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Investigation of Epidemiological, Anatomical, and Risk Factors of the Thoracic Aortic Aneurysm and Dissection, in Mazandaran Heart Center

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Abstract: **Introduction:** Aortic aneurysm is one of the most common cardiovascular diseases that can lead to numerous challenges for patients. The mortality rate of ruptured Thoracic Aortic Aneurysm (TAA) is observed to be high. In order to reduce this high rate, appropriate methods to diagnose TAA as well as its useful and aggravating factors are to be developed and/or identified. The objective of this study is the evaluation of the thoracic aortic aneurysm and dissection, in Mazandaran Heart Center. **Methods:** This cross-sectional study with a census design was performed on all patients with thoracic aortic aneurysm and dissection who have undergone aneurysm surgery, from December 2010 to January 2019. Patients' information was extracted from their medical records archive. SPSS 16.0 was used for statistical analysis. **Results:** From 53 patients with a thoracic aortic aneurysm, 77.4% were male. The mean age of patients was 59.70±12.07 years. 21 (39.6%) patients were more than or equal to 60 years old, while the remaining 32 (60.4%) were less than 60 years of age. The overall mortality rate was 11.3%. The mean aortic diameter of the patients was 5.42 cm. All patients had type A dissection. In other words, type B was not seen. **Conclusion:** Given the high prevalence and high mortality rate of thoracic aortic aneurysm, early screening can be beneficial and can increase the survival rate of patients. Laboratory and pathologic findings, along with clinical findings, can be very beneficial in early diagnosis.

Keywords: Aneurysm aorta; thoracic aortic aneurysm; aneurysm dissection; risk factor

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1. Introduction

Cardiovascular diseases are the leading cause of death. Unfortunately, there are many patients diagnosed with or experiencing cardiovascular disease in Iran. Aortic aneurysm is responsible for a high number of deaths due to cardiovascular diseases. In fact, aortic aneurysm remains one of the most common causes of mortality in the United States (1-3).

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There is no specific study on the prevalence of this condition in Iran, in saying that, limited studies have estimated the prevalence of AAA (abdominal aortic aneurysm) in Iran to be between 5-10% (4, 5). Aortic aneurysm is an abnormal deviation in the aortic wall in which the aorta gradually weakens and can lead to aortic dissection, rupture, and even death (1). Aortic aneurysm is defined as a fixed and regional aortic dilatation, 50% greater than the diameter of the aorta, and depending on the anatomical location of the aorta (6). The aneurysm can occur in different parts of the aorta (thoracic to abdominal). It occurs more frequently in the ascending aorta and less in the aortic arch. However, the incidence of the thoracic aorta is lower than that of the abdomen. The aortic arch is the portion of the main artery and distributes blood from the left ventricle of the heart to the rest of the body. Blockages restrict blood flow to the rest of the body, can eventually result in swelling and even an aneurysm. Aortic arch aneurysm also causes many problems for patients (7).

The mortality rate of ruptured thoracic aortic aneurysm (TAA) is observed to be high. In order to reduce this high rate, appropriate methods to diagnose TAA as well as its useful and aggravating factors are to be developed and/or identified (8).âĂń The etiologies of TAA are different and can range from degenerative aortic enlargement or hypertension to other genetic disorders (9).

Factors such as atherosclerosis, smoking, congenital disabilities, hypertension, age, sex, chronic lung disease, level of diverse lipids, Lipoproteins (Fasting Blood Sugar (FBS), Triglycerides (TG), Total Cholesterol (TC), High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL), are involved in aneurysm (10). According to studies, the prevalence of TAA in men is more than women, in the black race is more than those of white skin origin, and increases with age (2).

Aneurysm rupture increases the risk of death in patients, especially the elderly. In fact, symptoms of aneurysm appear after rupture, which increases the risk of death. On the other hand, early detection can reduce the probability of death to less than 6% (11).

