Influence of risk factors on size and localization of infrarenal abdominal aortic aneurysms

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ABSTRACT

The aim: to accomplish CT measurements and evaluate the impact of unchangeable risk factors and comorbidities on size and location of infrarenal AAA.

Methods. This is a retrospective evaluative study, in which we have evaluated CTA images of AAA of 46 patients. The measurements of the AAA have been conducted using the Syngovia program.

Results. There were 46 patients who participated in this study (7 female and 39 male). The average age of the men patients was 72,32 and 71,57 for women. The average length and width of AAA in a male group were 8,76 cm x 5,52 cm, respectively 7,48 cm x 4,79 cm in a female group. The most common comorbidities of the patients are hypertension, atherosclerosis, angina pectoris and stenosis of coronary arteries. The width of the aneurysm in hypertensive patients is estimated to be greater than 0.67 cm. Linear regression analysis showed that if the length increases by 1 cm, the width grows by 0,28 cm, accordingly, if width increases by 1 cm, the length grows by 1,36 cm. It was found, that the number of comorbidities, male gender and width of aneurysm affects the distance from AAA to aortic bifurcation. Also, there is a statistically significant correlation between the length and the distance from AAA to lower renal artery.

Conclusions. 1. Female gender affects the size of AAA: smaller length and width of aneurysms were observed. Male gender leads to the formation of larger thrombi. 2. The length of AAA was the most statistically significant variable since the P-value was always <0,05. Therefore, it is considered a good tool to use in evaluation of AAA size and location characteristics. 3. The linear regression analysis showed that hypertension has a statistically significant effect on the width of AAA by increasing its size.

Keywords: *Abdominal aortic aneurysm, CTA, hypertension, infrarenal AAA.*

INTRODUCTION

The most common disease of aorta is an aneurysm, which is formed due to the thinning of the vessel wall and altered blood circulation. There are three types of aortic aneurysms: abdominal, thoracic, thoracoabdominal. Abdominal aortic aneurysm (AAA) is an enlarged area of the abdominal aorta that is 50 percent greater than the normal aortic diameter – 2 cm [1]. The most common type of AAA is the infrarenal AAA [2]. This disease mainly affects males who are older than 65 years of age. According to statistics, three times more often than women [3, 4]. The main risk factors for AAA are age, gender and smoking. Additional risk factors associated with abdominal aneurysms include: hypertension, hypercholesterolemia, atherosclerosis, cerebrovascular disease, coronary artery disease, greater height, history of other vascular aneurysms, hereditary connective tissue diseases [5]. However, according to Hong Lu and co-authors, the relative contribution of each mechanism is unclear [6]. Majority of AAAs are asymptomatic until rupture occurs. Rupture of the AAA and associated consequences cause mortality in excess of 80% [3]. Therefore, the main goal is to identify an aneurysm in time and avoid rupture which would result in a fatal outcome. Diagnostic methods include physical examination, ultrasonography, MRI and CT angiography (CTA) [1, 7]. Aneurysms larger than 5,5 cm require treatment. Even though there is no special pharmacological treatment, AAAs can be fixed using interventional methods such as endovascular aneurysm repair (EVAR) or an open aneurysm repair (OR) [8].

AIM: to accomplish CT measurements and evaluate the impact of unchangeable risk factors and comorbidities on size and location of infrarenal AAA.

OBJECTIVES

1. To estimate unchangeable risk factors (gender, age) impact to the size and location of infrarenal AAA.
2. To analyze the significance of patient's comorbidities in the size and location of infrarenal AAA.
3. To determine how single comorbidity affects size and location of infrarenal AAA.

METHODS

The retrospective evaluative study has been done. Data of 46 patients was collected. Examinations have been undertaken using high-resolution spiral computed tomography with intra-aortic iodine-based contrast media using one of the two CT scanners, Toshiba Aqilion ONE (Canon Medical Systems Europe) or LightSpeed VCT (GE Healthcare). The Syngovia program has been used to conduct measurements of the AAA. The measurements were conducted at different positions of the AAA to improve the quality and accuracy of comparison between the patients. Only patients who fitted the following criteria were included: patients with non-operated infrarenal AAA with a minimum diameter of 3 cm undergoing CTA examination between the 11th of January 2017 and 29th of November 2017. To compare and analyse collected data, Microsoft Excel program has been further used.

