Infrarenal abdominal aortic aneurysm: significance of screening in patients of public hospitals in the metropolitan region of Salvador – Bahia, Brazil

Aneurysma da aorta abdominal infrarrenal: importância do rastreamento em hospitais do Sistema Único de Saúde na região metropolitana de Salvador – Bahia

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Abstract

Background: Infrarenal abdominal aortic aneurysm (AAA) is a vascular disease requiring continuous attention both in terms of screening and therapeutic improvement. Infrarenal AAA is a major condition because of its high mortality rate due to AAA rupture, as opposite to the low mortality rate related to elective surgical repair conducted in specialized facilities. In the metropolitan area of Salvador there are no data concerning the identification of patients with infrarenal AAA. Such lack of information prompted this study.
Objective: (1) to determine the prevalence of infrarenal AAA in patients with risk factors; (2) to identify risk factors; and (3) to determine whether the population at risk should be routinely screened.
Methods: In a study for AAA screening conducted by the Department of Vascular Surgery of Hospital Geral Roberto Santos and Hospital Geral de Camaçari from September 2008 to October 2009, 1,350 individuals aged 50 years or older with risk factors for aortic aneurysm were selected. Screening included completion of protocol and performance of color Doppler ultrasound.
Results: AAA prevalence in this sample was 3.9%. The most frequent risk factors associated with aneurysm were mean age of 72 years, male gender, smoking, and patients with peripheral obstructive arterial disease, coronary failure, and chronic obstructive lung disease. AAA screening should be considered in men aged over 65 years, mainly when one of these risk factors are present.

Keywords: abdominal aortic aneurysm; aortic aneurysm; screening programs.

Resumo

Introdução: O aneurysma da aorta abdominal infrarrenal (AAA) representa doença vascular que merece constante atenção, tanto para os estudos de rastreamento como de aperfeiçoamento terapêutico. Sua importância clínica se baseia na alta taxa de mortalidade que ocorre com a sua ruptura, em contraste com a baixa taxa de mortalidade descrita com a correção cirúrgica eletiva em serviços especializados. Na região metropolitana de Salvador, não se encontram dados relativos à identificação desses indivíduos. Esse fato encorajou nosso estudo.
Objetivos: (1) determinar a prevalência do AAA infrarrenal nos pacientes com fatores de risco; (2) identificar esses fatores de risco; e (3) a população que deve ser rotineiramente rastreada.
Métodos: Em estudo de rastreamento do AAA realizado pelos Serviços de Cirurgia Vascular do Hospital Geral Roberto Santos (HGRS) e do Hospital Geral de Camaçari (HGC) de setembro de 2008 a outubro de 2009, foram selecionados 1350 indivíduos com 50 anos ou mais que apresentavam fatores de risco para o aneurysma da aorta. A triagem incluiu o preenchimento de protocolo e a realização de ultrassom ***doppler*** colorido.
Resultados: A prevalência do AAA infrarrenal nesta amostra foi 3,9%. Os fatores de risco mais frequentemente associados foram: média de idade de 72 anos, gênero masculino, tabagismo, antecedente de AAA e portadores de doença arterial oclusiva periférica, insuficiência coronariana e doença pulmonar obstrutiva crônica. O rastreamento do AAA deve ser considerado em homens com idade superior a 65 anos, principalmente quando presente um desses fatores de risco.

Palavras-chave: aneurysma da aorta abdominal; aneurysma aórtico; programas de rastreamento.

This study was carried out at Hospital Geral Roberto Santos (HGRS), Salvador, BA, and at Hospital Geral de Camaçari (HGC), Camaçari, BA, Brazil.
The study was approved by the Research Ethics Committee of the School of Medical Sciences at Santa Casa de São Paulo.
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Introduction

The abdominal aortic aneurysm (AAA) represents an important condition in a vascular surgeon practice, with prevalence in the general population of 2% to 4% and with a man/woman ratio of 5:1[1-5]. With the increase of life expectancy, it has been observed a higher incidence of AAA[6-9], being that in the population over 65 years of age, the prevalence reaches 6%[1,2,9] and, in the age group over 80 years it is 10%[10].

Yano et al.[11] estimated 200,000 AAA new cases per year in the United Sates of America, of which 50,000 are subjected to surgical correction. In England, Thompson et al.[12] estimated that the abdominal aortic aneurysm was responsible for 11,000 hospital admissions and 10,000 deaths per year, and its rupture is the 13th cause of death in countries of Western Europe.

