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### **Epidemiological analysis of potential risk factors for abdominal aortic aneurysms - preliminary results.**

### **Analiza epidemiologiczna potencjalnych czynników ryzyka występowania tętniaków aorty brzusznej – wyniki wstępne.**

#### **Summary**

Abdominal aortic aneurysms are an important clinical problem due to both increasing the frequency of their occurrence and the occurring complications threatening the immediate loss of life. Risk factors for abdominal aortic aneurysm are: older age, sex, inherited tendencies, genetic predisposition, Ehlers Danlos syndrome, smoking, alcohol consumption, hyperlipidemia, atherosclerosis, hypertension, caucasian race, chronic obstructive pulmonary disease, ischemic heart disease.

The aim of the study was the assessment of the dietary habits and healthy and unhealthy behaviors of patients with abdominal aortic aneurysms and identify potential risk factors for this disease.

The investigated group consisted of all patients of Department of Vascular Surgery and Transplantology of Clinical Hospital of the Medical University in Białystok, diagnosed with an abdominal aortic aneurysm over the past 12 months. Assessment of the dietary habits and health behaviors of patients was carried out by using a diagnostic survey with an anonymous questionnaire, based on the recommendations of the Institute of Food and Nutrition and Cardiology Institute in Warsaw.

Half of people surveyed were overweight, and 15% were obese. Patients' BMI correlates with the size of the aneurysmal extension and the number of comorbidities. Only a small percentage of patients apply the principles of proper nutrition and admits that changing negative habits took place only after a diagnosis of the disease. Most people diagnosed with abdominal aortic aneurysm is or was addicted to nicotine and consumed alcohol in increasing quantities. All cases of abdominal aortic aneurysm coexisted with additional chronic disease entities. Most often reported were hypertension, atherosclerosis and heart failure.

**Key words:** abdominal aortic aneurysm, risk factors, healthy behaviours

### **Streszczenie**

Tętniaki aorty brzusznej stanowią ważny problem kliniczny, zarówno ze względu na coraz większą częstość ich występowania jak i na występujące powikłania zagrażające bezpośrednią utratą życia. Uważa się, że czynniki ryzyka tętniaka aorty brzusznej to m. in.: starszy wiek, płeć, skłonności dziedziczne, uwarunkowania genetyczne, zespół Ehlersa Danlosa, palenie tytoniu, spożywanie alkoholu, hiperlipidemia, miażdżycza zarostowa tętnic obwodowych, nadciśnienie tętnicze, rasa biała, przewlekła obturacyjna choroba płuc, choroba niedokrwienności serca.

Celem pracy było poznanie zwyczajów żywieniowych i zachowań pro- i antyzdrowotnych pacjentów z tętniakami aorty brzusznej oraz wskazanie potencjalnych czynników ryzyka tego schorzenia.

Badaniem objęci zostali wszyscy pacjenci Kliniki Chirurgii Naczyn i Transplantacji Szpitala Klinicznego Uniwersytetu Medycznego w Białymstoku ze zdiagnozowanym tętniakiem aorty brzusznej przebywający w Klinice w ciągu minionych 12 miesięcy. Ocena zwyczajów żywieniowych i zachowań zdrowotnych pacjentów została przeprowadzona metodą sondażu diagnostycznego za pomocą kwestionariusza anonimowej ankiety konstrukcji własnej, powstałego w oparciu o zalecenia Instytutu Żywności i Żywienia oraz Instytutu Kardiologii w Warszawie.

U połowy ankietowanych stwierdzono nadwagę, a u 15% otyłość. Wskaźnik BMI chorych koreluje z wielkością poszerzenia tętniakowego i ilością chorób współistniejących. Jedynie niewielki odsetek chorych stosuje się do zasad prawidłowego żywienia i przyznaje, że zmiana negatywnych nawyków żywieniowych nastąpiła dopiero po zdiagnozowaniu choroby.

