Comparison of Cardiac and Renal Involvement in Patients with Abdominal Aortic Aneurysm and Aorto-Illiac Occlusive Diseases who Underwent Elective Vascular Surgery

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Abstract

Objective: The aim of this study is to assess comorbidities such as risk factors between patients with AAA and AIOD who underwent elective surgery. Abdominal Aortic Aneurysm (AAA) as well as Aorto-Illiac Occlusive Diseases (AOID) is a major risk to health. Comorbidities, during these conditions, play an important role in clinical course and the outcome of the diseases.

Material and Methods: We studied 373 patients, 124 of them with AAA and 249 patients with AIOD. Age, gender, smoking status, hypertension, and dyslipidemia were assessed. Also, Glomerular Filtration Rate (GFR) was calculated for all patients. The history of Diabetes Mellitus (DM) was identified. The coexistence of Ischemic Heart Disease (IHD) was diagnosed according to clinical history or electrocardiographic and ultrasound criteria. In addition, Transthoracic Echocardiography (TTE) examination was performed for all patients.

Results: Out of 373 patients, a gender majority of them were male (94% in AIOD and 90% in AAA). Patients with AIOD were younger than patients with AAA (63.69 ± 8.219 and 67.90 ± 8.810 P= 0.0000, repectively). The prevalence of Hypertension (HT) was less in AOID and then in AAA. Diabetes mellitus (DM) was more prevalent in AIOD patients. Rate of Coronary Artery Disease (CAD) and Coronary Revascularization did not differ between groups. The prevalence of Left Ventricular Hypertrophy was lower in AIOD group (50.4% in AIOD vs 64.8% in AAA P=0.0084). Rate of

GFR ≤ 60 was found to be lower in AIOD group than in AAA group (20.16% vs 49.6% P=0.0000). Higher prevalence rate of Aortic Valve diseases of Aorta in patients with AAA was found (17.3% in AIOD vs 45.6% in AAA P=0.0000).

Conclusion: Higher prevalence rate of Aortic Valve diseases in patients with AAA was found. However, this association may be determined by the same factors that are responsible for inflammatory and degenerative changes in grate vessels in aneurismal disease. High rate of LVH and RF in AAA group indicates unfavorable risk profile in patients with AAA.

Keywords: Abdominal Aortic Aneurysm, Aorto-Illiac Occlusive Disease, Valve Diseses, Renal Failure, Left Ventricular Hypertrophy

Introduction

Abdominal Aortic Aneurysm (AAA) as well as Aorto-Illiac Occlusive Diseases (AOID) is carrying a major risk to health, and they are often disposed to life-threatening complications. Comorbidities, during these conditions, may play an important role in clinical course and on the outcome of AAA and AOID. Some previous studies were conducted to establish whether comorbidities have a significant influence on AAA. Luboš Kubíček et al. investigated patients with ruptured aneurysm and revealed that patients with COPD have the maximal diameter of their ruptured AAA to be significantly bigger than the diameter of patients without COPD (Kubíček, 2015). Consequently, Iaitskiĭ NA et al. showed that all patients, who underwent a selective surgery for abdominal aortic aneurism, had an ischemic heart disease and arterial hypertension, chronic nonspecific lung disease, and kidney disease. Thus, the most frequent complication was an acute renal insufficiency. Myocardial infarction and pneumonia took the second place in the structure of postoperative complications (Iaitskiĭ, 2014).