RESULTS

In study participated 46 patients (7 females and 39 males). The age of patients ranged from 53 – 89 years with an average age of 72,32 for male patients and 71,57 for female patients (Fig. 1). The mean length of AAA is 8,76 cm in male group and 7,48 cm in female. While the average width of AAA is around 5,52 cm in men and 4,79 cm in women (Tab. 1, Fig. 2). The average thrombus size in the female patients group is 1.87 cm and 2,20 cm in the male patients group (Fig. 3). This means that being of male gender has an influence on the formation of a larger thrombus. The distance of AAA to the aortic bifurcation is almost the same in both groups (female – 0,54 cm, male – 0,51 cm). In comparison, the average distance of AAA to the lower renal artery is much larger (female – 4,35cm, male – 3,64 cm). The most common comorbidities of the patients are hypertension, atherosclerosis, angina pectoris and stenosis of coronary arteries. On average both gender groups had 1,17 other comorbidities despite the diagnosis of AAA. Comparing female and male groups, females had more additional diseases for count of 1,29 per person and males – 1,15.

Tab. 1 Measurement results of the genders

Gender	Age (years)	Length of AAA (cm)	Width of AAA (cm)	Thrombus Size (cm)	Distance of AAA to bifurcation (cm)	Distance of AAA to Lower Renal Artery (cm)
Male	72,32	8,76	5,52	2,20	0,51	3,64
Female	71,57	7,48	4,79	1,87	0,54	4,35
Total	72,21	8,57	5,41	2,16	0,51	3,75