Większość osób ze zdiagnozowanym tętniakiem aorty brzusznej jest lub była uzależniona od nikotyny i spożywała alkohol w zwiększonych ilościach. Wszystkie przypadki tętniaka aorty brzusznej współistniały z dodatkowymi przewlekłymi jednostkami chorobowymi. Najczęściej stwierdzane były nadciśnienie, miażdżycza i niewydolność krążenia.

**Słowa kluczowe:** Tętniak aorty brzusznej, czynniki ryzyka, zachowania zdrowotne

### **Introduction**

Abdominal aortic aneurysm (AAA) this is a baggy or spindly limited expansion of the aorta below the renal arteries in excess of at least 50% of the normal size of the artery. In practice it is a widening of the main artery above 30 mm (Johnson et al., 1991). Over 95% of the AAA are located below the renal arteries. Abdominal aortic aneurysms are an important clinical problem due to both increasing incidence and the occurring complications threatening the immediate loss of life. Aneurysms occur in about 2.5% of the human population. Aneurysm rupture is the cause of about 0.8% of all deaths in the world. Population-based studies in Europe have shown that the death rate from the disease is still high even in countries with a well developed health care system, despite the use of more sensitive diagnostic techniques (Peters i wsp., 2007; Svensjo i wsp., 1996).

Risk factors for abdominal aortic aneurysm can be divided into two groups. They are: independent agents, for example: older age, sex, inherited tendencies, genetic predisposition, Ehlers Danlos syndrome, Caucasian race. The second group are factors that can be modified, for example: smoking, alcohol consumption, hyperlipidemia, atherosclerosis, hypertension, chronic obstructive pulmonary disease, ischemic heart disease (Brady et al., 2004; Vega de Ceniga et al. 2006).

Unhealthy behaviors make up the lifestyle, that indeed, in more than 50%, determines the human health. Unhealthy habits can exacerbate the natural degenerative body changes, including those that occur in the arterial vessels. Accumulation of harmful effects of risk factors in a period of time and more frequent exposure promotes the degenerative changes, and therefore the risk of it increases with age.

Smoking is an important environmental factor having a negative impact on human health and is likely to play an important role in the progression of arterial changes. It is the source of many toxic substances, including nicotine, nitrosamines, cyclic hydrocarbons, heavy metals, nitric oxide, acetone, cyanide, ammonia, benzene, formaldehyde, vinyl chloride, radioactive elements. Smoking is a major source of cadmium that incriminates blood vessels and cumulates in blood. Exposure to tobacco smoke increases incidence of ischemic heart disease. It has a mitogenic effect on vascular smooth muscle cells, causes hypoxia and generates at the same time oxidative stress that contributes to the process of the destruction of tissues and cells that is important in the case of cells building the artery wall. It is estimated that smokers are four times more likely to initiate the aneurismal process. Aortic aneurysm is diagnosed approximately 8 times more common among active smokers and 3 times more common among ex-smokers than non-smokers. Smoking cigarette for a year increases the risk of an aortic aneurysm by up to 4%. In examined tobacco smokers it is claimed that increased elastolytic activity with reduced antiproteolytic activity at the same time initiates and significantly enhances the development of aneurysm (Lindhold et al., 2001).

Observance of the principles of proper nutrition, diet balanced in terms of energy and nutrients determines the proper functioning of the body. Unhealthy, rich in fat, causing hyperlipidemia diet significantly burdens the cardiovascular system and contributes to the generation of atherosclerotic lesions that damage the structure of the blood vessels making them more susceptible to deformation. For the element initiating aneurismal changes shall be deemed the deposition of fatty deposits that cause excessive load on the walls, which in turn hardens them and induces hypoxia. Accumulation of homocysteine (the source of which is food is the amino acid that is the product of the methionine demethylation) can lead to irregularities in the construction of the vessel wall and the same to aortic aneurysm enlargement. The accumulation of homocysteine in the walls of the arteries may have toxic effects and lead to abnormalities in the structure of the vessel wall, dissection, fibrosis and distortion of the arteries; it also causes excessive proliferation of smooth muscle cells of the artery. (Lindhold et al., 2001).

