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RELATIONSHIP BETWEEN ANTHROPOMETRIC INDICATORS AND CORONARY OSTIA DIMENSIONS IN MEN

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The size of the coronary arteries is an essential parameter in assessing coronary anatomy, which depends on age and anthropometric indicators. However, there is limited data on the correlation between biometric indicators and coronary arteries' size among Ukrainian residents. The purpose of the study is to evaluate the size of the coronary ostia and study their correlation with age, height, weight, body mass index, and body surface area in men with and without coronary artery disease using coronary angiography. The study group consisted of 98 patients: 64 patients with and 34 patients without lesions of the coronary arteries (treated as healthy or within the norm). In patients with no coronary artery disease, the ostium of the left coronary artery is higher than that of the right coronary artery: 5.94±1.41 mm versus 5.09±1.36 mm, p=0.013. In men with coronary artery disease, the average parameters of the height of the left coronary artery (5.45±1.10 mm) are significantly more extensive than the height of the right coronary artery 4.91±1.05 mm (p=0.005). In the healthy group, a direct relationship of medium strength between the data of the height of the right coronary artery ostium and height was proven (r=+0.34, p=0.049), as well as an inverse relationship of medium strength between the value of the height of the right coronary artery ostium and age (r= -0.35, p=0.041). No correlation of age-anthropometric parameters with the value of the height of the ostium of the left coronary artery has been found. Relationships between the left coronary artery index and age, weight, and height have been established in men with coronary artery disease.

Key words: coronary angiography, coronary vessel, Ukraine, population, coronary artery disease, anatomy.

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ЗВ'ЯЗОК МІЖ АНТРОПОМЕТРИЧНИМИ ПОКАЗНИКАМИ ТА РОЗМІРАМИ ВІЧОК ВІНЦЕВИХ АРТЕРІЙ У ЧОЛОВІКІВ

Розмір коронарних артерій є важливим параметром в оцінці коронарної анатомії і залежить від вікових та антропометричних показників. Дані про кореляцію між біометричними показниками та розмірами коронарих артерій серед жителів України є обмеженими. Метою дослідження є оцінити розміри вічок вінцевих артерій та вивчити їхній взаємозв'язок між віком, зростом, масою, індексом маси тіла, площею поверхні тіла у чоловіків без та з ураженням вінцевих артерій (ішемічною хворобою серця) за допомогою коронарної ангіографії. Досліджувана група склала 98 пацієнтів: 64 пацієнти з ішемічною хворобою серця та 34 пацієнти – здорові. У групі норми висота вічка лівої вінцевої артерії встановлена вище ніж висота вічка правої вінцевої артерії: 5,94±1,41 мм проти 5,09±1,36 мм, p=0,013. У чоловіків з ураженням вінцевих артерій середні параметри висоти лівої вінцевої артерії (5,45±1,10 мм) є суттєво більшими, ніж висоти правої вінцевої артерії 4,91±1,05 мм (p=0,005). У нормі доведений прямий середньої сили взаємозв'язок між даними висоти вічка правої вінцевої артерії та зростом (r=+0,34, p=0,049), а також зворотній середньої сили зв'язок між значенням висоти вічка правої вінцевої артерії і віку (r=-0,35, p=0,041). У чоловіків з ішемічною хворобою серця встановлено взаємозв'язки між показником висоти вічка лівої вінцевої артерій та віком, вагою, зростом.

Ключові слова: коронарографія, вінцева артерія, Україна, населення, ішемічна хвороба серця, анатомія.

The study is a fragment of the research project "Morpho-functional features of organs in the pre-and-postnatal periods of ontogenesis under the influence of opioids, food additives, reconstructive operations and obesity", state registration No. 0120U002129.

Millions of coronary angiograms are performed in the world annually [11]. The size of the coronary arteries is an essential parameter in assessing coronary anatomy [5]. During percutaneous coronary interventions (PCI), the choice of stent size is based on the parameters of the coronary vessels [10]. In addition, preoperative planning of coronary artery bypass graft surgery (CABG) includes measurement of the coronary ostia.

