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Research Article

Prevalence of Aortic Aneurysms in Patients with Exertional Angina Pectoris and High/Very High cardiovascular Risk in the Southwestern Region of Romania

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Abstract

The prevalence of aortic aneurysm (AA) in patients with coronary artery disease (CAD), especially the correlation between the severity of atherosclerotic coronary artery disease and this prevalence, is not fully known. The relationship between atherosclerosis (ATS) and AA has been and is still controversial. Depending on the anatomical location, aortic aneurysms are classified into thoracic aneurysms (TAA), thoracoabdominal aortic aneurysms (TAAA), and abdominal aortic aneurysms (AAA). The objective of our study is to investigate the prevalence of AAs in patients with atherosclerotic coronary artery disease referred for invasive investigations (coronary angiography) to a tertiary center in Romania. In this current study, in patients with stenoses >50% on at least one coronary artery and anginal symptoms, the combined prevalence of AAA was higher than TAA or TAAA). Also, there is a correlation between cardiovascular risk factors (especially age, male sex, smoking, dyslipidemia), coronary artery disease (especially in triple-vessel disease) and abdominal AA, but not with TAA or TAAA.

Keywords: Coronary Artery Disease (CAD); Thoracic Aneurysms (TAA); Atherosclerosis (ATS)

Introduction

Aortic aneurysms (AA) are usually asymptomatic and are discovered by chance during imaging investigations (ultrasound, CT, MRI) performed for other indications. One of the most feared complications of aortic aneurysms is aneurysm rupture, which is usually fatal and is one of the causes of sudden cardiac death [1,2]. The total mortality from ruptured AA is high (80-90%) [3,4]. About 50% of AA patients end up in hospital after rupture, and approximately 50% survive surgery [5-8], with a slight improvement, mainly due to the improved screening methods [9,10]. Depending on the anatomical location, aortic aneurysms are classified into thoracic aneurysms (TAA), thoracoabdominal aortic aneurysms (TAAA), and abdominal aortic aneurysms (AAA) [11]. The relationship between atherosclerosis (ATS) and AA has been and is still controversial. Studies from recent years have shown that AA and ATS have common risk factors and that ATS is the cause of more than 80% of AA, especially in the case of AAA [12,13].

Purpose

The prevalence of AA in patients with coronary artery disease (CAD), especially the correlation between the severity of atherosclerotic coronary artery disease and this prevalence, is not fully known. The objective of our study is to investigate the prevalence of AAs in patients with atherosclerotic coronary artery disease referred for invasive investigations (coronary angiography) to a tertiary center in Romania. Our second aim was to identify cardio-

vascular risk factors associated with AA and the link between CAD severity and AA.

Determining the prevalence of AA in a population with cardiovascular risk factors, angina symptoms, and coronary ATS lesions is essential for several reasons. First, it helps us identify a link between coronary atherosclerosis, cardiovascular risk factors, and AA. Second, establishing the prevalence of AA in a high-risk population (such as CAD patients from the southwestern region of Romania) could lead to refining current screening methods for AA diagnosis.

Materials and Methods

This prospective study investigating the prevalence of AA in patients with exertional angina pectoris (Canadian class I-III) included patients who were referred to the Timisoara Institute of Cardiovascular Disease for invasive exploration (coronary angiography) between 01.01.2021-01.06.2023. The inclusion criteria comprised the presence of chronic coronary syndrome and stable exertional angina pectoris (Canadian Classes I-III) [14,15]. The exclusion criteria were patients with acute coronary syndrome (unstable angina, NSTEMI or STEMI), chronic kidney disease (GFR <30 ml/min/1.73m^2), heart failure with LVEF <35%, anemia, pregnancy, allergy to contrast medium, history of abdominal and/or thoracic aortic. Clinical characteristics and coronary lesion profile of patients are shown in Table 1.

Patients with coronary arteries without significant atherosclerotic lesions in the coronary arteries (<50% stenosis in the coronary arteries [16], visually estimated on coronary angiography and confirmed by quantitative coronary angiography (QCA)) were also excluded from the final analysis. All patients who had significant CAD (>50% stenosis in at least one large epicardial coronary artery) had aortic arteriography performed. Aortic arteriography was done using a 6F pigtail catheter through which two contrast dye injections (20 ml at 25 ml/min) were performed using an Angiomat contrast injection system at the level of the aortic arch and ascending aorta (to measure the aortic ring, the ascending aorta, the aortic arch, and descending aorta up to the diaphragmatic level) and at the level of the suprarenal abdominal aorta (to measure the abdominal aorta and the iliac arteries). Patients having an abdominal aorta diameter greater than 3 cm were diagnosed with AAA [17]. At the thoracic level, a diameter greater than 4 cm was termed thoracic aortic dilatation (TAD), and greater than 4.5 cm thoracic aortic aneurysm (TAA) [17].