There have been a number of recent advancements in the treatment of patients with TAA, that have been able to reduce the mortality rate. Surgery is also one of the treatments for these patients (12). Also, lifestyle modification is an essential aspect of the effective medical management in these patients (13). The best approach to prevent aortic aneurysm is to maintain the health of blood arteries (14, 15).

In this study, we assessed the demographic characteristics (using checklists) and laboratory findings of patients. In fact, the purpose of this study is to investigate epidemiological and anatomical examination of thoracic aortic aneurysm and the related risk factor of the dissection in patients admitted to Mazandaran Heart Center in Sari, in the past ten years.

2. Methods

2.1. Study Design

In this cross-sectional study, data were obtained from all patients admitted with thoracic aortic aneurysm and dissection to Mazandaran Heart Center, teaching hospital affiliated to Mazandaran University of Medical Science in Sari, Mazandaran, from January 2009 to January 2019.

2.2. Patient and Data collection

Fifty-three patients participated in our investigation. Patients' information was extracted from their medical records archive with the necessary ethical considerations of their privacy, using a self-made checklist. Two of our team members referred to Mazandaran Heart Center to complete the checklists. The checklist contains variables such as demographic features (age, gender), biochemical, and pathology test results. All data were obtained from computerized records and manual archives of the hospital. Inclusion criteria included medical records of all patients with thoracic aortic aneurysm and dissection, who had undergone surgery. On other hand, the exclusion criteria were as follows: 1) insufficient medical record, 2) patients without aortic dissection or with another type of aortic aneurysm.

2.3. Data analysis

At first, Microsoft excel 2016 was used to categorize the extracted data. Subsequently, Statistical Package for the Social Sciences 16.0 (SPSS 16.0 Inc. Chicago, IL, USA) was used for statistical analysis.

2.4. Ethical consideration

The ethics committee of Mazandaran University of Medical Sciences (MAZUMS) approved this study by the code IR.MAZUMS.REC.1398.023 which was adopted on Feb 20, 2018. The study research committee of the MAZUMS proceeded to send a request to Mazandaran Heart Center for collaboration. All information contained in the medical records archive was used confidentially and exclusively for the aim of this study to comply with ethical standards. All files were delivered back to the archive without any changes.

3. Results

From 53 patients, 77.4% were male. The mean age of patients was 59.70±12.07 years. 21 (39.6%) patients were more than or equal to 60 years old, while the remaining 32 (60.4%) were less than 60 years of age. The youngest and oldest subjects were 29 and 75 years old, respectively. 60.4% of the study population had a history of hypertension. A history of cardiovascular disease was seen in 28.3% of patients. 19% of patients were smokers. The mean aortic diameter of the pa-

Table 1: Demographics information of the patients

variable	Frequency (percent)
Total number	53 (100)
Age	
≤60	21 (39.6)
>60	32 (60.4)
Sex	
Male	41 (77.4)
female	12 (22.6)
History of hypertension	32 (60.4)
Diabetes mellitus	1 (1.9)
Smoker	9 (17)
Familial hypercholesterolemia	19 (35.8)
Cardiovascular disease	15 (28.3)
In hospital mortality	6 (11.3)
Diameter of aorta	
>3 cm	1 (3.7)
3-6 cm	19 (35.8)
>6 cm	7 (25.9)

Table 2: The distribution laboratory values in the patients

variable	Minimum	Maximum	Mean
Systolic BP	90	180	127.08
Diastolic BP	48	100	75.84
FBS	65	520	121.89
TG	51	430	128.80
TC	99	233	156.24
LDL	29	150	91.37
HDL	18	73	40.51

tients was 5.42 cm. The maximum and minimum diameters were 85 mm and 31 mm, respectively. The Demographics information of the patients is shown in table 1.

The mean level of Fasting Blood Sugar (FBS), Triglycerides (TG), Total Cholesterol (TC), High-Density Lipoprotein (HDL), and Low-Density Lipoprotein (LDL), were 121.89, 128.80, 156.24, 40.51, 91.37 (mg/dl), respectively. Status of systolic and diastolic blood pressure, FBS, TG, TC, LDL, and HDL of the patients are shown in Table 2.