Iarussi D et al. found that the left ventricular mass index was independently associated with aortic diameters. They concluded that the descending aorta diameters in patients with acute thoracic aortic dissection and left ventricular hypertrophy may be considered as a risk factor for aortic enlargement and subsequent dissection (Iarussi, 2001). Subsequently, Shinji Hagiwara et al. published their study where they have examined the incidence of CRF at that time and 30 months after the diagnosis of Abdominal Aneurysm (AA) and Acute Renal Failure (ARF) among AA patients who underwent surgery. Chronic Renal Failure (CRF) was highly prevalent in AA patients following CAD. They concluded that age, multiple aneurysms, and hypertension were related factors for CRF in AA patients; and preoperative CRF is a risk factor for postoperative ARF (Hagiwara, 2007). Furthermore, some authors believe that renal failure during AAA may

occur due to the influence of atherosclerosis which is often common for both conditions (Riambau, 2007). Aortopathy associated with Bicuspid Aortic Valve (BAV) disease certainly predisposes individuals to aortic dilatation, aneurysm formation, and aortic dissection (Losenno, 2012). However, there are no definite studies between associations AAA and tricuspid aortic valve stenosis and regurgitation. Also, there are some differences of risk factors between patients with AAA and AIOD. In this study, we aimed to assess comorbidities such as risk factors between patients with AAA and AIOD who underwent elective surgery.

Material and Methods

Data was collected for all adult patients who underwent surgical repair of AAA or AOID at "The Center of Vascular and Heart Diseases" between 2010 and 2014. We studied 373 patients, 124 of them with AAA and 249 patients with AIOD. The majority of patients were male (92% for both groups). The data were not analyzed for female due to its small number. Subsequently, for all patients, the following examinations were performed: electrocardiography, transthoracic echocardiography, dopler ulatrasound examination, carotid and peripheral artery ulatrasound scanning, computer tomography, and biochemical tests.

In patients with AIOD, according to Fontaine classification, limb ischemia at stage IIb, III, and IV was an indication for open surgical or endovascular treatment. Abdominal aorta with diameter of ≥5 sm was considered for surgical treatment.

For all patients, demographic data, history of the disease, existence of risk factors, and comorbidities (age, gender, smoking status, Hypertension (HT) according ESC/ESH 2014 Guideline, Dyslipidemia) were assessed. Serum creatinine was measured and Glomerular Filtration Rate (GFR) was calculated using The Modification of Diet in Renal Disease (**MDRD**) study equation. The history of Diabetes Mellitus (DM) was identified. All study subjects were routinely examined by cardiologist to assess a perioperative cardiac risk. Coexistence of Ischaemic Heart Disease (IHD) was diagnosed according to clinical history (angina, myocardial infarction, coronary revascularization) or electrocardiographic and ultrasound criteria (pathological Q waves, regional wall motion abnormalities). Transthoracic Echocardiography (TTE) examination was performed according to American and European Society of Echocardiography's Guidelines and Standards Committee (Lang RM., 2005).

Statistical Analysis

For the quantitative data, the average rate and standard deviation was detected. Also, the equality of variances was tested by Levene's

Test of Equality. In order to evaluate the differences between the groups, independent samples t-test was examined. Also, dichotomous data were presented as number and percentage. The Mann-Whitney–U test or Fisher exact test was used to analyze categorical variables. Multivariable regression analysis was performed to evaluate the difference between patients with AIOD and those with AAA. However, statistical significance difference was set at $p<0.05$. The analysis was performed using statistical software package SPSS 22.

Results

Out of 373 patients, a gender majority of them was male (94% in AIOD and 90% in AAA). Patients with AIOD were younger than patients with AAA (63.69 ± 8.219 and 67.90 ± 8.810 P= 0.0000 repectively). Also, there was no statistically significant difference in smoking status between two groups (73% and 69% P= 0.4601, respectively). The prevalence rate of dyslipidemia did not differ between two groups (48% in AIOD and 47% in AAA P=0.9300). The prevalence of HT was less in AOID than in AAA (Table 1). DM was more prevalent in AIOD patients (Table 1). Prevalence rate of CAD did not differ significantly between groups (Table 1). The rate of the coronary revascularization was 11% AIOD and 8% in AAA P=0.3220. In addition, the prevalence of Left Ventricular Hypertrophy was lower in AIOD group (Table 1). Rate of GFR ≤ 60 was found to be higher in AAA group than in AIOD group, and the difference was statistically significant (Table 1). Also, higher prevalence rate of Aortic Valve and Mitral Valve diseases in patients with AAA was found (Table 1). The number of patients with EF < 40 prevailed in AIOD, but there was no significant difference between the two groups.

