

DOMINANCE OF CORONARY ARTERY DISEASE AMONG PATIENTS WITH ANEURYSM OF ABDOMINAL AORTA

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Persons with aneurysm of the abdominal aorta have high prevalence of risk factors of cardiovascular disease. It cannot be stated with certainty whether these persons die in a large number due to the existence of risk factors or the genesis and complications of aneurysm itself. In patients with aneurysm of the abdominal aorta, there is a high correlation with the coronary artery disease; therefore, the aim of the study was to prove whether or not this is the case. The patients in preparation for the resection of the abdominal aorta aneurysm at the Institute of Cardiovascular Disease underwent the examination. The study included 377 examinees, of whom 341 males and 36 females, aged 45 to 83 years, during the three-year interval (from 2004 to 2006). The aim of the study was to determine the dominance of the coronary artery disease among the patients with aneurysm of the abdominal aorta. In the process of analyzing the data obtained from patients and medical evidence, it was found out that a large number of the abdominal aortic aneurysm patients were at the same time the coronary artery disease patients (55,2%; $H_i=15,04$; $p<0,05$). A large number of those who still have some other risk factors for the genesis of the disease belonged to the same group. Of the total patient number with the coronary artery disease, the percentage of males was larger (85%). The number of smokers with the coronary artery disease was larger (60%), while the number of former smokers (28%) was almost equal to the number of non-smokers (12%). The number of patients with increased body mass (>80 kg) was larger, as well as the percentage of patients with hypertension (89%) and increased levels of cholesterol and triglycerides (67%). There was a great number of those with the inherited factor (40%). It has been proven that the risk factors for the development of coronary artery disease are in direct association with the risk factors for the abdominal aortic aneurysm. Also, there is a great predominance of the coronary artery disease among the patients with aneurysm of the abdominal aorta. The coronary artery disease is one of the main risk factors. If we managed to prevent the appearance of this disease or achieve the timely diagnosing of it and eventual curing, we would be able to decrease the development of the abdominal aortic aneurysm well as the consequences and further complications. *Acta Medica Medianae 2007;46(4):20-25.*

Key words: abdominal aortic aneurysms, risk factors, coronary artery disease

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Introduction

Under the Abdominal Aortic Aneurysm we understand permanently localized aortic dilatation of at least 50 % concerning normally expected aortic diameter. The Abdominal Aortic Aneurysm (AAA) is still one of the most leading mortality causes for patients aged over 65 years and is responsible for a large number of death incomes due to its rupture. Until the development of vascular reconstructive surgery patients that had AAA were under greatest risk of bleeding out.

The first successful surgery method of repairing AAA was introduced by Dubost in 1952, introducing artery homograft (Table 1).

Abdominal Aortic Aneurysm is very frequently called 'the silent killer' because it develops without symptoms. It can be very large, except when there is a catastrophic income, i.e. its rupture.

AAA can also be small and without symptoms. It is most commonly detected during regular ultrasound examinations, or ultrasound examinations for other reasons. AAA can be as well accompanied with symptoms which most commonly are an early filling, nausea, vomiting, urinary symptoms, vein (vascular) thrombosis, back pains, limb ischemia, the feeling of stomach pulsation, or the doctor can detect the pulsation mass by touch. One of the most important ways of this illness manifestation is its rupture which lead to a death income in 95% of cases. It is manifested as back pains, flank (side) or abdominal pains, the sensation of stomach pulsation,

and shock. Bleeding that occurs in the retroperitoneal cavity can be with better income because it causes its own tampon, but unfortunately this happens in only 20% of cases. This manifestation demands an urgent surgical intervention. The income of this kind of treatment is far more unfavorable compared to the incomes of surgically treated unruptured aneurysms (Tables 1,2).

