0.19 mm from the actual value obtained through CT diagnostics, which is also significantly less than 5% of the margin of permissible error.

Thus, these examples prove the effectiveness of this model to determine the predicted value of the height of the posterior aortic sinus in men with aortic valve lesions.

The next dependent variable that had been analyzed by multifactor logistic regression was the height of the left coronary artery ostium. As a result, 4 independent predictors, which had a proven optimal effect on the vessel parameter, were identified: age, height, weight, and BMI. The regression coefficient was R = + 0.61, the adjusted coefficient of multiple determination R2adj = + 0.37, which shows the influence of these predictors in 37% of cases (p = 0.046, standard error 1.68). The calculated β-coefficients show the direct influence of age, height and BMI and the inverse effect of weight on the height of the left coronary artery ostium. The correctness of the developed model is confirmed by the Durbin-Watson autocorrelation criterion, which is 1.733 (within the norm) (Table 5). The linear equation of this model is the following:

Table 5. The results of logistic regression calculations for predicting the height of the left coronary artery ostium in men with severe aortic stenosis.

Indicators	Designated reference	β- coefficients	p
Constant		-76.4325	0.21
Age	A1	0.0581	0.058
Height	A2	50.5529	0.16
Weight	A3	-0.2654	0.41
BMI	A4	0.7264	0.43

Height of the left coronary artery ostium = $0.0581^{x}A1 + 50.5529^{x}A2 - 0.2654^{x}A3 + 0.7264^{x}A4 - 76.4325$

Based on the calculations, the average predicted value of the height of the left coronary artery ostium is 11.91 ± 1.18 mm (minimum value – 9.28 mm, maximum – 13.71 mm), which is identical to the actual average value of 11.91 ± 1.94 mm. A graphical representation of the normal probability of the influence of independent predictors on the predicted value of the height of the left coronary artery ostium is given in Figure 5.

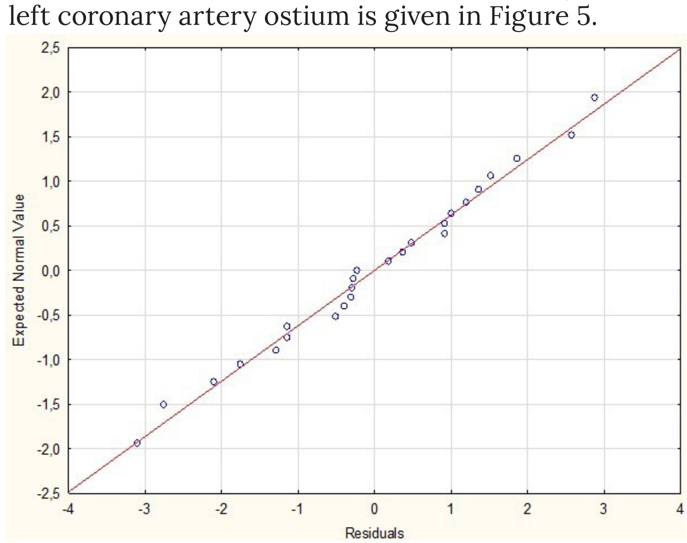

Figure 5. Normal probability of the predictors' influence on the predicted value of the height of the left coronary artery ostium in men with severe aortic stenosis

To establish the credibility of this logistic model, the calculations were made for two patients with different anthropometric and age parameters.

Example № 3. Patient № 13 from the database: male, 63 years old, height 1.61 m, weight 85 kg, BMI 32.79 kg/m2, the height of the left coronary artery ostium 9.37 mm. Having inserted the patient's data into the given linear equation of logistic regression, we obtained the following result:

Height of the left coronary artery ostium = 0.0581^{X}63 + 50.5529^{X}1.61 – 0.2654^{X}85 + 0.7264^{X}32.79 – 76.4325 = 9.88 mm.

The difference between the actual and estimated value is 0.51, which does not exceed the permissible 5% error.

Example № 4. Patient № 17 from the database: male, 28 years old, height 1.75 m, weight 83 kg, BMI 27.10 kg/m2, the height of the left coronary artery ostium 11.50 mm. Having inserted the patient's data into the given linear equation of logistic regression, we obtained the following result:

Height of the left coronary artery ostium = 0.0581^{X}28 + 50.5529^{X}1.75 – 0.2654^{X}83 + 0.7264^{X}27.10 – 76.4325 = 11.32 mm.

The estimated value of the height of the left coronary artery ostium of 11.32 mm is almost the same as the one obtained through CT assessment (11.50 mm), which proves in practice the effectiveness of the given model.