A properly balanced diet containing among others vitamins, provides a correct metabolism and homeostasis of the body's internal environment. Antioxidant vitamins - A, C and E play important functions in organism, for example a protective antioxidant role (Michota-Katulaska, 2000). Vitamin C is involved in the synthesis of collagen, which is essential for pathogenesis of aneurysm, and also facilitates the absorption of iron. In addition, stimulates the immune system, the metabolism of lipids and participates in the biosynthesis of catecholamines. Vitamin C deficiency leads to damage in the blood vessels, spontaneous bleeding, formation of ecchymoses beneath the skin and hinders wound healing. What is more, causes joint and muscle soreness, swelling of the limbs, weakness, and reduction of physical exercise capacity. In terms of prevention of cardiovascular disease, the role of vitamin C seems to be not to overestimate (Jacob, Sotoudeh, 2002; Rutkowski et al., 2010).

An important factor in the development of aneurysm is hypertension. It increases the risk of developing structural and functional changes in vascular system. In people with long-term illness incidence of aneurysm may increase more than two-fold. Blood pressure affecting the abdomen section of the aorta wall is always higher than in the other sections of the aorta. High blood pressure causes the increase in stress in the wall of the aneurysm, accelerates its expansion and increases the risk of rupture. High blood pressure also increases the processes leading to the degradation of collagen and elastin.

An important issue when discussing risk factors is undoubtedly the presence of comorbidities, that additionally burdens organism and hinders the regenerative processes of the body. High risk of aneurysm incidence is also the effect of chronic inflammation with lymphocytes, plasmacytes, monocytes and macrophages predominated, which is a consequence of bacterial infections, for example in the course of heart disease. Inflammatory cells are the source of proteolytic enzymes that degrades extracellular matrix proteins and results in the formation of an aneurysm. Secondary infection with bacteria can also initiate rupture of the aneurysm. Also important is the role of the infection of *Helicobacter Pylori* and *Chlamydia Pneumoniae*. Other micro-organisms that can play a role in the pathogenesis of aneurysm is Herpes Simplex Viruses and Cytomegalovirus. They can initiate processes associated with elastin degradation.

Another important risk factor of AAA is genetic predisposition. A high percentage of patients has a positive family history in terms of this disease. The cause of the lesions is considered gene mutations responsible for structural construction of the aorta. These mutations may cause the disappearance of various proteins of the aorta and disturb the balance in the hemostatic process. The cause of congenital aneurysm is considered genetically conditioned diseases such as Marfan syndrome and Ehlers-Danlos syndrome. In the majority of patients predisposition to the development of aneurysms is multigenic. Genetic factor is an independent risk factor, it occurs in about 25% related people with abdominal aortic aneurysm (Singh et al., 2001).

Expanding abdominal aortic aneurysm often does not cause any symptoms. This fact significantly impedes early diagnosis and effective treatment for this disorder. For this reason, such a large role in reducing the incidence of abdominal aortic aneurysms is attributed to prevention of this disorder consisting of minimizing negative impact of modifiable risk factors.

### **Material and research methods**

The investigated group consisted of all patients of Department of Vascular Surgery and Transplantology of Clinical Hospital of the Medical University in Bialystok, diagnosed with an abdominal aortic aneurysm over the past 12 months. This group comprised 20 people-19 men and 1 woman.

The assessment of the dietary habits and health behaviors of patients was carried out by using a diagnostic survey with an anonymous questionnaire, based on the recommendations of the Institute of Food and Nutrition and Cardiology Institute in Warsaw. The survey questionnaire consisted of 4 parts (68 questions). The first part included questions about demographic data of the patient, where they were asked of age, sex, residence, education. Dietary habits before the period of hospitalization were

analyzed in the second part. Part three dealt with health behaviors, for example: physical activity, smoking of cigarettes, alcohol consumption, and part four concerned abdominal aortic aneurysm and comorbidities.

Respondents have been informed about the purpose of the test and the anonymity of the data obtained and of the possibility of withdrawal of consent for a further part in the test without giving reasons on each stage of the duration of the test. For the implementation of the project the local Ethics Committee on the Medical University of Bialystok approval has been obtained.