Its importance is based in the high mortality rate observed upon rupture, which contrasts with the low mortality rate described when elective surgical correction is applied in specialized medical departments. It is estimated that the annual incidence of AAA rupture is of eight cases per 100,000 inhabitants[13] being responsible for 2% of deaths in the population over 60 years of age[8].

In fact, the AAA early diagnosis contributes significantly to the indication for elective surgical treatment and to the patient prognosis. Operative mortality is less that 5% and is even lower with endovascular correction[14,15].

Literature reports distinct values for the prevalence of abdominal aortic aneurysm in screening programs. Those prevalence values can vary depending on the clinic characteristics of each population sample and on the region.

Ashton et al.[16], in a multicenter AAA screening study (MASS – *Multicentre Aneurysm Screening Study*), analyzed 67,800 individuals aged between 65 and 74 years. The authors registered a prevalence of aortic aneurysm of 5% in male patients. The risk of death by rupture or by treatment-related complications in the screened population was significantly lower when compared to the not assisted population.

In the United Kingdom, a screening study performed in men over 50 years of age showed prevalence of abdominal aortic aneurysm of 0.3% in the population with ages between 50 and 64 years, of 2.5% between 65 and 79 years, and of 4.1% in patients older than 80 years[17].

Prevalence of infrarenal AAA in the global population is poorly studied, once that it requires a routine screening with high and difficult to measure operational costs. For AAA screening to be recommended in a population, it is necessary that, besides a high prevalence, exist the possibility of changing its progression by an easy and effective treatment, that the diagnostic examination is non-invasive and that the costs of that screening are acceptable.

The benefits of the screening are justified by the asymptomatic progression of the majority of the patients, being the rupture, possibly its first manifestation. Besides this, the usage of color Doppler ultrasound to the early diagnosis of dilatations of abdominal aorta made easier the indication for an elective surgical correction of AAA, reducing the mortality by rupture[18].

In the same way, the possibility to perform an accurate diagnosis using the color Doppler ultrasound together with life expectancy of treated patients that equals the one of healthy individuals in the same age group, represent stimuli to perform screening[19-21].

In the context of the Bahia state, there are no data concerning the screening of these individuals in the general population or even in any selected population. It is also important to note that the high costs of an indiscriminate screening of the general population, associated with the surgical treatment costs of these patients in regions with low socioeconomic status and an overloaded health system, represent the reality of Brazilian northeast. Such facts encourage the present study, which aims to contribute for a better understanding of the role of infrarenal AAA screening in hospitals of the Brazilian Public Unified Health System (Sistema Único de Saúde, SUS) in the population with risk factors for the mentioned disease.

Objectives

The objectives were to determine infrarenal AAA prevalence in patients with risk factors in public Unified Health System hospitals of the Metropolitan Region of Salvador; to identify their risk factors and the population in risk for development of infrarenal abdominal aortic aneurysm that should be routinely investigated.

Methods

The Departments of Vascular Surgery of the Hospital Geral Roberto Santos (HGRS) and the Hospital Geral de Camaçari (HGC) performed a cross-sectional study in the form of a prevention campaign for AAA complications between September 2008 and October 2009.

Population was informed about this campaign through advertisements in newspapers, flyers, radio stations, posters

displayed in magazine shops, pharmacies, as well as in public and private institutions, with information about the disease and the possible etiologic factors.

Project was submitted for approval of the Ethics Committee in Research of the Faculty of Medical Sciences of Santa Casa de Sao Paulo.

Patients answered a pre-established questionnaire with personal data, existence of risk factors for AAA and existence of AAA-related signs and symptoms. All participants in the study were invited to sign the free and informed consent form. Table 1 shows the analyzed variables.

Were included patients with age equal or over 50 years and presenting one or more of the following clinical conditions: *Diabetes mellitus (DM)*, systemic arterial hypertension (SAH), smoking, chronic obstructive pulmonary disease (COPD), peripheral arterial occlusive disease (POAD), coronary insufficiency (CI), non-ischemic congestive heart failure (CHF), dyslipidemia, extracranial carotid artery *disease (*carotid stenosis), obesity, chronic kidney disease (CKD) and family background of aortic aneurysm and/or collagen diseases (Marfan syndrome and Ehlers–Danlos syndrome). Patients with a previous diagnosis of AAA were excluded.

In the next step, color Doppler ultrasound was performed to identify the presence of infrarenal AAA, with or without involvement of iliac arteries, and the presence of stenosis and/or obstructions.

Color Doppler ultrasound examinations of the abdominal aorta and iliac arteries were performed by four professionals using the same criteria to assign infrarenal AAA diagnosis[22] as described below.