Having performed the calculations, we obtained another multifactorial regression model for predicting the value of the upper edge of the left coronary artery ostium in men with severe aortic stenosis depending on 4 predictors: age, height, weight, and BMI. The regression coefficient of this model is R = + 0.62, the adjusted coefficient of multiple determination R2adj = + 0.38, which indicates the influence of these predictors in 38% of cases. The reliability of the given indicators of the model is confirmed by Fisher confidence error (p = 0.040), and standard error (StEr = 2.305).

As a result of calculations of predictors' β-coefficients, the direct influence of age, height, BMI and the inverse influence of weight on the height of the upper edge of the left coronary artery ostium was established. The correctness and quality of the developed regression model is proved by the Durbin-Watson autocorrelation criterion, which is within the norm (1.591) (Table 6). The linear equation of this model is the following:

Table 6. The results of logistic regression calculations for predicting the height of the upper edge of the left coronary artery ostium in men with severe aortic stenosis

Indicators	Designated reference	β-coefficients	p
Constant		-131.301	0.12
Age	A1	0.046	0.26
Height	A2	85.717	0.09
Weight	A3	-0.515	0.25
BMI	A4	1.470	0.25

Upper edge of the left coronary artery ostium = 0.046^{x}A1 + 85.717^{x}A2 – 0.515^{x}A3 + 1.470^{x}A4 – 131.301

When performing calculations, the average predicted value of the upper edge of the left coronary artery ostium is 16.78 ± 1.65 mm (minimum value of 13.44 mm, maximum – 19.18 mm), which coincides with the actual average value obtained through CT assessment (16, 78 ± 2.67 mm). A graphical representation of the normal probability of the influence of independent predictors on the predicted value of the upper edge of the left coronary artery ostium is presented in Figure 6.

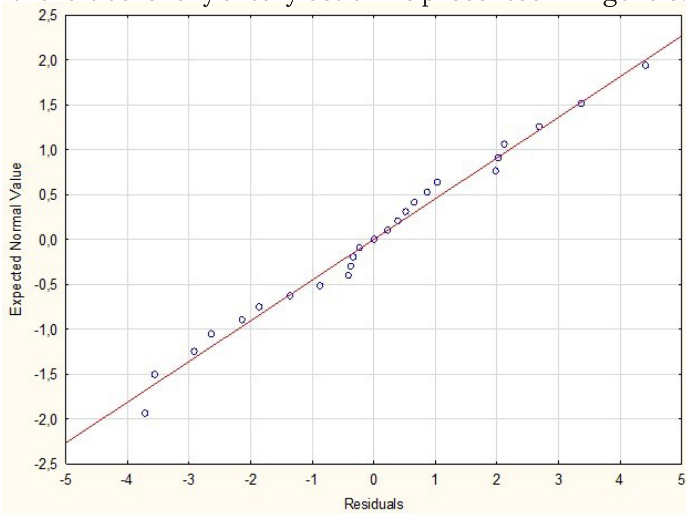

Figure 6. Normal probability of the predictors' influence on the predicted value of the upper edge of the left coronary artery ostium in men with severe aortic stenosis

To establish the credibility of this model, the calculations to obtain predicted values of the height of the upper edge of the left coronary artery ostium were made for two patients with different anthropometric and age parameters.

Example №5. Patient № 11 from the database: male, 43 years old, height 1.74 m, weight 96 kg, BMI 31.70 kg/m2, the height of the upper edge of the left coronary artery ostium based on CT assessment 16.60 mm. Having inserted the patient's data into the given linear equation of logistic regression, we obtained the following result:

Upper edge of the left coronary artery ostium = 0.046^{X}43 + 85.717^{X}1.74 – 0.515^{X}96 + 1.470^{X}31.70 – 131.301 = 16.96 mm.

Thus, we observe a minimum difference of 0.36 mm between the actual and estimated value, which is within the permissible 5% error.

Example №6. Patient № 25 from the database: male, 72 years old, height 1.65 m, weight 85 kg, BMI 31.22 kg/m2, the height of the upper edge of the left coronary artery ostium obtained through CT assessment 15.30 mm. Having inserted the patient's data into the given linear equation, we obtained the following result:

Upper edge of the left coronary artery ostium = 0.046^{X}72 + 85.717^{X}1.65 – 0.515^{X}85 + 1.470^{X}31.22 – 131.301 = 15.53 mm.

The obtained predicted level of the upper edge of the left coronary artery ostium is almost the same as the actual level of the ostium, with a minimum difference of 0.23 mm, which is within 5% of the permissible error; thus, it proves the effectiveness of the model.