Patients with an aortic aneurysm greater than 4 cm were referred to computed tomography angiography (CTA) to better define and characterize the AA anatomically. Before coronary angiography and aortic arteriography, patients signed an informed consent form. The study was approved by the Timisoara Institute of Cardiovascular Disease ethics committee.

Statistical analysis

SPSS IBM version 25.0 for Windows was used for statistical analysis. Normally distributed continuous variables were presented as mean +/- standard deviation (SD). Categorical data were presented as frequencies and percentages. For continuous variables, a two-tailed t-test was performed, while for categorical data, the χ^2 homogeneity test was the preferred statistical test. The association between two independent factors was assessed by Odds Ratio with a 95% confidence interval. A value of $p < 0.05$ was considered statistically significant.

Results

During the study period, 2458 patients with stable exertional angina pectoris underwent coronary angiography. 614 patients (25%) had epicardial coronary arteries without significant angiographic lesions (coronary stenoses <50%). Aortic angiography was not performed in these patients. Patient characteristics and cardiovascular risk factors are described in Table 1.

Of the 1844 pts who underwent both coronary angiography and aortic arteriography, 312 patients (17.4%) were diagnosed with aortic aneurysms. Most of them were abdominal aortic aneurysms (AAA) (n = 173, 9.4%), followed by thoracic aortic dilatation (TAD) (n = 88, 4.8%), thoracic aortic aneurysm (TAA) (n = 38, 2.1%), and thoracoabdominal aneurysm (TAAA) (n = 13, 0.7%). For TAA, the prevalence was higher in women (3.43% vs. 1.47%, $p < 0.005$), while for AAA, the prevalence was higher in men (11.38% vs. 4.7%, $p < 0.0001$).

In AAA, the higher prevalence was found in those over 65 years (12.5% vs 3.25%, $p < 0.0001$), males (11.38% vs. 4.7%, $p < 0.001$), smokers (12.5% vs 3.25%, $p < 0.0001$), dyslipidemia (11% vs 7.4%, $p < 0.05$) and with triple-vessel CAD (13.6% vs 6.7% single vessel CAD, $p < 0.05$). Thoracic aneurysms had a higher prevalence in hypertensive patients (2.4% vs 1.35%, $p < 0.05$).

In a multivariate analysis, AAA was positively associated with an age over 65 years (OR = 2.1, 95% CI 1.51-2.91), male sex (OR = 2.6, 95% CI 1.69-4.00), active smoking status (OR = 2, 95% CI 1.44-2.78) and triple-vessel coronary artery disease (OR = 1.91, 95% CI 1.38-2.61). AAAs were not associated with hypertension (OR = 0.66, 95% CI 0.48-0.91) or diabetes mellitus (OR = 0.82, 95% CI 0.56-1.24). TAAs were positively correlated with hypertension (OR = 1.78, 95% CI 0.81-3.91), but with no association with older age (over 65 years) (OR = 0.9, 95% CI 0.47-1.73), male sex (OR = 0.41, 95% CI 0.22-0.79), active smoking status (OR = 0.8, 95% CI 0.42-1.53), dyslipidemia (OR = 0.61, 95% CI 0.31-1.1), triple-vessel coronary artery disease (OR = 0.72, 95% CI 0.34-1.54), or diabetes mellitus (OR = 0.74, 95% CI 0.30-1.79).

Table 1: Clinical characteristics.

Clinical characteristics	Value (percentage)
Over 65 years	903 pts (49%)
Male	1291 pts (70%)
Smokers	933 (50%)
Hypertension	1254 pts (68%)
Diabetes mellitus	369 pts (20%)
Dyslipidemia	996 pts (54%)
Single vessel CAD	686 pts (37%)
Double vessel CAD	623 pts (34%)
Three vessel CAD	535 (29%)

Discussions

In this current study on patients with stenoses >50% on at least one coronary artery and anginal symptoms, the combined prevalence of AA was 12.14% (9.4% for AAA, 2.1% for TAAA, and 0.7% for TAAA). This suggests that there is a link between cardiovascular risk factors (especially age, male sex, smoking, dyslipidemia), coronary artery disease (especially in the triple-vessel disease) and AAA, but not with TAA or TAAA. This supports the current theory that there are common etiological factors between CAD and AAA, which does not apply to TAA where the primary mechanism is cystic degeneration of the media.