All of the patients had type A dissection, and type B was not seen. Most of the patients, i.e. 52 individuals (98.1%), in the ascending aorta, had aneurysms. 6 (11.3%) patients in their descending aorta and 9 (17%) patients in their aortic arch, had aneurysms. 44 (83%) patients had aneurysm in one cite and 9 (17%) patients had an aneurysm in multi-site. Degenerative aortic aneurysms were seen in all of the patients. Distribution of aortic aneurysm type in the patients is shown in table 3.

Table 3: Distribution of aortic aneurysm type in the patients

variable	Frequency (percent)
Ascending aorta	52 (98.1)
Descending aorta	6 (11.3)
Aortic arch	9 (17)
Aneurysm location number	
One site	44 (83)
Multi-site	9 (17)

4. Discussion

Mortality from cardiovascular disease is one of the biggest challenges facing our modern society. Furthermore, aortic conditions, including aortic aneurysms, account for a notable proportion of these diseases (16). In this study, we sought to determine the epidemiology and anatomical prevalence of thoracic aortic aneurysm and dissection. And we report different variables relating TAA. Several other papers studied the subject of aortic aneurysms, but for the most part, they did not study the prevalence of a thoracic aortic aneurysm. Whereas, our study focused on the investigation of the aneurysm in parts of the thoracic aorta (17-19). Many studies determined that the prevalence of aortic aneurysm can vary according to gender, age, and geography (20, 21). The data collected from our study showed that men are about four times as likely as women to experience aortic disease. That is roughly equivalent to global statistics .(22)However, a study that was done by Johansson et al., showed that the prevalence of the disease is equal between the different genders (8). Besides, a study done by F. Nicolini, focused on the impact of gender on the population's aortic aneurysm, revealed that women were more likely to experience aortic disease. Furthermore, it was reported that they had a higher mortality rate. Some researchers recommend further examination of hormonal and molecular explanations for sex differences (16). Age was considered as one of the variables in the rate of incidence of aortic aneurysm. In our study, we observed a slight increase in the prevalence of aortic aneurysm with age. Many studies have investigated the age variable as one of the factors affecting the rate of aortic aneurysm, and some of them contradict each other (23-26). A study by A Brady AR et al. reported that age had no association with aortic aneurysm. In contrast, a study by Wilmink TB et al., declares that the risk of aortic aneurysm increases with advancing age (23, 24). With increasing age, the arterial muscles become more stiff and weak, increasing the risk of aortic aneurysm (27). A review study that was done by Boocher et al. advised that patients with TAA should be screened for the presence of concurrent genetic or familial disorders, which increase their individual risk of aneurysm progress or complications. Risk factor analysis for Coronary Artery Disease (CAD) and symptoms that can be attributed to CAD (e.g., blood pressure) should also be considered (13). The mean blood pressure in our population was in the normal range. Nevertheless, some patients had very high sys-