Coronary artery parameters depend on age [11] and anthropometric indicators: height [2, 9], weight, body mass index (BMI) [7, 8], and body surface area (BSA) [4, 14]. Limited data are available on the correlation between biometric indicators and the size of coronary arteries among the residents of Ukraine. Therefore, the development of interventional cardiology in Ukraine [1] requires an analysis of intravital coronary anatomy. Results could be implemented in the daily practice of Ukrainian interventional cardiologists and cardiac surgeons when planning and performing coronary angiography, balloon angioplasty, stenting, and CABG.

The purpose of the study was to use coronary angiography to evaluate the coronary ostia dimensions and study their relationship with age, height, weight, body mass index, and body surface area in men with and without coronary artery disease.

Materials and methods. The study was conducted following the Declaration of Helsinki and approved by the University Bioethics Committee (protocol No. 10, December 20, 2021). All patients signed informed consent to participate in the study.

Male patients older than 18 years of age who had been scheduled for diagnostic coronary angiography were included in the study. We did not include patients after coronary artery bypass surgery, stenting and balloon angioplasty, valve replacement surgery, and operations on the ascending aorta (Bentall, David, Yacoub, etc., procedures) in the study. In addition, we excluded patients with identified congenital diseases, anomalies, and structural changes of the ascending aorta or coronary arteries. We recorded age, height, and weight based on which BMI and BSA were calculated (according to Mosteller). The study group consisted of 98 patients divided into two subgroups: 64 patients with lesions of the coronary arteries (CAD) and 34 patients without lesions of the coronary arteries (treated as healthy or normal).

Coronary angiography was performed on the Siemens Artis Zee Floor Eco angiograph (Munich, Germany). The radial artery was punctured under local anesthesia with 2 % lidocaine solution (Lekhim-Kharkiv, Kharkiv, Ukraine). An introducer, Radiofocus Terumo (Fujinomiya, Japan), of the required size was installed using the BMU Universal II Abbott guide (Abbott Park, Illinois, USA). Selective coronary angiography of the left and right coronary arteries was performed with Impulse Boston Scientific diagnostic catheters (Boston, USA). Contrast Ultravist 470 (Bayer, Germany) was used. The analysis, evaluation of images, and measurement of the size of the coronary ostia were carried out according to the described method [2] using Siemens software (Munich, Germany). Statistical analysis was performed using Student's t-test (comparison of mean values), and Pearson's linear correlation (r) (correlation between observed variables). We used the software R version 4.0.5 (R Core Team, 2021). The level of $p<0.05$ was considered reliable.

Results of the study and their discussion. We analyzed the data of 98 men, 34 of whom had no lesions of the coronary arteries (average age 60.50±10.87 years, height 1.76±0.08 m, weight 89.79±20.12 kg) and 64 with lesions of the coronary arteries (62.5±10.06 years, height 1.73±0.06 m, weight 85.33±14.31 kg). There were no anthropometric and age parameter differences between the two groups ($p>0.05$).

In men without lesions of the coronary arteries, a more excellent value of the height of the left coronary artery (LCA) ostium than the right coronary artery (RCA) ostium was proven: 5.94±1.41 mm versus 5.09±1.36 mm, p=0.013. In men with lesions of the coronary arteries, the average parameters of the height of the LCA were significantly more extensive (p=0.005) than the height of the RCA: 5.45±1.10 mm versus 4.91±1.05 mm, respectively. A comparison of the LCA and RCA ostia height in two groups showed slightly higher values in healthy men than in patients with CAD: the LCA ostium height by 8.95% (p=0.08), and the RCA ostium height by 3.71 % (p=0.50).

The Pearson's linear correlation analysis showed a proven direct relationship between the LCA and RCA ostia height (r=+0.27, p=0.030) in men with coronary artery disease (Table 1).