Fig. 1 Age distribution among the patients

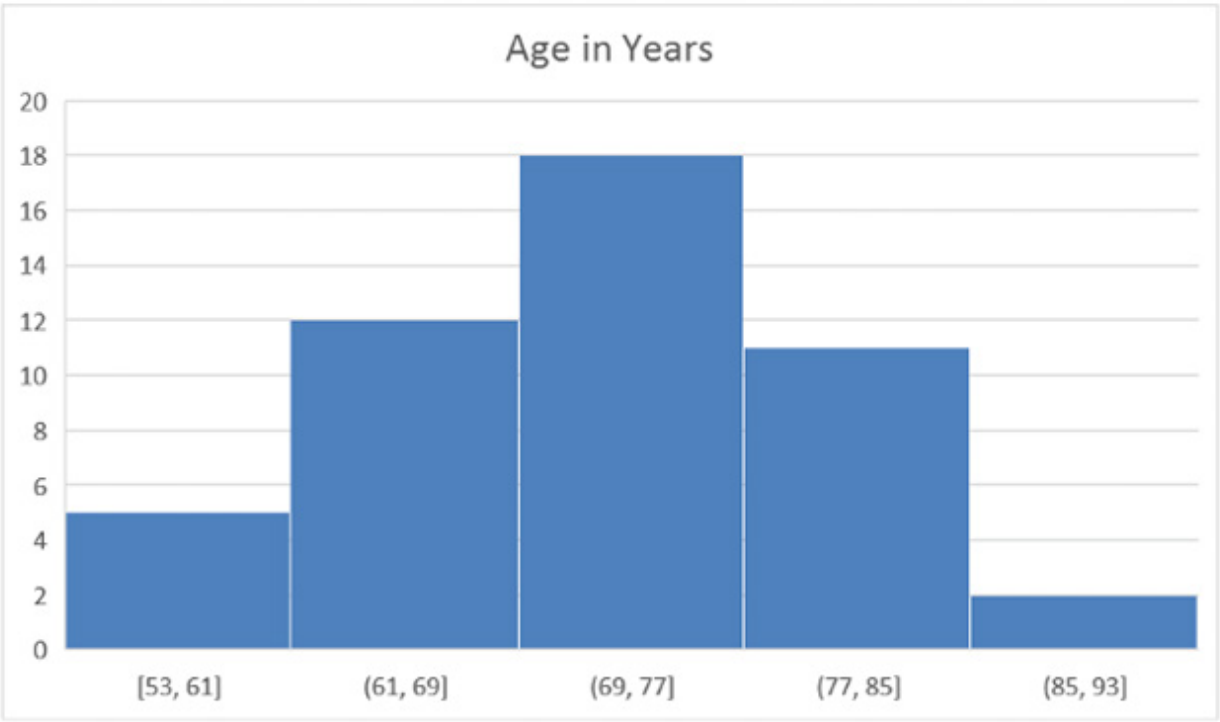


Fig. 2. Length of AAA measurements. On the left, length of AAA measured in the sagittal section (D1). On the right, length of AAA measured in the frontal section (D7)

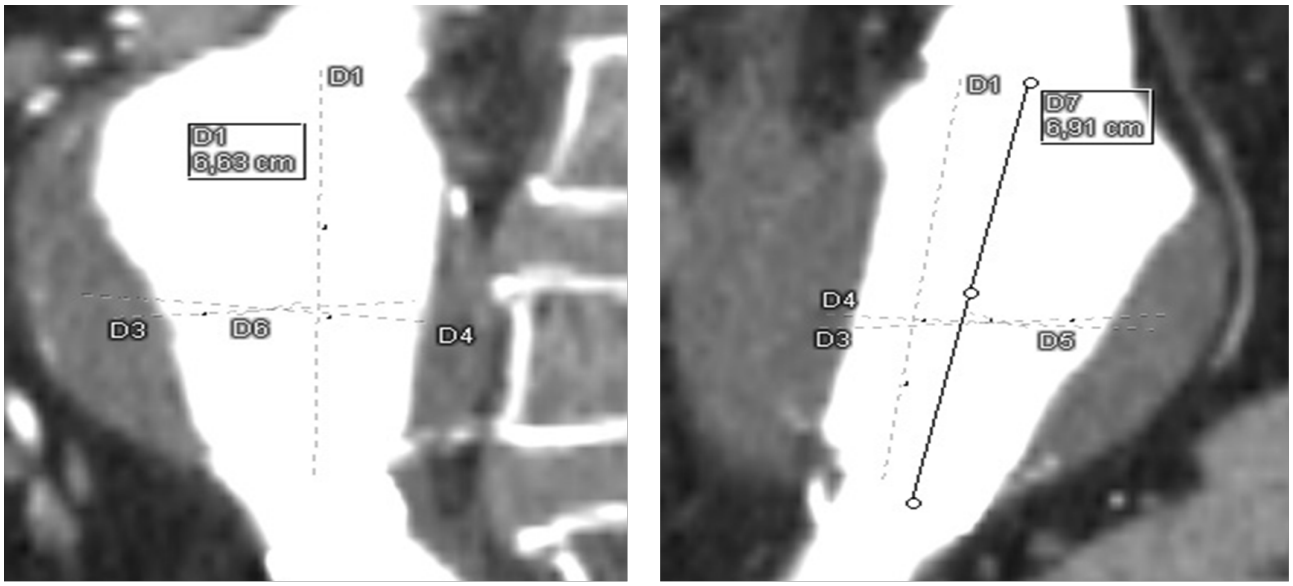
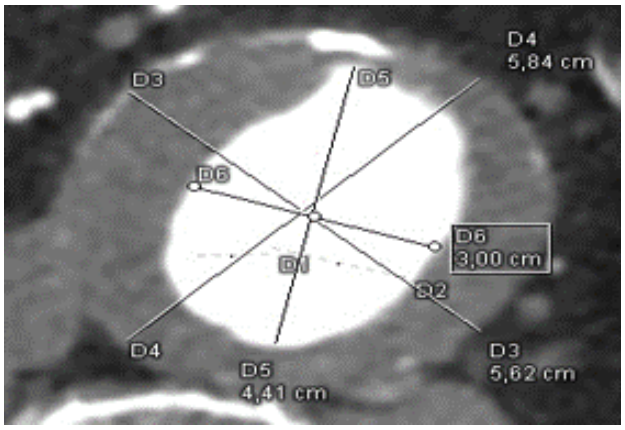