The aim of the study was the assessment of the dietary habits and healthy and unhealthy behaviors of patients with abdominal aortic aneurysms and identification of potential risk factors for this disease.

### An overview of research results

In the test group, the majority were men. The age of respondents was in the range of 47 to 84 years. average age amounted to 68.5 years (SD 9.40). The most numerous was the group aged 60-69 years, 45% of respondents. The least the presence of an aneurysm was observed in the age group below 49 years.

Half of those surveyed were overweight-BMI above 25 and at 15% of obesity. This indicator was correlated with the size of the aneurismal extension and the number of comorbidities. The vast majority of patients lived less than 20 thousand residents have basic education or basic vocational training and by most of his life doing the hard work. Detailed description of the test group is set out in Tab. 1.

Tab. 1. Characteristics of the test group.

Feature		Number of re- spondents (n)	%*
Age	40-49	1	5
	50-59 (avg 58.0)	2	10
	60-69 (avg 65.2)	9	45
	70-79 (avg 74.4)	5	25
	>80 (avg 83.0)	3	15
	TOTAL (avg 68.5)	20	100
BMI**	<18.50	0	-
	18.50 – 24.99 (avg 23.3)	7	35
	≥ 25.00 (avg 27.9)	10	50
	≥30.00 (avg 35.6)	3	15
	Total (avg 20.4)	20	100

Place of residence	< 20000 residents	11	55
	>20000 < 50000	1	5
	>50000 < 150000	2	10
	>150000	6	30
Education	Basic and/or vocational basic	9	45
	Secondary	8	40
	Higher	3	15
Professional activity	Yes	5	25
	Unemployed	0	0
	Retired	11	55
	Pension	4	20
Work done for most of one's life	Intellectual work	7	35
	Intellectual-physical work	3	15
	Physical	10	50

\* - percentage of respondents.

\*\* - according to WHO - [http://apps.who.int/bmi/index.jsp?introPage=intro\\_3.htm](http://apps.who.int/bmi/index.jsp?introPage=intro_3.htm)

Another part of the survey questionnaire included questions concerning the dietary habits. Seventy-five percent of respondents say that they eat regular meals (Tab. 2), and 60% of them say that they consume 4 meals a day: breakfast, lunch, dinner and supper. Unfortunately, most of the respondents admit they began to take care of their nutrition hygiene only after the disease was diagnosed. For breakfast, which eat 100% of the people interviewed, mostly white bread was eaten (83% of those polled), ham (60%) and dairy products - milk, cheese, semi-fat cottage cheese (72%). Lunch consisted of mostly fruits (apples, bananas) – 87% of eating this meal. For dinner, respondents consumed mainly food containing pork - 80% of the people interviewed, poultry 75% and beef 30%. For the second dish mostly potatoes were added - 90% of patients. Salad with fresh vegetables was eaten by only 40% of the polled. Seventy percent of patients said they prepare lunch menu, using full-fat products. Afternoon tea, which was eaten by only 20% of hospitalized included fruit – 75% and sweets and sweet bread - 25%. For dinner (100% of respondents) were given the mostly dairy products - 74% of those polled. Unfortunately, 15% said that their dinner contained of fat meat dishes. Seventy percent of the interviewers snack between meals. These are mostly salty snacks and sweets (tab. 3). Unfortunately, only 15% of patients eat daily fresh fruits and vegetables rich in vitamin C (tab. 2), such as cranberries, kiwi, citrus fruits, black currant tomatoes, pepper, and parsley.

Most people surveyed complement detrimental effect on their health of a high supply of white sugar used to sweeten beverages – 60% of the respondents. A significant group of people sweetened them up with three tea spoons. For a sweetened drinks such as Cola, soda, fruit juice reach 45% of those polled, and still mineral water in amount of 1.5-2 liters per day - 30%.