There is a large number of theories that can explain the genesis of this illness. All of these theories explain it within the group of people that have some common characteristics, and all of these people have some risk factors that are important for the genesis of this disease. Risk factors that lead to the development of AAA are: age, sex, time tendency, smoking, high blood pressure, the level of lipids and lipoproteins, the level of creatinine, height, weight, diabetes, chronic obstructive lungs disease, coronary disease and genetic factors. The coronary artery disease is in a large number found in the patients suffering from AAA. It still remains a basic death cause after vascular reconstruction. Today there are new theories that explain the genesis of AAA, that do not only include the process of arteriosclerosis. None of them excludes the importance of coronary artery disease; they really increase the rate of disease development from AAA in the patients that have a string of common risk factors within the population of elderly people. Preventing these two diseases by investigating these risk factors and their management we can reduce the development of these diseases, prolong and improve the life quality of the patients (Tables 3,4 and 5.)

Aims

The aim of this study was to investigate the frequency of the coronary artery disease in the patients suffering from AAA. The intention was to evaluate its etiological importance and to investigate potential variable determinants which can be developed into preventive and therapeutic strategies.

Material and methods

This study prospectively included a three-years period (from January, 2004 to December, 2006). We evaluated the patients suffering from AAA, hospitalized and operated by conventional method of endoaneurysmography at the Institute for Cardiovascular Diseases "Dedinje" in Belgrade. This study included 337 patients divided by sex. The study group was also divided into patients with ruptured and unruptured aneurysms. Patients with the lethal income represented, concerning mortality analyses, a separate group.

Basic methods that were used were anamnestic data, clinical examinations, laboratory and functional diagnostics. From the anamnestic data we got the information concerning sex, age, present or previous smoking, present or past using of the antihypertensive therapy, the presence of diabetes, coronary disease, genetic predetermination, chronic obstructive lung disease, prior brain infarction. Clinical examinations included

standard height and weight measuring, blood pressure, aneurysm palpation, establishing the existence of the carotid noise. The height and weight were measured without clothes on, only in hospital pyjamas; blood pressure was measured in all of the patients with the same instrument by medical technicians. Hypertension was defined as the elevation of systolic pressure above 120 mm Hg and the diastolic pressure above 80 mmHg.

Aneurysm palpation was performed by department doctors and was given in centimeters. Laboratory diagnostics was used for the establishing of the level of triglycerides and cholesterol, creatinine and glucose. Normal values of triglycerides are <1.70mmol/l, cholesterol <5.20mmol/l, creatinine 50-110 μ mol/l, glucose 4.2-6.4mmol/l. Functional diagnostic was conducted for the reason of determining the existence of coronary disease and AAA. For those purposes the following techniques were used: electrocardiogram (ECG), exercise tests, echocardiogram, Color Doppler of the coronary blood vessels, computerized tomography (CT), magnetic resonance (MR) and arteriography.

Coronary artery disease was determined as myocardial infarction, angina pectoris, coronary bypass surgical intervention or the existence of the coronary vessels' stenosis perceived during coronary angiography. Electrocardiogram was taken as pathological if there were present: ST segment depression, ST segment elevation, presence of the Q peak or QS abnormalities. The diagnosis of the coronary artery disease was determined based on positive anamnesis of the myocardial infarction or angina pectoris, presence of the typical Q peak on the ECG, positive stress test or the existence of the coronary vessels' stenosis on the angiogram. Color Doppler was routinely used. In cases of higher levels of carotid artery stenosis, endarterectomy was performed first.

AAA is defined as the abdominal aortic dilatation for more than 3.5 cm. For the reason of determining the dimensions and existence of AAA there were several methods conducted, starting with clinical examination, ultrasound examination, CT, MR and arteriography. The largest number of diagnoses was established by using CT. Based on CT we could certainly detect its existence, dimensions, location and form, contact with other organs.

In the paper, all the necessary statistical methods were used, and the obtained results were presented in tables and graphs.

Results

The total number of patients suffering from AAA in this research was 377. They were divided according to the presence or absence of coronary artery disease. Out of the whole number there were 208 patients suffering from artery coronary disease and 169 who did not. These patients were divided according to sex (gender), which made 177 males and 31 females suffering from artery coronary disease. The characteristics of these patients and their factors of risk, as well those who did not suffer from artery coronary disease are shown in Table 1. There was a significant frequency of the risk factors shown in the patients already

suffering from artery coronary disease, which were at the same time the risk factors for the development of AAA.