The prevalence of AAA in the general population ranges from 1.1%-8.9%, being higher in men [18]. It also increases with age, which is confirmed by our study (higher incidence in those over 65 years).

A study conducted on a selected population in Qatar reported a 0.5% incidence of AAA in a population with cardiovascular risk factors (82% men, 66% hypertensive, 60% smokers, 50% dyslipidemia) but only 36% with coronary heart disease. Incidence increases to 5% in those over 80 [19]. They also reported an increased incidence of mortality in patients with coronary artery disease and AAA, highlighting the need for screening in elderly patients with cardiovascular risk factors. However, no correlation was made with coronary artery disease severity, and no TAA incidence was reported in this study.

A recent meta-analysis comprising 23 studies reported the prevalence of AAA in various population groups with and without coronary artery disease [20]. They found an increased prevalence in men - 9.5% (comparable to our study where it was 9.4%) and in patients with triple-vessel coronary artery disease (11.4%) who were revascularized by coronary artery bypass grafting (CABG) (11.4%), also comparable to our study in trivascular patients (13.64%).

Another meta-analysis performed by Elkalioublie., *et al*. showed that the prevalence of AAA is higher in CAD patients compared to those without atherosclerotic coronary artery disease (8.4% vs. 2.4%), but without assessing the prevalence of thoracic and thoracoabdominal aneurysms [21]. Like in our study, a higher prevalence in smoking patients was observed, along with a higher prevalence in patients with peripheral arterial disease (carotid stenosis OR 2.14, 95% CI [1.20-3.79] or lower limb ischemia, OR 2.66, 95% CI [0.82-8.61]). Our study did not evaluate the association with peripheral arterial disease, as this was investigated separately in another paper, especially in AA patients requiring surgical or endovascular repair.

The prevalence of AAA in patients with acute coronary syndrome was assessed in a study that included 306 patients by Long., *et al*. They reported an incidence of AAA in 7.7% of patients, mainly in those over 50 years of age, but without correlating it with the severity of coronary artery disease [22]. Most patients had an AAA up to 4 cm, associated with age (past 50 years in their study, 65 years in our study) and male sex (same as in our research) without assessing other cardiovascular risk factors. AAA diagnosis was performed by abdominal ultrasound, not peripheral angiography, as in our study. In contrast to our research, there was no reported difference between men and women.

A similar study by Durieux., *et al*. reported a low prevalence of only 4.2% in patients who underwent coronary angiography prior to valve surgery and in those with suspected coronary artery disease [23]. The low incidence could be explained by the inclusion in the analysis of those with non-obstructive coronary artery stenosis (coronary artery stenosis ATS between 20- 50%) as well as those with coronary arteries without atherosclerotic lesions (coronary artery stenosis <20%). This patient category was excluded from our study. The prevalence of TAA and TAAA was also not assessed in this study. This study also concluded that the prevalence of AAA was higher in those over 65 years (8.6%), men (5.9%), and those with triple-vessel coronary artery disease (14.4%), which is similar to our findings.

Like other studies, our current findings show a higher prevalence of AAA in patients over 65 years, men, smokers, and dyslipidemias, but with no correlation between these risk factors and TAA. Among cardiovascular risk factors, only hypertension was associated with an increased prevalence of TAA.

Conclusions

In patients with atherosclerotic coronary disease from the SV region of Romania, the incidence of AA is increased, especially of AAA. There is a correlation between cardiovascular risk factors (age over 65, male sex, smoking, dyslipidemia) and the presence of AAA. The higher incidence of TAA was associated with cardiovascular risk factors with HTN, not being influenced by the others. Thus, AAA screening in this category of patients is necessary regardless of the therapeutic method chosen for coronary disease (medication or revascularization).

Author Contributions

Conceptualization, D.A.B, A.M.J, D.M.B, and M.B.; writing—original draft preparation, D.A.B, D.M.B; writing—review and editing, R.P., I.M., D.P., and M.M.; supervision, R.P., A.M.J; project administration, A.M.J., D.A.B, and D.M.B.

All authors have read, reviewed, and agreed to the published version of the manuscript.

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Availability of Data and Materials

All data and materials supporting the present study's results are available on request from the corresponding author. The data are not publicly available to limit the amount of publicly available personal information, as classified by the European Union General Data Protection Regulation.

Ethics Approval and Consent to Participate

The participant institutions granted the study ethical approval.

Patient Consent for Publication

Written informed consent was obtained from patients before enrollment.

Competing Interests

The authors declare that they have no competing interests.

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