Patients were recommended to consume a light diet on the day before examination, with low ingestion of carbohydrates, dairy products and carbonated drinks. Color Doppler ultrasound equipment were from GE, with equally calibrated convex transducers of 2 to 4 MHz. Exam was performed with patient in horizontal dorsal and/or left lateral decubitus positions and comprised the longitudinal and axial planes of abdominal aorta, since the branching point of the renal arteries and until the common, external and internal iliac arteries, bilaterally. The aortic diameters were measured a*t* the level of the renal arteries, one and five centimeters below renal arteries and at the branching level. Common iliac artery diameter was assessed in its distal and proximal thirds and the diameters of the external and internal iliac arteries were measured in their proximal third. These measurements were done with frozen images in systole and the duration of examination was approximately 10 minutes.

It was considered infrarenal AAA to a dilatation of 3.0 cm or larger measured at the largest transversal diameter. It was also considered to be aneurysm of the common and external iliac arteries, a dilatation of 1.5 cm or larger measured at the largest transversal diameter. Alterations in systolic and diastolic velocities were analyzed for stenosis evaluation. Once documented the findings of aneurysm in the abdominal aorta and/or in iliac arteries, patients were indicated for aneurysm screening in the femoral and popliteal arteries, and received orientations and adequate treatment for the diagnosed infirmities.

To compare the mean age of individuals with and without AAA, were used the *t* test and Wilcoxon test. To analyze the prevalence and the risk factors for AAA, were used the chi-square test[23] and the logistic regression[24]. A significance of 0.05 was used to differentiate statistically relevant factors.

Patients

Using a pre-established protocol, were consecutively analyzed the data of 1350 patients seen in hospitals of the Brazilian public Unified Health System, in the Metropolitan Region of Salvador (Bahia), in the period between September 2008 and October 2009.

The clinical aspects and the characteristics of the population sample (total of 1350 individuals) are listed in Table 1.

From the 53 cases diagnosed with infrarenal AAA, 40 (75.5%) were male and 43 (81.2%) were black. The associated diseases present in those patients are listed in Table 1.

The majority of our patients (77.4%) were asymptomatic at the moment of diagnosis being the abdominal pain the most frequent symptom, present in 12 (22.6%) patients.

On note, the abdominal palpation only detected 25 (47%) aneurysms and in 15 patients without abdominal aortic aneurysm a pulsatile abdominal mass was found.

In the group of 53 patients with AAA, observed seven (13.2%) aneurysms in the common iliac artery, five of them with bilateral involvement and two with unilateral involvement. We did not find aneurysms in the internal and external iliac arteries or any isolated aneurysm of the common iliac arteries.

Concerning the characteristics of the aortic aneurysms, 51 (96.3%) were fusiform and two (3.7%) were saccular.

Table 1. Sample profile (1350 individuals) screened for the presence of infrarenal AAA in the Metropolitan Region of Salvador (Bahia) by the Departments of Vascular Surgery of the Hospital Geral Roberto Santos (HGRS) and the Hospital Geral de Camaçari (HGC) between 2008 and 2009 (absolute values and percentages).

Clinical Aspects	AAA				*P*
	Yes		No		
	n	%	n	%	
Sex					
Male	40	75.5	409	31.5	
Female	13	24.5	888	68.5	0.001
Total	53	100	1297	100	
Age group (a)					
50-59	0	0	285	22.0	
60-64	3	5.7	301	23.2	
65-69	15	28.3	236	18.2	0.0001
70-74	17	32.0	318	24.5	
75-79	12	22.6	112	8.6	
>80	6	11.4	45	3.5	
Total	53	100	1297	100	
Ethnicity					
White	10	18.8	261	20.2	
Black	43	81.2	1028	79.2	0.651
Asian	0	0	8	0.6	
Total	53	100	1297	100	
Abdominal Pain					
Yes	12	22.6	61	4.7	
No	41	77.4	1236	95.3	0.348
Total	53	100	1297	100	
Pulsatile mass					
Yes	25	47.2	15	1.2	
No	28	52.8	1282	98.8	0.501
Total	53	100	1297	100	
SAH					
Yes	42	79.3	766	59.0	
No	11	20.7	531	41.0	0.072
Total	53	100	1297	100	
Smoking					
Yes	42	79.3	151	11.6	
No	11	20.7	1146	88.4	0.001
Total	53	100	1297	100	
COPD					
Yes	32	60.4	11	0.85	
No	21	39.6	1286	99.15	0.0025
Total	53	100	1297	100	
Coronary insuf.					
Yes	36	67.9	17	1.3	
No	17	32.1	1280	98.7	0.001
Total	53	100	1297	100	
DM					
Yes	24	45.3	608	46.9	
No	29	54.7	689	53.1	0.0819
Total	53	100	1297	100	

Source: Hospital Geral Roberto Santos (HGRS) and Hospital Geral de Camaçari (HGC).