Tab. 2. The selected health behavior

Feature	Regular meals consumption			Consumption of Vitamin C rich fruits and vegetables		Physical activity				
	Yes	No	Rarely	Yes	No	None	Once a week	Twice a week	4-5 times a week	6-7 times a week
Number	15	5	0	3	17	9	4	4	3	0
%	75	25	-	15	85	45	20	20	15	-

Respondents were also asked about their health behavior concerning the frequency of alcohol consumption, cigarette smoking, or taking physical activity. Thirty-five percent of respondents strongly abused alcohol (daily intake). In an AAA patients group there has been no abstainers -Tab. 3. The most frequently chosen alcohols were vodka and beer (respectively to 85% and 45% of those polled). Cigarettes smoked more than half of the surveyed, 40% quit after the aneurysm was diagnosed, and only one person (female) has never smoked cigarettes.

Until hospitalization active lifestyle led 55% of respondents. Most of them worked in the garden/the field -73%. The preferred active form of relaxation was walking.

Tab.3. The selected anti-health behaviour

Feature	Snacking between meals				Alcohol intake					Smoking		
	No	Carbohydrate-rich foods	Products containing large amounts of salt and fats	Fruits/vegetables	None	Occasionally	Once a week	A few times a week	Daily	Yes	Ex-smoker	Never
Number	6	13	14	5	0	5	3	5	7	11	8	1
%	30	65	70	25	0	25	15	25	35	55	40	5



Tab. 4. Health behaviors and the size of the aneurysmal expansion and co-morbidities.

Feature		The size of aneurysmal extension (average and SD)	n	The number of co-existing diseases				
				None	1-2		≥ 3	
					n	%*	n	%*
Alkohol intake	Rarely	73,25 (22.56)	12	0	5	41.7	7	58.3
	> 2 times a week	81.58 (16.12)	8	0	4	50.0	4	50.0
Smoking	Never	60 (-)	1	0	1	100.0	-	-
	Yes	85.36 (19.21)	11	0	4	36.4	7	63.6
	Ex-smoker	70.75 (13,31)	8	0	3	37.5	5	62.5

\* - percentage of consuming alcohol rarely/ >2 a week; and percentage of non-smokers, smokers and ex-smokers

All patients were diagnosed with at least one co-existing disease. **Most frequently diagnosed chronic** diseases were hypertension, atherosclerosis, and heart failure (70%, 65% and 60%). The least frequently stated diseases were kidney and gastrointestinal tract diseases - the two cases. None of the patients was diagnosed with reduced blood pressure. The relationship between the frequency of alcohol consumption, cigarette smoking and co-existing diseases shows Tab. 4.

The average size of the aneurysmal enlargement was 78.25 mm (SD 18.85) and correlated with increased consumption of alcohol and tobacco addiction – Tab. 4.

## Discussion

Age is one of the main factors predisposing to abdominal aortic aneurysm. Since the majority of aneurysms of this part of the aorta are asymptomatic it is very difficult to determine the average age at which the first lesions appear. Despite the use by researchers of different definitions of the aneurysm, in most studies the increase in the frequency of their occurrence in people over 60 years of age was observed. Screening ultrasound showed the presence of AAA in 4.4% of people aged 40-75. In the autopsy and screening epidemiological studies prevalence among people under 60 years of age is less than 1 percent. AAA occurs in about 3% of men aged 60-65, 6% aged 65-74 and 9% aged 75 and older. In people over 80 years of age prevalence increases rapidly and reaches a plateau level (Simoni et al, 1995; Pateci et al, 1995).

Abdominal aneurysms are diagnosed up to eight times more often in men than in women. This predominance depends on the age group. Incidence of AAA in men increases rapidly after age 55. The highest incidence among women i.e. 4.5% was found in the population over 90 years of age. Ratio of male to female patients between the ages of 60 to 64 years is 11: 1. Statistical studies on mortality records also showed higher mortality in men than women (Lilienfeld et al, 1987).