Fig. 3. Width of AAA and thrombus measurements. Width of AAA measured in the axial section (D3, D4). Thrombus measurements in the axial section (D5, D6). Now the average of D3+D4 is taken as well as the average of D5+D6. To get the approximate size of thrombus the average of D5+D6 was subtracted from D3+D4



1. The following data was derived using linear regression analysis:

1. Male patients on average have a 0,36 cm larger width of AAA than female patients. It was found that if the length increases by 1 cm, the width grows by 0,28 cm too (Fig.4). This means that the correlation between width and length of AAA is statistically significant ($p<0,001$).

2. Since it was found that the correlation between the length and width of the aneurysm is statistically significant, this means that an increase of 1 cm in width leads to an increase of 1,36 cm in length (Fig. 5).

3. The investigation showed that there is a statistically significant correlation between the length and the distance from AAA to the lower renal artery (Fig. 6).

Fig. 4. Official and estimated width of AAA represented using the correlation between width of AAA and length of AAA

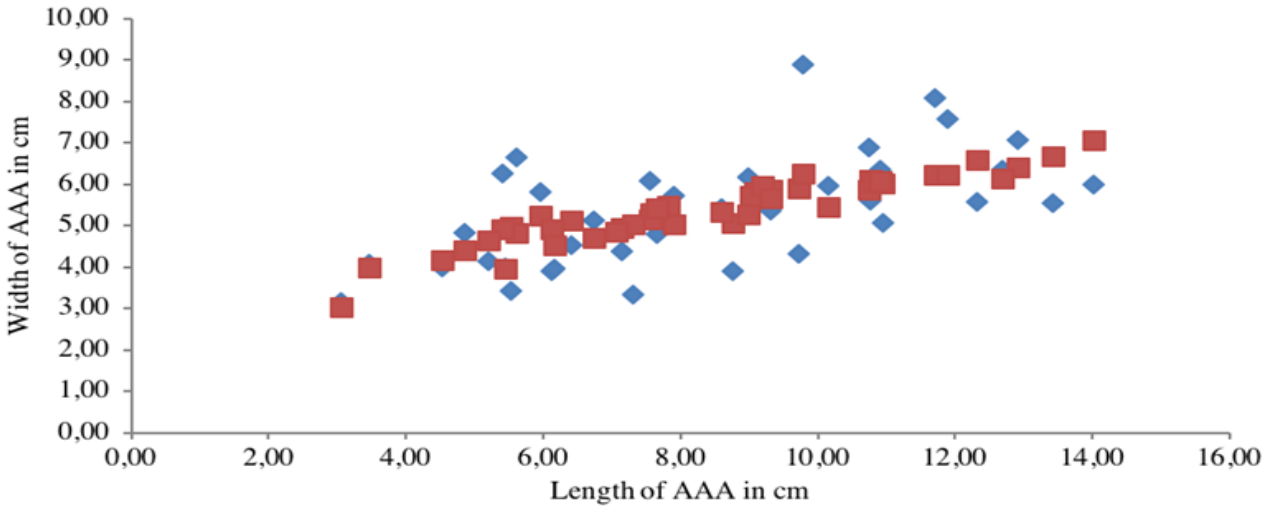


Fig. 5. Official and estimated width of AAA represented using the correlation between width of AAA and length of AAA