Table 1. Continued...

Clinical Aspects	AAA				*p*
	Yes		No		
	n	%	n	%	
CKD					
Yes	2	3.8	36	2.8	
No	51	96.2	1261	97.2	0.331
Total	53	100	1297	100	
POAD					
Yes	29	54.7	73	5.6	
No	24	45.3	1224	94.4	0.001
Total	53	100	1297	100	
Obesity					
Yes	17	32	304	23.4	
No	36	68	993	76.6	0.199
Total	53	100	1297	100	
Family background					
Yes	16	30.2	2	0.2	
No	37	69.8	1295	99.8	0.0033
Total	53	100	1297	100	
Carotid Sten./ CVA					
Yes	11	20.7	147	11.3	
No	42	79.3	1150	88.7	0.081
Total	53	100	1297	100	
CHF					
Yes	**7**	13.2	41	3.2	
No	46	86.8	1256	96.8	0.242
Total	53	100	1297	100	
Dyslipidemia					
Yes	13	24.5	195	15	
No	40	75.5	1102	85	0.192
Total	53	100	1297	100	

Source: Hospital Geral Roberto Santos (HGRS) and Hospital Geral de Camaçari (HGC).

AAA diameter varied between 3 and 8 cm, with a mean of 3.9 (±1,1), median of 3.7 cm. Six (11.3%) patients showed AAA with a diameter larger than 5.5 cm and nine (17%) larger than 5.0 cm.

All aneurysms of the common iliac artery were fusiform and showed a mean diameter of 2.7 cm (±0.53) and a median of 2.8 cm. Four patients had aneurysm in the common iliac artery with a diameter larger than 3.0 cm.

In 29 patients (54.7%) there was POAD manifestation as suggested by the physical exam, being the infrapatellar the most affected segment (26.4%).

Results

As result of the campaign, 1468 individuals showed up in the scheduled appointments, however 118 of these patients did not fulfilled the adopted criteria and therefore were excluded from the study. The final population sample was therefore comprised of 1350 patients screened for infrarenal AAA (Table 2). From those, 53 had AAA, being estimated a prevalence of 3.9% in this population sample of the Unified Health System in the Metropolitan Region of Salvador – Bahia (Table 2). It is noteworthy that the prevalence in the male gender was 9% (40/409) and in the female gender was 1% (13/888).

The age of the patients varied between 60 and 87 years, with a mean of 72.4 (±5.7) years and median of 72 years. In our analysis we verified that from the 53 patients with infrarenal AAA, 50 (94.3%) showed age equal or over 65 years and that 35 (66%) showed age equal or over 70 years.

Table 3 show the descriptive statistics for the patient age variable, being considered two groups separately based

in the presence or absence of aneurysm. Of note, mean age in the patient group with aneurysm is 9 years higher than one verified for the group without aneurysm. Median value corroborates this difference.

When correlating the gender of the individuals with the presence or absence of AAA (Table 1), it was observed a higher prevalence of this condition in the male gender, a fact statistically relevant ($p = 0.001$). It was not found a difference between positivity and negativity for AAA when we considered ethnicity (Table 1).

When the data of the individuals were correlated with the positivity or negativity for AAA, it was observed a higher frequency of this condition in patients with the following risk factors: smoking, COPD, POAD, coronary insufficiency and a family background of aortic aneurysm (Table 1), all with statistical significance ($p < 0.05$).

There was no statistically significant relation ($p > 0.05$) for the other associated clinical conditions (SAH, *diabetes mellitus, obesity, carotid stenosis, renal failure,* dyslipidemia, and non-ischemic CHF).

The overall effect of all variables was analyzed using the logistic regression technique.

Table 4 shows the estimates of parameters for the logistic regression after exclusion and inclusion of other variables, using the stepwise selection of predictors. During the process, all the available variables were tested and Table 5 shows the result for the final equation only from those variables that, indeed, showed to be statistically significant (P value lower than 5%)

The estimated parameters indicate that the risk of AAA increases with age and with the presence of CI, COPD, smoking and POAD. Persons with familiar background and persons of the male gender also have a higher risk of aneurysm. Indeed, this represents the aortic aneurysm risk population that should be routinely screened.

Estimates of the parameters in Table 4 do not allow a direct interpretation and, to do that, it is necessary to use additionally the Table 5. Table 5 shows the estimates of the odds ratio for each variable in the final model.