Table 2 shows the patients divided according to sex, and form of the artery coronary disease in these groups. There was a significant difference shown among these patients in regard to the frequency of certain forms of the coronary artery disease ($H_i=12.079$, $p<0.05$). The largest number of them suffered from angina pectoris 120 (34 %).

Table 3 presents the patients surgically treated (operated) for AAA and those that died after the treatment (all of them were males). Also, the level of the presence of artery coronary disease

among these groups was presented. Out of the whole number of patients with ruptured AAA ($n=19$), only one patient did not suffer from artery coronary disease. Based on this chart, it could be concluded that the patients with ruptured AAA mostly had some form of artery coronary disease ($n=14$). The number of those suffering from artery coronary disease compared to those who were not was much larger. The total number of patients who died after having been operated from AAA was $n=17$, of which 4 died due to AAA rupture, and all of them had some form of the artery coronary disease.

Table 1. Characteristics of the patients suffering from AAA with or without coronary artery disease

risk factors	males		females	
	suffering from AAA	not suffering from AAA	suffering from AAA	not suffering from AAA
age (years)	64*	65	66	65
current smokers (%)	109 (84,5)	94 (97)	20 (15,5)	3 (3)
ex-smokers (%)	52 (88)	44 (96)	7 (12)	2 (4)
non-smokers (%)	16 (80)	26 (100)	4 (20)	0 (0)
height (cm)	180*	179	174	174
weight (kg)	81**	80	71	70
HTA (%)	164 (85)**	139 (97)	29 (15)	4 (3)
DM (%)	21 (91)	19 (100)	2 (9)	0 (0)
glucose intolerance (%)	12 (80)	11 (100)	3 (20)	0 (0)
HOBP (%)	28 (85)	21 (100)	5, (15)	0 (0)
heredity (%)	78 (84)*	57 (100)	15 (16)	0 (0)
level of triglycerides (%)	135 (90)**	100 (97)	15 (10)	3 (3)
level of cholesterols (%)	135 (90)*	100 (97)	15 (10)	3 (3)
level of creatinine (%)	36 (97)*	16 (100)	1 (3)	0 (0)
cerebrovascular disease (%)	15 (83)	12 (100)	3 (17)	0 (0)

HTA, high blood pressure; DM, diabetes; HOBP, chronic obstructive lungs disease; * $p<0,01$; ** $p<0,001$

Table 2. Frequency of some forms of coronary artery disease among patients suffering from AAA

forms of coronary disease	males ($p<0,05$)		females ($p<0,05\%$)	
	number	%	number	%
angina pectoris	111	86	18	14
previous myocardial infarction	25	68	12	32
previous aortocoronary bypass surgery	41	98	1	3

Table 3. Frequency of coronary artery disease in ruptured AAA in operated males

forms of coronary disease	survived ($p<0,05$)		deceased ($p<0,05$)	
	number	%	number	%
previous myocardial infarction	2	67	1	33
angina pectoris	9	75	3	25
previous aortocoronary bypass surgery	3	100	0	0

Discussion

Coronary artery disease is the leading cause of death among patients recovering after the AAA operation, as well as in the early postoperative period among patients with the AAA resection. According to a few large studies, the myocardial infarction is responsible for the lethal outcome of more than 40% of patients having undergone AAA resection. The myocardial infarction has much higher frequency among patients that were diagnosed with coronary artery disease before the operation.

Many studies have shown the correlation between AAA and the coronary artery disease, and they have proven its large association. Crawford et al. have through many studies shown this connection, as well as the operative risk among patients that had implanted coronary artery bypass before, and they have proven that there is a higher mortality rate (6). Szilagyi et al. have proven that more than 71% of their patients that were prepared for the AAA resection die from the myocardial infarction (7). Hertzler published, after detailed research, that there is a strong connection between AAA and coronary arteriosclerosis. Among more than 47% of those patients there is highly developed coronary artery disease (8).