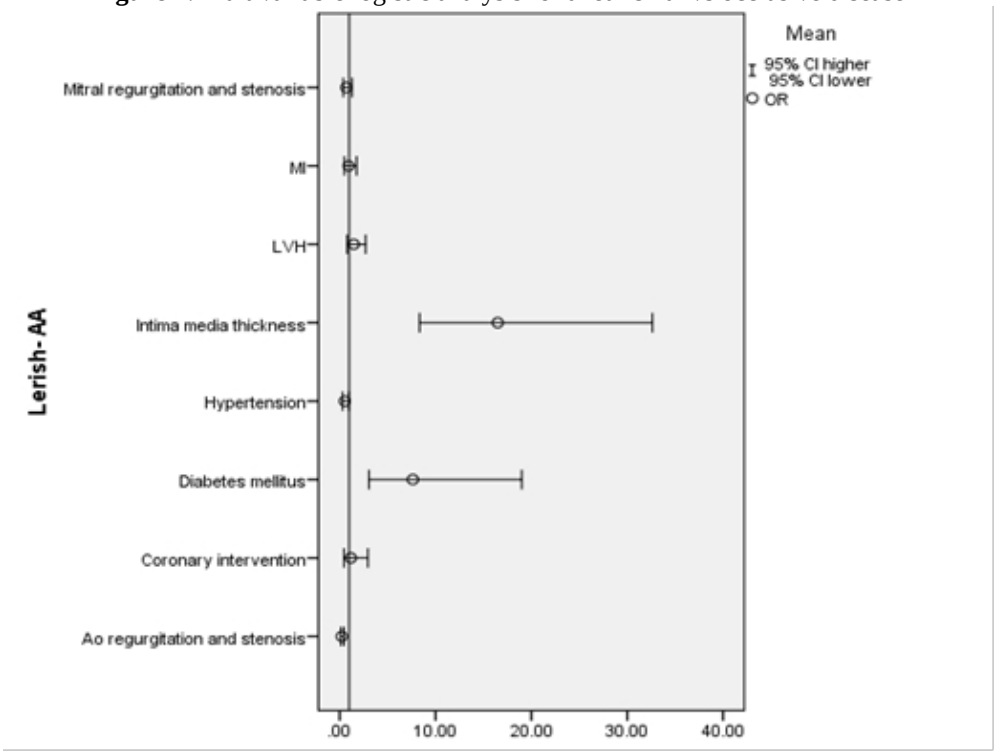
Table 1. Prevalence of co-morbidities, increased CIMT, LVH valvular diseases, and GFR ≤ 60 in Patients with AAA and AOID

Characteristics	AOID N=248	AAA N=125	p
Myocardial Infarction (%)	68(27.4)	35(28.0)	0.7797
Hypertension (%)	121(48.8)	82(65.6)	0.0021
Coronary Revascularization (%)	28(11.3)	10(8.0)	0.3220
Diabetes Mellitus (%)	66(26.6)	8(6.4)	0.0000
LVH (%)	125 (50.4)	81(64.8)	0.0084
GFR≤ 60 (%)	50(20.16)	62(49.6)	0.0000
Mitral Regurgitation and Stenosis (%)	76(30.6)	62(49.6)	0.0004
Aortic Regurgitation and Stenosis (%)	43(17.3)	57(45.6)	0.0000

Multivariable logistic regression analysis showed that abnormal CIMIT (> 0.9mm) was associated with Aorto-Illiac occlusive disease (odds ratio [OR] 0.06; 95% CL 0.03-0.13 P=0.0000). Diabetes mellitus was also

associated with occlusive arterial disease (odds ratio [OR] 0.15; 95% CL 0.06-0.36 P=0.0000). Nevertheless, arterial hypertension (odds ratio [OR] 1.80; 95% CL 1.02-3.19 P=0.0430), aortic valve diseases (odds ratio [OR] 4.17; 95% CL 2.23-7.81 P=0.0000), and LVH and GFR ≤60 (odds ratio [OR] 3.24; 95% CL 1.80-5.83 P=0.0000) were associated with aneurysmal disease (Figure 1).