Concerning the presence of AAA, the coefficients between odds ratios of aneurysm incidence for each risk factor are shown in third column of Table 5. According to the results presented, the odds ratio of male individuals is almost ten times higher that the odds ratio for female individuals. For the age of patient factor, for each additional year of age, the odds ratio increases 10%.

The presence of IC caused a 116.7-fold increase in odds ratio, while the presence of COPD increased the odds ratio 35.7 times. Finally, the factor familiar background seems to be the one with greater impact in terms of increasing the chances of aneurysm. Notably, the coefficient between the odds ratios for this factor is of 500 times.

Table 2. Infrarenal AAA prevalence in the sample of the Brazilian Public Unified Health System in the Metropolitan Region of Salvador (Bahia) screened by the Departments of Vascular Surgery of the Hospital Geral Roberto Santos (HGRS) and the Hospital Geral de Camaçari (HGC) between 2008 and 2009.

Infrarenal AAA *Doppler color* USG	N (%)
Yes	53 (3.9%)
No	1297 (96.1%)
Total	1350 (100%)

Source: Hospital Geral Roberto Santos (HGRS) and Hospital Geral de Camaçari (HGC).

Table 3. Sample distribution respective of the color Doppler ultrasound results according the age (absolute values and percentages).

Age	AAA		
	No	Yes	P
Mean	63.2	72.4	
Median	63	72	
Minimum	50	60	p = 0.0001
Maximum	88	87	
Standard Deviation	6.6	5.7	
Variance	43.8	32.5	
Total	1297	53	

P: *t*-test and nonparametric test (Wilcoxon test).

Discussion

The formation of a multidisciplinary team, composed by medical vascular-surgeons, radiologists, interns, students of medicine, nurses and nursing technicians, represented

Table 4. Distribution of patients with infrarenal AAA screened in the municipally of Salvador (Bahia) by the Departments of Vascular Surgery of the Hospital Geral Roberto Santos (HGRS) and the Hospital Geral de Camaçari (HGC) between 2008 and 2009, according to the statistically significant risk factors (logistic regression).

Model Parameter	Estimate	Standard error	chi-square statistics	P-value
Sex - female	−1.1465	0.4137	7.6790	0.0056
Age	0.1032	0.0591	3.0472	0.0809
CI - no	−2.5590	0.4790	28.5436	0.0001
COPD - no	−1.7867	0.4434	16.2398	0.0001
Smoking - no	−0.9632	0.3692	6.8039	0.0091
POAD - no	−1.6545	0.3966	17.4030	0.0001
Background - no	−3.0330	1.0706	8.0250	0.0046

P: Estimates of parameters for the logistic regression.

Table 5. Distribution of patients with infrarenal AAA screened in the municipality of Salvador (Bahia) by the Departments of Vascular Surgery of the Hospital Geral Roberto Santos (HGRS) and the Hospital Geral de Camaçari (HGC) between 2008 and 2009, according to the risk factors with statistical significance (odds ratios estimate).

Variable	Comparison type	Estimate for ratio of odds rations	Lower limit	Upper limit
Sex	Male versus Female	9.9	2.0	50.0
Age	Each additional year of age	1.1	1.0	1.2
IC	Yes versus No	166.7	25.6	>1,000.0
COPD	Yes versus No	35.7	6.3	200.0
Smoking	Yes versus No	6.8	1.6	29.4
POAD	Yes versus No	27.0	5.8	125.0
Background	Yes versus No	500.0	6.5	>1,000.0

P: Estimate for the ratios of odds rations for the aneurysm incidence.

a fundamental step in the execution of this project. The acquisitions of the color Doppler ultrasound equipments, of the physical space and of the financial resources to carry out this research in a public service, are still difficulties to perform an epidemiologic study of this size in our context.

The cost-benefit ratio of the abdominal aortic aneurysm screening is extremely difficult to quantify. A factor that can be taken in consideration is the significantly lower mortality observed in elective surgeries when compared with surgeries of ruptured aneurysm.

A study performed in Denmark by Lindholt et al.[25] with 12,658 individuals with age over 65 years and with aortic aneurysm concluded that, after surgical correction of 1/3 of these cases, the follow-up of these patients can be cost-effective in terms of survival.

Bonamigo et al.[21], in their cohort, concluded that some groups would beneficiate more with AAA screening. Among those groups were the elderly, smokers and carriers of POAD and coronary insufficiency. On the other side, in the female gender that shows low prevalence, the screening did not prove to be cost-effective. Puech-Leão et al.[3] reinforces the higher prevalence of aneurysm in men with age over 60 years and Meirelles et al.[9], in carriers of cardiopathies, mainly coronary insufficiency.