Table 1

Correlation data (r) of the studied parameters in men with coronary artery disease

Parameters		Age	Height	Weight	BMI	BSA	Height of RCA	Height of LCA
Age	r	-	-0.36	-0.28	-0.15	-0.30	0.07	-0.09
	p		0.003	0.023	0.25	0.015	0.60	0.46
Height	r	-0.36	-	0.53	0.12	0.65	0.17	0.10
	p	0.003		<0.0001	0.33	<0.0001	0.17	0.45
Weight	r	-0.28	0.53	-	0.91	0.99	0.08	0.20
	p	0.023	<0.0001		<0.0001	<0.0001	0.54	0.11
BMI	r	-0.15	0.12	0.91	-	0.83	0.01	0.19
	p	0.25	0.33	<0.0001		<0.0001	0.92	0.13
BSA	r	-0.30	0.65	0.99	0.83	-	0.11	0.20
	p	0.015	<0.0001	<0.0001	<0.0001		0.40	0.12
Height of RCA	r	0.07	0.17	0.08	0.01	0.11	-	0.27
	p	0.60	0.17	0.54	0.92	0.40		0.030
Height of LCA	r	-0.09	0.10	0.20	0.19	0.20	0.27	-
	p	0.46	0.45	0.11	0.13	0.12	0.030	

We established no significant pairwise relationships between age-anthropometric parameters and the data of the studied coronary arteries ($p>0.05$). However, in a comprehensive comparison of several researched factors, the direct dependence of the RCA ostium height on height and BSA (Fig. 1) and the LCA ostium height on the age and weight of the patient was established (Fig. 2).

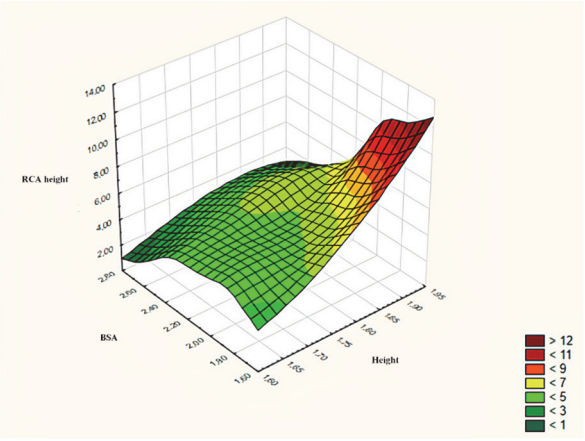

Fig. 1. Combined correlation between height, BSA, and the value of the RCA ostium height in men with coronary artery disease

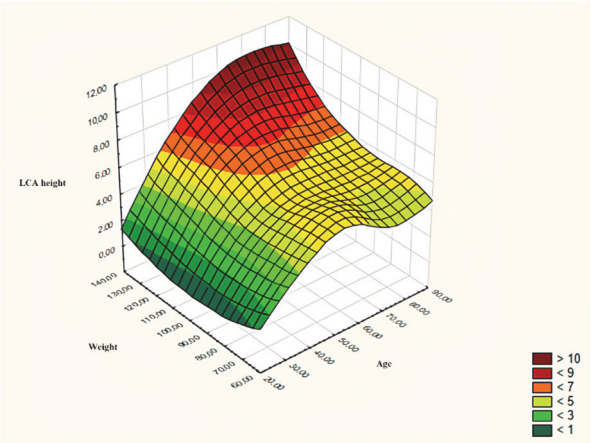

Fig. 2. Combined correlation between age, weight, and the value of the LCA ostium height in men with coronary artery disease

An inverse relationship between age and most anthropometric parameters was proven: height (r=-0.36, p=0.003), body weight (r=-0.28, p=0.023), BSA index (r=-0.30, p=0.015). The height index, in addition to age, was directly related to the weight indicators (r=+0.53, p<0.0001) and BSA (r=+0.65, p<0.0001).

The study of correlations between the same parameters in a group of healthy men (n=34) showed a proven direct relationship of medium strength between data on the height of the RCA ostium and height (r=+0.34, p=0.049), as well as an inverse relationship of medium strength between the RCA ostium height and age (r=-0.35, p=0.041) (Table 2, Fig. 3).