Multifactor regression analysis of independent predictors (anthropometric and age indicators) and other dependent variables (morphometric indicators: the height of the left and right aortic sinuses, the height of the right coronary artery ostium and the upper edge of the right coronary artery ostium) did not prove significant correlation between these indicators in men with severe aortic stenosis: the multiple correlation coefficient R ranged from + 0.22 to + 0.53, the adjusted coefficient of multiple determination R2adj ranged from – 0.20 to + 0.10, with $p > 0.05$ (according to Fisher).

Discussion

Aortic root is a complex structure. State-of-the-art intervention on the heart, the ascending aorta, and the coronary arteries is performed in the aortic root segment. Many studies describe the anatomy of the Valsalva sinuses[9–11] and the coronary arteries[2,9,12,13] using different diagnostic modalities. Computed tomography is considered a "gold standard" in the assessment of aortic anatomy[7, 8].

Aortic stenosis is a common valvular heart disease[1]. According to the 2020 ACC/AHA Guidelines[8] severe aortic stenosis is defined as both asymptomatic (Stage C1, C2) and symptomatic (Stage D1, D2, D3). Severe aortic stenosis is typical in elderly people[2]annulus, sinus of Valsalva, and ascending aorta.\n\nResults\nThe study population comprised 80 men and 97 women (age: 82 ± 6 years. In our study the mean age of patients was 58.48 ± 13.93 years. The reason is that heart disease in Ukraine manifests itself earlier than in the countries whose data have been published before.

Anthropometric peculiarities affect the morphometric parameters of the aorta. The values of height, weight, body mass index, body surface area, and age among different population groups differ significantly1[4–16]. Estimation of morphometric parameters in the selected study groups allows for predictive modeling. The practical significance of modeling is the extrapolation of the results of theoretical research into clinical practice.

In our study we performed a morphometrical analysis of the height of the sinuses of Valsalva in male patients with severe aortic stenosis and tested the predictive modeling of the height of the sinuses of Valsalva based on anthropometric and age differences.

The findings of the study revealed that height of men with severe aortic stenosis ranged from 1.60 m to 1.79 m. It confirms the data that short people are more likely to suffer from cardiovascular disease than tall people (17, 18). The age of men in the first group (height up to 1.7 m) was 62.46 ± 12.88 years, while the second group (taller than 1.71 m) was 54.17 ± 14.28 years. The taller people were younger. The height of the posterior sinus, the right and left coronary sinuses and the coronary arteries ostia were higher in Group 2 (group of the taller patients). Consequently, a significant correlation was established between the height and the studied parameters of the left side of the aortic root: a direct medium strength connection with the height of the left aortic sinus and the height of the left coronary artery ostium. This is consistent with the correlation between height and diameter of different levels of the aorta[19].

In men with severe aortic stenosis, weight correlated only with the height of the posterior aortic sinus (direct medium strength connection). At the same time, no significant correlation was established with BMI and age. BSA correlated with the height of the posterior aortic sinus and the height of the left aortic sinus (direct medium strength connection). BSA did not correlate with the height of the coronary arteries. These findings might be consistent with the publications in which no correlation was found[20]. In addition, BSA has significant correlation with the aortic diameter in patients without heart valve disease[16, 21].

Correlation analysis showed significant correlation between anthropometric data and morphometric parameters based on CT assessment. Evaluation of the correlations showed that with the increasing height of the right and left aortic sinuses the height of the coronary arteries ostia increases as well.

Multifactor regression analysis was performed between independent (age, height, age,) and dependent (morphometric parameters) predictors. The reliability of the logistic model for defining the height of the posterior aortic sinus and the height of the left coronary artery ostium was confirmed. According to estimates, the average predicted values almost completely coincided with the actual average value which proves the effectiveness of the use of the given model for determining the size of the aortic sinus and the height of the left coronary artery ostium in men with severe aortic stenosis.

Multifactor regression analysis between anthropometric parameters, age and the height of the left and right aortic sinuses, the height of the right coronary artery ostium did not show any significant correlation.

Conclusion

In men with severe aortic stenosis, anthropometric peculiarities affect the morphometric parameters of the aorta. The height of the left aortic sinus, the height of the left coronary artery ostium and the height of the right aortic sinus is bigger in taller men with severe aortic stenosis. Height indicator is related to the height of the left coronary sinus and the height of the left coronary artery ostium. No significant connection was found with BMI and age. BSA correlated with the height of the posterior aortic sinus and the left aortic sinus, but it did not correlate with the height of the coronary arteries. The credibility of the logistic model use for predicting the height of the posterior aortic sinus and the height of the left coronary artery ostium was verified.

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