The prevalence of AAA has been increasing in the last years, possibly due to the increase in life expectancy, higher clinical suspicion and higher accuracy of imaging methods. This growth in the prevalence is also associated to an important increase in the ratio of rupture. Aneurysm rupture in men with age over 65 years represents the thirteenth cause of death in the United States (US) and the tenth cause in Canadá[26].

In our cohort, the global prevalence (men and women) of infrarenal AAA was 3.9%, comparable with Leopold et al.[27] and Bonamigo et al.[28], that reported in their cohorts a prevalence of 3.2% of AAA. This value is also in accordance with Molnar et al.[29] that, studying 193 individuals, have shown a prevalence of 3.1% in male elderly people. At last, some authors have found lower AAA prevalence rates.

Barros et al.[4], examining 834 individuals of the municipally of Vitória (Espírito Santo), between the period of December 2002 and June 2003, found 21 cased of AAA, registering a prevalence of 2.5%. Similarly, Lucarotti et al.[30], in a study performed in the United Kingdom has also documented a prevalence of aortic aneurysm of 2.5%.

In a necropsy study performed by Faculdade de Medicina da Universidade de São Paulo, in the period between September 1992 and April 1995, were found 29 (4.5%) aneurysms in a total of 645 dissected abdominal aortas[31].

In necropsy studies as in screenings for the detection of aortic aneurysm in living patients, the prevalence of AAA increases if the population is selected according to its age, gender and associated factors.

Studies performed in population with age over 65 years, have shown prevalence of AAA of 5% to 6%[1,2,16], and in octogenarian individuals, of 10% to 13%[9,10].

The age of the patients reported in the present study is different from that of some other published works. We find mean age of 72.4 (±5.7) years, so an older age group when compared with the ones discussed in other studies[9,32,33].

In our cohort, we did not find aortic aneurysms in individuals younger than 60 years, reinforcing the orientations of several authors to perform the screening in populations older than this age[4,9,10,21,29,34].

Concerning the gender, in Brazilian research studies, as the one presented by Barros et al.[4], in which 284 men and 550 women were evaluated, it was observed a prevalence of 1.7% and 0.7% respectively, with statistical significance. Similarly, in the estate of São Paulo, Puech-Leão et al.[3] reported a prevalence of AAA of 4.6% in men and 0.6%

in women. In our series, in line with the international literature, was found a predominance of aortic aneurysm in male individuals in a ratio of 3:1.

When we analyze only the male individuals, we find a prevalence of 8.9% (40/449), much higher to the results described in the international literature[4,16,31]. This can be explained by the fact that our male patient cohort presents a greater number of risk factors for cardiovascular and aneurysmal diseases, as well as by the fact that some patients have been designated by the services of cardiology and pneumology of our hospital (biased sample). Besides that, we observe more resistance of male patients in participating in the AAA screening study, in performing any medical treatment and in the adequate clinical follow-up (sample composed of patients with severe and decompensate diseases).

Differently from Silva et al.[31], that found a predominance of aortic aneurysm in white individuals (93.1%), we report a dominance of black individuals (81.2%). This fact, without statistical significance, can be explained by the substantial African ancestors of the population living in the Metropolitan Region of Salvador.

Concerning the clinical signs, we observe that the vast majority of our patients was asymptomatic (77.4%) in the moment of diagnosis, a fact already described by other authors[4,9,16,19,28,32-36]. Concordantly with the studies of Molnar et al.[29] and Puech-Leão et al.[3], in which the abdominal palpation only detected 33% and 60% of the screened aneurysms respectively, we also demonstrate a low sensitivity of the physical examination for the AAA detection (47%), reinforcing the importance of an imaging-based exam in the diagnosis of these individuals.

The POAD evidenced in 54.7% of AAA carriers, was superior to that described by Barros et al.[4], a fact that might reflect the great number of individuals with multiple risk factors for atherosclerosis that were present in our sample.

Diverse studies emphasized that POAD represents a risk factor for AAA. Among those is the study of Bengtsson et al.[37] in which the authors analyzed 183 patients with intermittent claudication in the lower extremities and found aortic aneurysm in 25 (13.7%) of the cases. Similarly, Barba et al.[38] have studied individuals with and without POAD and observed that the prevalence of infrarenal AAA was significantly higher in the group showing POAD (14.2% versus 4.7%). In accordance with these authors, our cohort show a higher frequency of POAD in the group with AAA, a fact with statistical significance ($p = 0.001$).

Regarding the topography of POAD, and in accordance with the findings of Carvalho et al.[33], in the present study we report a greater involvement of the infrapatellar region, but without a statistically significant correlation.