Association of obesity with the presence of abdominal aortic aneurysm is not completely proven, but Stackelberg and co-workers on the basis of population-based studies conducted in Sweden found that the risk of AAA was 30% higher for individuals with increased waist circumference than those with normal size waist. It was also shown that the risk of AAA was increasing by 15% along with the increase of waist circumference for each 5 cm. In

these studies, there was no clear relationship between body mass index and the prevalence of abdominal aortic aneurysm, however, the relationship of abdominal obesity in the incidence of the disease was proven (Stackelberg et al, 2013). Golledge and colleagues have also noted a positive correlation between anthropometric indicators of obesity, such as waist circumference and the waist-hip ratio with the size of aortic dilatation. They argue that this relationship is particularly evident in cases where the extension is more than 40 mm. They also show the dependence of serum adiponectin and resistin, and no connection of leptin with the aneurysmal extension (Golledge et al, 2007).

Overweight and obesity is closely associated with abnormal eating habits of the patients. Eating food products containing high amounts of saturated fatty acids and salt contributes to an increased risk of cardiovascular disease, and thus the dredging of the disease and worse prognosis after surgery (Golledge et al, 2007).

Not without significance is the fact of interaction of several risk factors at the same time. Especially when the exposure is chronic. Back in the 50's of the twentieth century were conducted prospective studies that have shown a high correlation between the formation of abdominal aortic aneurysm and smoking and high blood pressure, or these two factors simultaneously. In patients with AAA smokers were 85%. (Johnson, Scobie, 1988).

Jozwiak and colleagues in their study also confirm the association of smoking with risk of cardiovascular disease. They claim that nearly 80% of smoking respondents reported hypertension, and most of the patients with hypertension are ex-smokers (Jozwiak, Szmagaj, 2012). This fact and its possible connection with the development of an aneurysm suggest the results of this work, where the majority of the respondents declared that either now or in the past were addicted to tobacco. In studies on the pathogenesis of atherosclerosis and abdominal aortic aneurysm Pallazouli et al also confirm the connection of the presence of nicotine addiction with aneurysmal abnormalities (Pallazouli et al, 2008).

A heavy burden for patients with abdominal aortic aneurysm is the coexistence of additional diseases. The majority of patients with AAA tend to fall for a few disease entities. In patients with diagnosed AAA coronary heart disease was found in 33% to 68% of patients (Cronenwett et al, 1995), impaired cerebral circulation in 20% of people, and with symptoms of chronic lower limb ischemia in 25% of patients. Hypertension may also contribute to the formation of aneurysms, mainly by permanent mechanical deformation of the aortic wall. The forces which arise as a result of high blood pressure cause a violation of the structural integrity of the aortic wall, which in combination with other factors, leads to abnormalities of the aorta and can also cause the aneurysm (Tilson, 1992)

In this paper only the preliminary results were presented. The continuation of the research will identify unhealthy behaviors that contribute to the onset and development of abdominal aortic aneurysm. This could contribute to the formulation of recommendations aimed at reducing negative effects of factors that predispose to the disease, especially those at greatest risk. Education in the field of the negative effects of unhealthy behaviors and avoiding them could improve the prognosis of the patient in the course of therapy and improve postoperative recovery.

### **Conclusion**

1. Excessive body weight is associated with the presence of an abdominal aortic aneurysm. Half of people surveyed were overweight, and 15% were obese. Patients' BMI correlates with the size of the aneurysmal extension and the number of comorbidities.
2. Only a small percentage of patients apply the principles of proper nutrition and admits that changing negative habits took place only after a diagnosis of the disease.
3. Patients consume few products that are a source of vitamin C, which is attributed to the protective antioxidant effect and participates in the synthesis of collagen, which is important for the pathogenesis of aneurysm.
4. Most people diagnosed with abdominal aortic aneurysm is or was addicted to nicotine and consumed alcohol in increasing quantities. These patients had an increased diameter of the aneurysmal enlargement compared to those consuming less alcohol and non-smokers.
5. Increased body weight and unhealthy behavior, such as smoking, alcohol abuse and improper eating habits can be the effect of ignorance about their dangers and lead to the formation and progression of abdominal aortic aneurysms.
6. All cases of abdominal aortic aneurysm coexisted with additional chronic disease entities. Most often reported were hypertension, atherosclerosis and heart failure. This suggests that the cocurrence of these diseases takes part in the intensity of the progression of degenerative changes and the formation of aortic aneurysm.

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