tolic blood pressure (above 140mmHg). It seems that High Systolic BP in type A dissection can increase the risk of rupture. Because blood has more pressure at the beginning of the aorta, it causes more damage to the artery wall. Consequently, the risk of rupture rises. High blood pressure in the ascending aorta and high cystic medial degeneration may be the reasons for this finding in the patients (28). If the TAA was diagnosed early and treated promptly, the survival rate is significant. In the event of a vascular rupture, however, there is little hope for survival. The relatively low in hospital mortality rate (11.3%) in the patients examined, may be due to the proximity of the blood transfusion center to Mazandaran Heart Center. This is due to the fact that aortic rupture surgery requires a large amount of blood transfusion. However, this factor does not appear to have a significant impact on reducing mortality and the role of factors such as family history, age, or laboratory findings, should be considered more important. The laboratory data of our study that were associated with blood lipids, were generally in the normal range. However, the HDL index was not satisfactory. It is important to note that high levels of LDL and TG, can lead to vascular stiffness and rising the risk of rupture (29). The results of our study about FBS showed that this indicator had a high average. However, only one person in our study population had diabetes. This result was explored in other studies. A review study by S. Shantikumar et al. determined that the incidence of the aortic aneurysm was lower in people with diabetes than in non-diabetics (30). The study by Tsai CL et al. demonstrated that patients with diabetes had a reduced prevalence of thoracic and abdominal aortic aneurysms, and that the observed paradoxical inverse relationship between the severity of DM and aortic aneurysms was clear (17). Our result showed that 17% of the examined population in the study were smokers, which is a notable portion. A study by Wilmink et al. revealed that smokers were 7.6 times more likely to have aortic aneurysms than non-smokers (24). Another study carried out by Auerbach O et al. showed that only 16% of thoracic aorta patients had never smoked regularly, and that even 41% of the patients smoked 1-2 packs per day (31). Studies have shown that the risk of the aneurysm in people who smoke one to two packs a day, is eight times more than non-smokers. As a result, this condition is found in 16% of heavy smokers (32). A number of studies have shown that tobacco is also directly related to vascular stiffening. This hardening increases the risk of aortic aneurysms (33). The majority of the patients in our study, had an aortic diameter of between 3 and 6 cm. Meanwhile, the aortic diameter of 7 patients was more than 6 cm. Remarkably, no mortality was observed in any of these patients before or after surgery. The original history of TAA, as in any aneurysm, is relevant to size. Aortic diameter is one of the most important factors in aneurysms. Following the primary studies in 1966 by Szilagyi et al. (34), size has been shown to be a significant risk factor for aortic rupture. Survival expectancy in untreated small AAA (<6 cm) was shown to be better than that for larger aneurysms (>6 cm). For non-operated aneurysms across ten years, the risk of rupture was 19.5% for small aneurysms and 43% for larger aneurysms (1). The aortic dissection is divided into two categories. This classification is based on the site of the intimal tear and the extent of the dissection. According to the Stanford classification system, Type A dissection involves the ascending aorta. It may also include the aortic arch or the descending aorta. On the other hand, type B dissection is restricted to the descending aorta. If the onset of dissection is from the ascending aorta, it defines as type A dissection. Whereas, if dissection begins from descending aorta, it is then called a type B dissection (1, 35). Roughly 50% of TAA is in the descending aorta. Type B dissections, as opposed to type A dissection, are less common to rupture. The small diameter of the descending aorta may be the cause of this (36). This study includes some limitations. For example, the number of subjects (sample size) is low. In other words, a larger sample size would have been preferred, to make a sound conclusion. A small sample size could be responsible for significant failure in the relationship between variables. We could not include all of the variables that affect aneurysm, and this may be another limitation of this study. Therefore, it is recommended that conducting a study on a larger population and the inclusion of more variables, will be able to cover the gaps that became apparent in this study.

5. Conclusion

Given the high prevalence and mortality rate of TAA, lifestyle modifications and early screening can be beneficial and thereby increase the survival rate of patients. In saying that, in our study, mortality rates were relatively low due to factors such as proximity to a blood transfusion center. Patients with TAA should be screened for the presence of concurrent genetic or familial disorders which increase their risk of aneurysm progress or complications. According to the evidence and the resulting statistics in our study, it can be concluded that laboratory and pathologic findings along with clinical findings, can be very beneficial in early diagnosis of this conditions. Considering the results of our study and its limitations mentioned above, newer and broader studies with larger sample sizes are recommended.

6. Appendix

6.1. Acknowledgements

This study resulted from a research project approved by Mazandaran University of Medical Sciences and the Student Research Committee, with the approval code IR. MAZUMS.

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6.2. Author contribution

All the authors have shared the same workload and thereby are entitled to equal acknowledgement.

6.3. Funding/Support

None.

6.4. Conflict of interest

The authors declare no conflict of interest.

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