Concerning to the characteristics of the aneurysms, accordant with the findings of Barros et al.[4] and Meirelles et al.[9], we also find a predominance of the fusiform type, constituting 96.3% of our cases. The mean diameter of our aneurysms was also comparable with those found in the large series[37,39,40].

The association of the aneurysm in the aorta and in the iliac arteries in seven (13.2%) patients is in accordance to the results presented by Barros et al.[4], however lower to the results described by Cronenwett et al.[41].

Similarly to the international literature, we report a population sample constituted by individuals with several risk factors for the aortic aneurysm, as well as for other associated diseases.

In Brazil, Bonamigo and Siqueira[21] screened 2281 men aged over 50 years, being that, from these, 760 were under clinical cardiac treatment (SAH, dyslipidemia, *CHF* and other cardiopathies) and 500 were carriers of coronary insufficiency. In the same way, Singh et al.[42] have observed that the majority of the individuals with aortic aneurysm, showed multiple associated diseases like SAH, dyslipidemia, cardiophathy and smoking. In line with this author, in our sample, 42 (79%) were hypertensive, 36 (67.9%) had coronary disease and 7 (13.2%) showed *CHF*.

Atherosclerosis is described as an important risk factor in the etiology of aortic aneurysm, despite a possible involvement of metabolism disorders in the connective tissue[43,44]. In fact, atherosclerosis and AAA share several risk factors as age, smoking, SAH and hypercholesterolemia[42].

The direct relation between smoking and the risk of AAA development has already been described by several studies over the years[4,32-34,38,43-45].

Meirelles et al.[9] observed that the risk of smokers to show aortic aneurysm was 6.8 times higher when compared with groups of non-smoking patients. Singh et al.[42] have added that the smoking duration is more important in the genesis of AAA that the number of cigarettes smoked per day.

Bonamigo et al.[21], in a descriptive study performed in Porto Alegre, have clearly showed higher prevalence of aortic aneurysm in elderly and smoking patients. These authors observed that the prevalence of AAA was seven times higher in smoking individuals in comparison with non-smokers of the same age. This association, with statistical significance, emerged also in our study ($p = 0.001$).

The association between coronary insufficiency and AAA is already widely reported in the literature.

Acute myocardial infarction (AMI) is responsible for 37% and 39% of the deaths respectively in the early and late post-operative period after surgical correction of aortic aneuriysm[46]. In a study of 263 cases of asymptomatic AAAs that were subjected to catheterization, 31% showed coronary disease with indication for surgical correction.

Hollier et al.[47], analyzing operated aortic aneurysm patients, have observed that 22% have died of AMI in a follow-up period of two years, demonstrating the high incidence of coronaropathy in these individuals. Similarly, Carvalho et al.[33], analyzing 134 patients subjected to elective surgical correction of infrarenal AAA by the service of vascular surgery of the Santa Casa de São Paulo, observed that coronary insufficiency represented the main cause of death.

The presence of coronary insufficiency as AAA predictive factor was also analyzed by Meirelles et al.[9]. These authors observed that the number of coronary lesions was correlated with the prevalence of aneurysm, indicating that the patients showing a more diffuse atherosclerotic disease, independently of the coronary obstruction degree, showed higher probability of developing aortic aneurysm. On the other hand, Bengtsson et al.[48] and Barros et al.[4] did not find association between AAA and coronaropathy. In our population sample, coronary insufficiency had proved to be a predictive factor for infrarenal AAA.

The COPD represents a frequent cause of morbidity and mortality in the surgical treatment of infrarenal abdominal aortic aneurysm[33,36]. This fact was also strengthened by Anacleto et al.[49], that followed 200 patients operated for AAA and reported 5.3% of pulmonary complications, among those were pneumonia, atelectasis and pleural effusion.

The frequency of the individuals with COPD and with family background for aortic aneurysm was also significantly higher in the group positive for AAA, a fact already described by Pleumeekers et al.[50] and Bonamigo and Siqueira[21]. Different of these findings, in the work described by Singh et al.[42] it was not observed a correlation between these variables and the aortic aneurysm.

In the present study, it was not evidenced statistical significance concerning the variables: ethnicity, dyslipidemia, obesity, SAH, *diabetes mellitus,* congestive heart failure (non-ischemic), CKD, carotid stenosis (>50%) and stroke. Neither the sum of these risk factors and the associated clinical conditions was predictive of aortic aneurysm.