Table 2

Correlation data (r) of the studied parameters in healthy men

Parameters		Age	Height	Weight	BMI	BSA	Height of RCA	Height of LCA
Age	r	-	-0.34	-0.15	-0.02	-0.20	-0.35	0.02
	p		0.050	0.40	0.91	0.25	0.041	0.92
Height	r	-0.34	-	0.47	0.01	0.62	0.34	-0.05
	p	0.050		0.005	0.97	0.0001	0.049	0.77
Weight	r	-0.15	0.47	-	0.88	0.98	0.18	0.09
	p	0.40	0.005		<0.0001	<0.0001	0.31	0.62
BMI	r	-0.02	0.01	0.88	-	0.79	0.03	0.14
	p	0.91	0.97	<0.0001		<0.0001	0.87	0.42
BSA	r	-0.20	0.62	0.98	0.79	-	0.22	0.08
	p	0.25	0.0001	<0.0001	<0.0001		0.21	0.67
Height of RCA	r	-0.35	0.34	0.18	0.03	0.22	-	0.08
	p	0.041	0.049	0.31	0.87	0.21		0.65
Height of LCA	r	0.02	-0.05	0.09	0.14	0.08	0.08	-
	p	0.92	0.77	0.62	0.42	0.67	0.65	

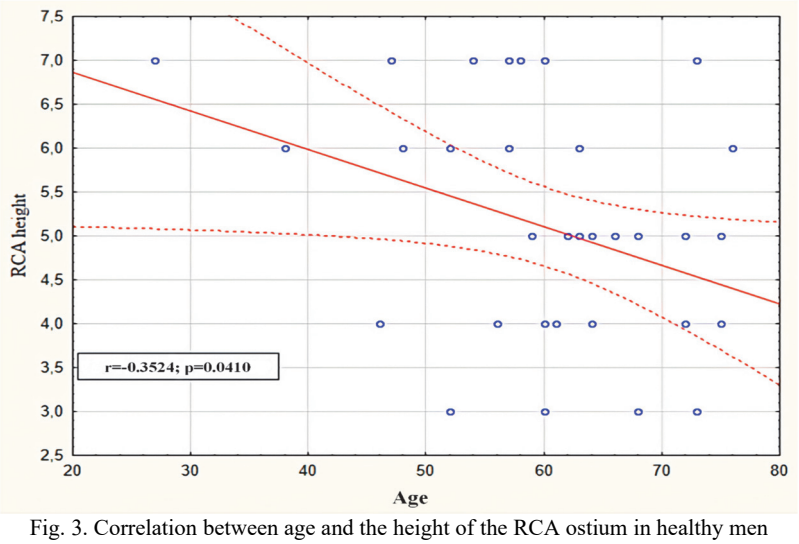

Fig. 3. Correlation between age and the height of the RCA ostium in healthy men

However, no correlation between age-anthropometric parameters and the value of the height of the LCA ostium was proven.

It was also revealed that combinations of several parameters affected the size of the ostia of both coronary arteries. Height and BSA values were most optimally associated with the RCA ostium height. The height of the LCA ostium was directly influenced by the combined values of the patient's age and height (Fig. 4).