Previous studies were conducted among older or middle-aged patients, and this particular study includes patients of all age groups that were prepared for the AAA resection. Based on this data it was concluded that AAA disease has four times higher prevalence among males than females. Prevalence grows with age. The complex pathological genesis of AAA is still in the phase of researching. The aortic wall consists not only of vascular flat cells, but from the important matrix proteins eglantine and collagen as well as, which are spread in concentric circles so that can deal with artery pressure. If we want to understand the modern etiologic, pathologic and genetic concept of this degenerative artery disease, we should start from the fact that in normal aorta there is gradual, but significant reduction of the number of the eglantine concentric circle layers. These eglantine concentric circle layers represent very important bonding tissue structure of the media.

Starting with proximal thoracic aorta (at which level there is 60 – 80 concentric circle layers of eglantine) and going more distally, this number is decreasing. At the level of infrarenal aorta it is about 30 layers, which causes successive thinning of the media. Similar changes are determined concerning the presence of collagen, that is as well organized in concentric layers. Accordingly, there have been found a significant reduction (for about 58%) of the contents of eglantine in the infrarenal aorta, compared to its suprarenal segment, with the decreasing of the proportion of the eglantine compared to collagen. Fragmentation and degeneration of the eglantine that is histologically proven in the wall of the aneurysm, with the facts that are given above, explains predominant infrarenal localization of

aortic aneurysms. Eglantine is, in fact, the main bonding and supportive architectonic structure of the aorta that fights with the aneurysmal dilatation of the wall.

Collagen acts as a 'security net' that prevents the rupture of the already formed aneurysm. Half-life of the eglantine is 40-70 years. Its synthesis in the aorta of the adults is not possible, which explains its reduction with the aging which for the consequence has focal dilatation of the weakened wall of the aorta, which cannot stand high hydrostatic pressure. The refracted aortic bifurcation waves increase the wall tension and pulsation amplitude of the smaller elastic artery sclerotic infrarenal aorta (9).

The abdominal aorta during time starts to be affected with sclerotic changes as all of the other blood vessels are. We can say without hesitation that progressive enlargement of the blood vessels diameter i.e. aorta, is a compensatory process contrasted to artery sclerosis. Artery sclerosis causes aging of the blood vessels causing higher and higher stiffness of the aortic vessels. In time, it causes medial degeneration and therefore the development of the aneurysm (10). Artery sclerosis causes, apart from the degeneration of the blood vessels, the increasing of the pressure on its walls and diminishes its capability to bear that pressure which leads to the weakening of the wall and forming of the aneurysm (11).

Coronary artery disease is an important risk factor for the development of the AAA. It is in high percentage present among patients that are prepared for the resection of the AAA. The presence of the coronary artery disease is important for the conducting of the resection. It is one of the main mortality factors after or during the resection. During the resection there is the clamping of the abdominal aorta performed, which leads to the increasing of the afterload into the myocardium. The increasing of the afterload acts as a stress on the left chamber of the myocardium, which consequently disturbs subendocardial perfusion. Finally, it leads to myocardium ischemia and the arrest of the cardiac function (12). Due to the known high mortality risk, many of the patients suffering from suspected coronary artery disease are not taken in consideration as potential candidates for resection. There are exceptions if there is an expansive growth or if a possible rupture is present. That is the reason why there is a coronary angiography and preoperative revascularization done before the operation of elective resection is performed; that significantly decreases mortality rate during resection. All of this shows that there is a need for a detailed examination of the patients in search for some undiagnosed coronary patients before the AAA resection.

Among our patients prepared for AAA resection, 208 (55.2%) of them had some form of the coronary artery disease. The largest number of them was present among males. 88% of them were smokers, and 60% were still smoking, of which the largest number of males. Hypertension, as one of the very important risk factors for the

development of the AAA and for the beginning of the coronary disease, was present in a very high percentage – 89%. It was equally highly present among males and females, too. Concerning height and weight, there are very little differences between males and females. We can conclude that increasing height and weight increases the frequency of coronary disease. Diabetes and chronic obstructive lungs disease are present but not influencing much, contrasted to the genetic inheritance which is very important. The level of cholesterol and triglycerides is present among large number of patients (67%). It is equally present among both sexes and correlates with increased level of creatinine. CVI is also present but in a small percentage; its presence is proportional to the development of generalized artery sclerosis. It is proven that the most important risk factors are present in a high percentage in coronary artery disease. It is known that those risk factors are of high importance for the development of AAA, so we can conclude the artery coronary disease is very important for the development of AAA.