The association between dyslipidemia and AAA has been described in some publications[51,52], but not in all[38]. The study of Singh et al.[42] demonstrated a positive relation between the low level of HDL cholesterol and the risk of aortic aneurysm. In that same study, the authors observed that the risk of developing AAA was 40% lower in individuals with high serum HDL. In our study, the presence of dyslipidemia was not a predictive factor of abdominal aortic aneurysm, a fact also documented in other publications[4,39,53-56].

The association between carotid stenosis and abdominal aortic aneurysm has been reported in several screening studies including the one of Bengtsson et al.[48]. These authors found a prevalence of 24.5% of abdominal aortic aneurysm in a total of 287 patients subjected to carotid endarterectomy, emphasizing the screening of AAA in carriers of extracranial carotid disease. In a similar way, Johnston et al.[57] reported that patients with aortic aneurysm should be examined with color Doppler ultrasound of the carotid and vertebral arteries, with the aim of identifying those patients with higher risk of post-operative cerebral vascular accident.

One other screening study in individuals with carotid stenosis, performed by Macsweeney et al.[58], highlighted the statistically significant association with AAA. In the same way Barros et al.[4] observed that, from the 14 patients with abdominal aortic aneurysm, 86% showed carotid stenosis, being 14% considered as severe (stenosis equal or greater that 70% or occlusion of carotid artery, assessed by color Doppler ultrasound).

Different from these authors, the association between abdominal aortic aneurysm and stenosis of carotid arteries was not confirmed in our study.

In a study of Singh et al.[42], the authors reported a positive association between systemic arterial hypertension (high systolic blood pressure) and abdominal aortic aneurysm in female but not in male patients. In our series, the presence of systemic arterial hypertension was not significantly correlated with AAA, in the same way that many scientific studies did not demonstrate positivity in this association, although being considered a risk factor for the atherosclerosis genesis[4,21,31,38,39,48,52-55,59].

The association between *diabetes mellitus* and AAA was also not shown in our study, in the same way as the majority of the studies existing in the literature do not demonstrate this relation, despite being also considered a risk factor for aterosclerosis[4,38,54,55,59].

The presence of non-ischemic CHF as risk factor for aortic aneurysm has not been routinely observed in the large series. Nevertheless the approach followed by Silva et al.[31], concluded that CHF represented an important cause of death in AAA patients. A possible interpretation is that congestive heart failure often occurs as a consequence of coronary ischemia (acute myocardial infarct). In fact

the association between myocardial ischemia and the abdominal aortic aneurysm was already widely described in the literature. In our study, congestive heart failure has not proven to be a predictive factor for the occurrence of aortic aneurysm ($p = 0.242$).

Concordant with the majority of the scientific studies[8,21,28,32,60], the association between aortic aneurysm and obesity was also not confirmed by our approach.

Among the analyzed risk factors, the presence of advanced age, male gender, smoking, COPD, peripheral arterial occlusive disease, family background and coronary insufficiency have showed a correlation with statistical significance for the occurrence of infrarenal abdominal aortic aneurysm in the uni- and multi-variate analysis (logistic regression).

In this way, seems important to recommend that men, older than 65 years, mainly when in the presence of some of these risk factors (POAD, COPD, smoking, IC and a family background of aneurysm) should be submitted to a screening for infrarenal abdominal aortic aneurysm using an imaging exam, especially the color Doppler ultrasound.

After having performed this study, in which individuals were screened for the presence of infrarenal abdominal aortic aneurysm in the Metropolitan Region of Salvador, we observe a greater awareness of our population for the importance of this condition and of its early diagnosis. This fact is reinforced by the higher demand of risk factors carriers for aortic aneurysm, in our vascular surgery outpatient.

The accomplishment of additional studies on the cost-benefit of the screening of individuals caring AAA should be encouraged.

Possibly the adoption of more stringent and specific criteria for AAA screening, as the ones reported in the present study, associated with the acquisition of portable Doppler ultrasound equipments, would allow a better cost-benefit ratio of these studies.

Conclusions

Through this study, in which individuals suffering from infrarenal abdominal aortic aneurysm were screened in public Unified Health System hospitals of the Metropolitan Region of Salvador, we can conclude that:

- The prevalence of infrarenal abdominal aortic aneurysm in this population sample of the Metropolitan Region of Salvador (Bahia) was 3.9%;
- The most frequent risk factors in this population were an average age of 72 years, male gender, coronary insufficiency, POAD, COPD, smoking and a family background of aneurysm;
- Infrarenal abdominal aortic aneurysm screening should be taken in consideration in defined risk groups like men with age over 65 years, mainly when it is present also coronary insufficiency, COPD, POAD, smoking or a family background of aneurysm diseases.

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