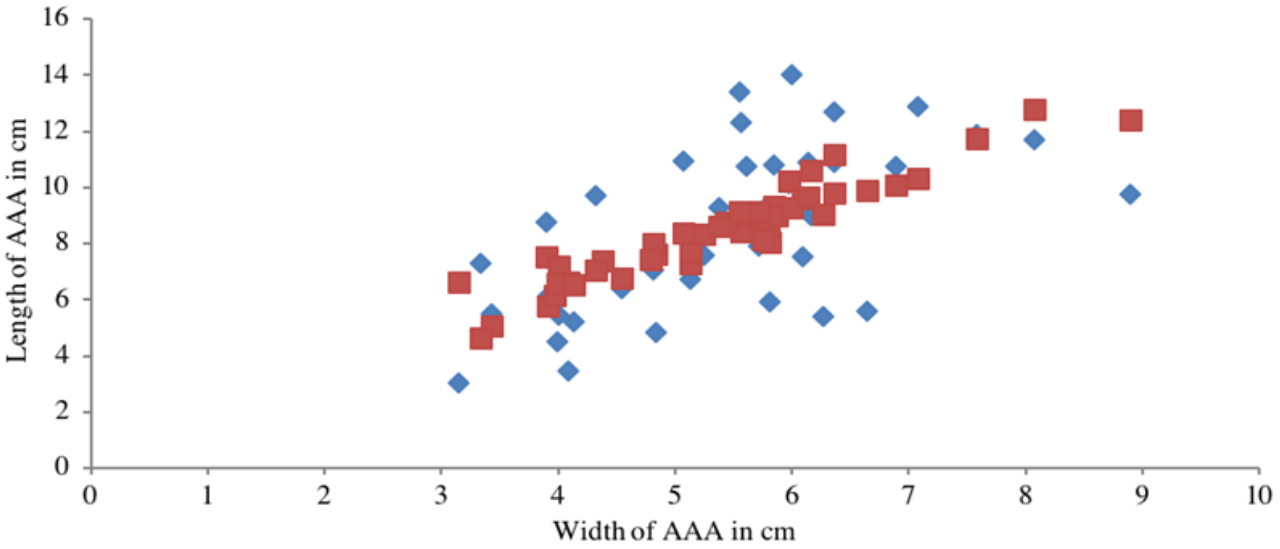
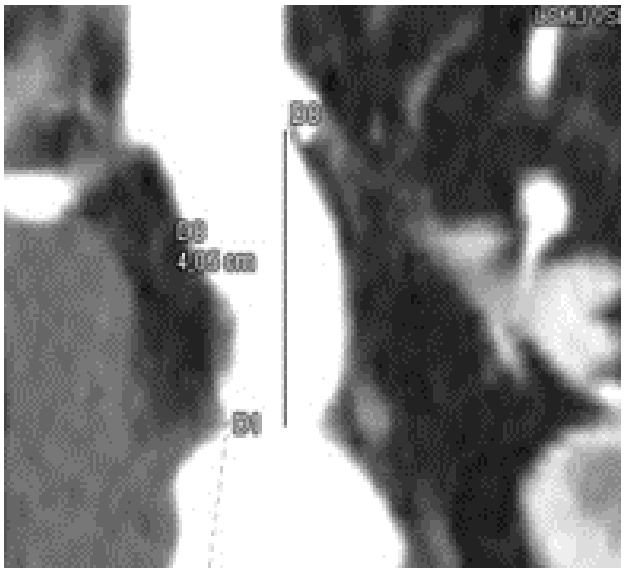
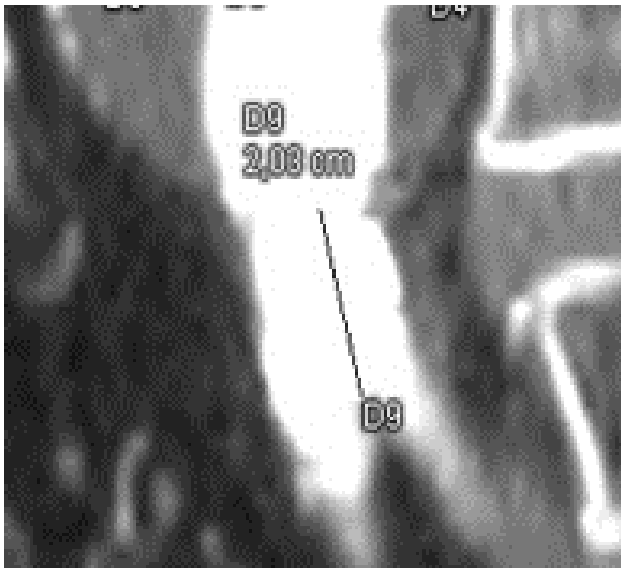