The total number of patients with ruptured AAA is n=19, of which 14 patients suffering from artery coronary disease. In this group, most of the patients are those diagnosed with angina pectoris. That is another fact that supports the theory of the significance of the artery coronary disease for the patients suffering from AAA (especially with the ruptured ones).

Taking in consideration the division of the coronary artery disease by its forms we come to the fact that it is highly presented among both sexes. Among this group, the patients that have died are separately studied, and all of them belong to males. Within this group there was a high percentage of the coronary artery disease as well, most of the patients having angina pectoris. Next in the line are the patients with coronary artery bypass. These facts coincide with other studies, and contribute to the validity of this study.

Conclusion

Abdominal aortic aneurysm is a very important cardiovascular disease of the elderly population. The preclinical development of the aneurysm is perfidious. It is discovered accidentally during examinations for other diseases or complications, or its sudden rupture. With the aim of preventing this condition we can do a lot to help the patients by identifying the risk factors and their treatment. There is a high mortality rate during AAA resection or its rupture. The coronary artery disease is highly present among these patients, which increases the number of fatal incomes. These are the reasons why we want to prevent a large number of risk factors of AAA, first of all, coronary artery disease or to conduct its early diagnosing and possible treatment.

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ZASTUPLJENOST KORONARNE ARTERIJSKE BOLESTI KOD BOLESNIKA OBOLELIH OD ANEURIZME ABDOMINALNE AORTE

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Osobe sa aneurizmom abdominalne aorte imaju veliku prevalencu rizikofaktora za kardiovaskularne bolesti. Ne može se sa sigurnošću pokazati da li ove osobe umiru u većem broju zbog postojanja rizikofaktora ili nastanka i komplikacije same aneurizme. Bolesnici sa aneurizmom abdominalne aorte imaju veliku korelaciju sa koronarnom arterijskom bolešću, što je ujedno i cilj ove studije da to dokaže. Ispitivani su bolesnici koji su se pripremali za resekciju aneurizme abdominalne aorte na Institutu za kardiovaskularne bolesti. Studija obuhvata 377 ispitanika, 341 muškarac i 36 žena starosne dobi od 45 do 83 godine u trogodišnjem intervalu od 2004. do 2006. godine. Cilj studije bio je određivanje zastupljenosti koronarne arterijske bolesti kod bolesnika obolelih od aneurizme abdominalne aorte. U toku analiziranja podataka dobijenih od bolesnika i medicinske dokumentacije došlo se do saznanja da je veliki broj bolesnika sa aneurizmom abdominalne aorte koji imaju koronarnu arterijsku bolest (55,2%; $H_i=15,04$; $p<0,05$). Takvim bolesnicima pripada veliki broj onih koji imaju još neke od faktora rizika za nastanak bolesti. Od ukupnog broja bolesnika koji imaju koronarnu arterijsku bolest, veći je procenat muškaraca (85%). Veći je broj pušača sa koronarnom bolešću (60%), dok je broj bivših pušača (28%) približan broju nepušača (12%). Veći je broj bolesnika sa povećanom telesnom masom (>80 kg), veći je procenat bolesnika sa hipertenzijom (89%), veći je procenat zastupljenosti bolesnika sa povišenim nivoima holesterola i triglicerida (67%). Veliki je broj onih koji imaju nasledni faktor (40%). Dokazano je da su faktori rizika za nastanak koronarne arterijske bolesti u direktnoj vezi sa faktorima rizika za aneurizmu abdominalne aorte. Takođe je dokazana velika zastupljenost koronarne arterijske bolesti kod bolesnika sa aneurizmom abdominalne aorte. Koronarna arterijska bolest je jedan od glavnih faktora rizika. Ukoliko bismo prevenirali nastanak ove bolesti ili postigli njeno blagovremeno dijagnostifikovanje i eventualno lečenje smanjili bismo razvoj aneurizme abdominalne aorte i posledice ove bolesti ili njenih komplikacija. *Acta Medica Medianae 2007;46(4):20-25.*

Ključne reči: aneurizma abdominalne aorte, faktori rizika, koronarna arterijska bolest