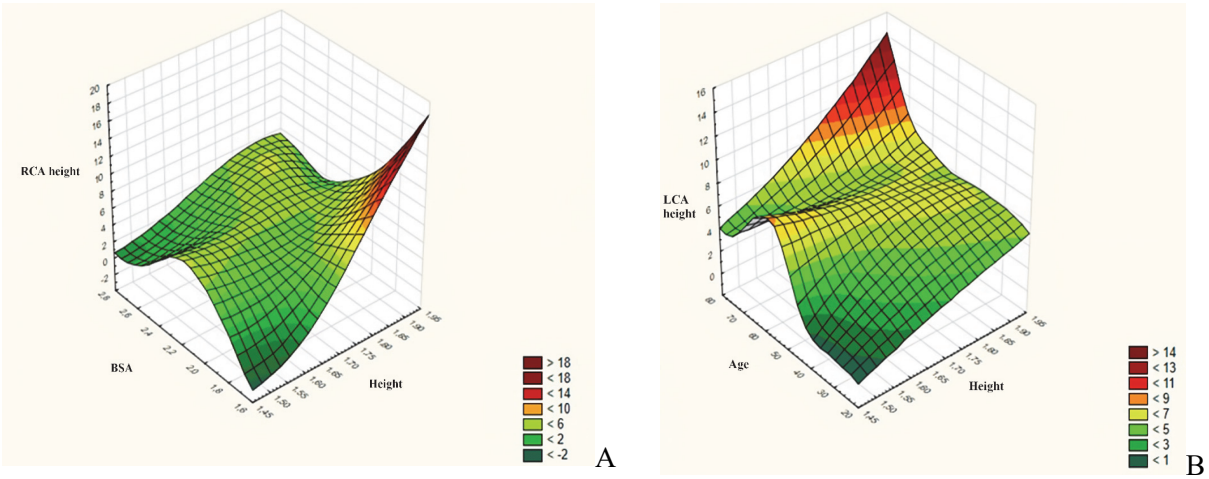

Fig. 4. A. Correlation between body surface area, height, and the right coronary artery ostium height. B. Correlation between age, height, and the left coronary artery ostium height in healthy men

Similarly, to men with coronary artery disease, in healthy men, an inverse relationship between height and age (r=-0.34, p=0.050) was established; a direct relationship between height and body weight (r=+0.47, p=0.005) as well as between height and BSA index (r=+0.62, p=0.0001) were proven.

In the given study, we showed that the size of the LCA ostium is larger than the size of the RCA in healthy men and in men with coronary artery disease. No statistical significance was found between the groups regarding the height of the coronary ostia. In both groups of men, an increase in the RCA height was associated with an increase in both height and BSA. In men without coronary artery disease, the RCA index decreases with age. In men with coronary heart disease, an increase in the LCA height is associated with increasing indicators of age and weight; height, body weight and BSA decrease with age. In healthy men, height decreases with age. A simultaneous increase in age and height impacts the increase in the LCA parameter.

According to the literature review, this is the first study on the relationship between the angiographic parameters of the coronary ostia and age-anthropometric indicators among men conducted in Ukraine. Thus, we can compare the received data only with the foreign studies. The size of the LCA is also larger among the residents of Europe [6], America [3], Africa [8], and Asia [10, 15]. Measurements of the height of the coronary arteries in our study are close to the measurements in Caucasian individuals and higher in comparison with Asian-Indians [6]. The obtained results support data on the relationship between height and cardiovascular events [2, 13]. It has been claimed that a reduction in height contributes to the development of cardiovascular events [14]. Interpretation of the effect of BMI on the cardiovascular system is changing. Obesity was previously thought to be a predictor of CAD, but recent evidence suggests that high BMI is only associated with an increased risk of cardiovascular diseases [7]. In the course of the study, we did not find evidence that BMI affects the size of the coronary ostia. At the same time, the correlation between the ostia height and age varied in the two groups. However, there is a belief that age does not affect the diameter of the ostia of the coronary arteries [3].

When analyzing the literature, we did not find data on the relationship between the height of the coronary ostia and age-anthropometric data among the residents of Ukraine. The results can be implemented in the daily practice of interventional cardiologists and cardiac surgeons when planning and conducting diagnostic and treatment procedures, i.e., coronary angiography, balloon angioplasty, stenting, and aortocoronary shunting.

The study is single-centred since it involves men mainly from the Western part of Ukraine. Extrapolation to the entire state requires the involvement of people from other regions of the country. Patients underwent diagnostic coronary angiography according to the indications, so even the absence of coronary arteries damage does not fully represent the statement “healthy”. When analyzing the published data, it is important to pay attention to the difference in the interpretation of the height of the coronary ostia in computer tomography, angiography, and intravascular ultrasound.

Conclusion

We established relationships between the height of the coronary ostia and age-anthropometric parameters in men with and without coronary artery disease in Ukraine. The size of the LCA ostium is larger than that of the RCA. The RCA height is associated with the increasing height and BSA. In men

without coronary artery disease, the RCA index decreases with age. In men with coronary artery disease, relationships between the LCA index and age, weight, and height have been established. The obtained data are important for interventional cardiologists and cardiac surgeons when planning and carrying out diagnostic and treatment procedures, i.e., coronary angiography, balloon angioplasty, stenting, and aortocoronary bypass.

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