Figure 1. Multivariable logistic analysis for aneurismal vs occlusive disease



Discussion

Current study showed that Rates of CAD and Coronary Revascularization did not differ between patients with AAA and AIOD. Hypertension was common in patients with AAA as well as LVH. Therefore, these findings indicated an unfavorable risk profile in AAA patients. Hypertension is an independent risk factor for atherosclerosis, coronary heart disease, sudden death, heart failure, and stroke (Gradman, 2006). LVH may be associated with heightened risk of complication in affected individuals. The presence of LVH is a strong independent risk factor for future cardiac events (including congestive heart failure, coronary heart disease, atrial fibrillation, supraventricular and ventricular arrhythmias, and stroke), and all of them causes mortality (Vakili, 2001). Hypertension may lead to increased afterload which will stimulate cardiomyocyte hypertrophy, collagen formation, and fibroblasts proliferation. This, thus, will lead to the

remodeling of the myocardium with a disproportionate increase in fibrous tissue. These will reduce LV compliance and vascular coronary flow reserve. In addition, myocardial ischemic episodes may result in transient diastolic dysfunction (Pacifico, 2003). Furthermore, a strong correlation is established between ventricular arrhythmia and myocardial hypertrophy. Myocardial hypertrophy may lead to triggered activity. Increased dispersion of repolarization may sustain the arrhythmia. In the hypertrophic myocardium myofibrillar disarray, heterogeneous gap junction distribution and fibrosis are additional potentially arrhythmogenic components (Kahan, 2005).

According to our study results, GFR $\leq$ 60 prevailed in patients with AAA. GFR $\leq$ 60 is associated with a Chronic Kidney Disease (CKD) stage 3 and below. Earlier studies showed that CKD was associated with AAA (Takeuchi, 2016). The postoperative Acute Renal Failure is a common complication in AAA patients (Barratt- Brewster, 2000-2003). Thus, the incidence of CKD and the prognosis in AAA has not been fully investigated. Cause of CKD in these patients may be pre-renal factors such as low blood flow in the kidneys. Shinji Hagiwara et al. reported that imaging information from AAA patients suggests that reduced renal blood flow due to renal artery stenosis, intraluminal thrombus, or calcification of the aorta might affect the incidence of CRF in these patients (Hagiwara, 2007). The prevalence rate of Valvular diseases of Aorta, such as Aortic Stenosis and Regurgitation as well as mitral valve disorders in patients with AAA, were higher in comparison with AOID. In our study population, all patients had tricuspid aorta. Other studies showed that Bicusrpid Aortic Valve diseases are associated with variable degrees of valvular stenosis and insufficiency and associated abnormalities including aortic coarctation, hypoplastic left heart structures, and ascending aortic dilatation (Losenno, 2012).

We hypothesized that the association of AAA and heart valve disorders may be determined by the same factors that are responsible for inflammatory and degenerative changes in grate vessels in aneurismal disease. The association of tricuspid aortic valve disease and AAA has not been sufficiently investigated. In addition, other studies are required to clarify some correlations between aneurysmal and aortic valve disease.

However, as reported above, RF prevailed in patients with AAA as compared with AIOD patients. This was despite the higher rate of DM (one of the common causes of chronic RF) in patients with AIOD. In addition, high rate of LVH and RF indicates an unfavorable risk profile in patients with AAA.

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