Fig. 6. On the left, measurement of the distance from the lower renal artery to the beginning of AAA in the frontal section (D8). On the right, measurement of distance from the AAA to the aortic bifurcation in the sagittal section (D9)





4. During the study it was found, that with an increasing number of comorbidities, male gender and increasing width of aneurysm, the distance from AAA to aortic bifurcation also increases.
5. It is known that there is statistical significance between length, width and hypertension. The width of the aneurysm in hypertensive patients is estimated to be greater than 0.67 cm.
6. We have also found, that hypertension and angina pectoris have a negative effect on AAA length. This means that patients, who have those diagnoses have shorter AAA comparing to patients without those diagnoses.
7. The study considered that angina pectoris and hypertension aren't statistically significant to the distance of AAA to the lower renal artery. Therefore, in our sample for the patients who were diagnosed with either hypertension or angina pectoris or an increased length of AAA showed on average smaller values for the distance of AAA to the lower renal artery than patients without those diagnoses.

8. Lastly, we determined, that just the length of AAA has statistically significant relation with the distance of AAA to the aortic bifurcation. Thus, with a corresponding increase in the length of AAA by 1 cm, the distance to bifurcation increases by 0.2 cm.

DISCUSSIONS

The study group consisted of 46 patients, who had an infrarenal AAA and underwent CTA examination at the HLUHS CK Radiology Clinic in 2017. The age of participants ranged from 53 to 89 years, with an average age of 72,32 in male group and 71,57 in female group. To our knowledge in the majority of studies the average age was similar [1, 5, 9, 10]. The investigation showed that the length of infrarenal AAA was 8,76 cm in men and 7,48 cm in women, while width respectively was 5,52 cm in men and 4,79 cm in women. The study of Matthew J. Grima and co-authors suggests that average diameter in different countries varies from 5,7 cm to 6,8 cm [11]. Several studies have found that smoking, male gender, age, atherosclerosis, hypertension and hyperlipidaemia are strong risk factors for AAA development [5, 12, 13]. Similar results were obtained during our study. Especially, hypertension had the greatest effect on the width of the aneurysm, by our calculations, patients with this comorbidity had an aneurysm wider by 0,67 cm. Also, we found out that hypertension and angina pectoris have no effect on AAA length. In comparison, other studies determined that risk factors like atherosclerosis has no statistically significant correlation with the size of AAA [14]. In terms of gender, males have a positive effect on the formation of the larger thrombus, which is larger by 0,33cm comparing to the females. In the previous study, Hiroshi Yasuhara and co-authors reported that “female gender was the only patient characteristic independently significantly correlated with small thrombus" (Hiroshi Yasuhara, Nobusuke Ohara, Hirokazu Nagawa, 2001) [15]. According to our findings, CTA is one of the greatest diagnostic methods to evaluate AAA size and localisation, and the length is the most statistically significant variable to evaluate these parameters. Meanwhile, other authors say that CTA is generally not needed to diagnose AAA, but is a good tool to evaluate size and localisation before surgical treatment [1, 16]. All in all, our study cannot be applied on the whole population because of the lack of participants, but the initial results are similar to those of other studies and literature data.

CONCLUSION

1. Female gender affects size of AAA: smaller length and width of aneurysms were observed. Male gender leads to the formation of larger thrombi.
2. The length of AAA was the most statistically significant variable since the P-value was always <0,05. Therefore, it is a good tool to use in evaluation of AAA size and location characteristics.
3. The linear regression analysis showed that hypertension has a statistically significant effect on the width of AAA by increasing its size.

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