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# Mediastinal adipose tissue and aortic measurements in thoracic CT: is it related to atherosclerosis?

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## ABSTRACT

**Aim**: We aimed to investigate whether the mediastinal adipose tissue plays a role in thoracic aortic atherosclerosis with thoracic Computed Tomography (CT) imaging. We aimed to elucidate the relationship between the amount and density of mediastinal adipose tissue, age, sex, and the presence of atherosclerotic plaque in the aorta.

**Material and Method**: In this retrospective study, the thoracic computed tomography (CT) images of 45 patients (21 men and 24 women) were examined in two groups. There were 23 patients aged >60 years in group 1 and 22 patients aged <60 years in group 2. The measurements were manually performed from the image where the mediastinal fat tissue, located anterior compartment of the aorta and the pulmonary artery, is viewed widest. The area and density of mediastinal fat tissue, the diameter of the aorta and the distance from the anterior of the aorta to the sternum were measured. The narrowest distance between the aorta and the pulmonary artery, and the subcutaneous fat tissue thickness from the anterior of the sternum in the same section were measured. The presence and absence of atherosclerotic plaque in the aorta were also recorded.

**Results**: We found no significant differences in demographic and clinical data between the groups. Among the patients aged >60 years (group 1) and <60 years (group 2), statistically significant differences in fat density, sternal fat thickness, and aortic diameter were found. Age was associated with the presence of atherosclerotic plaque. A statistically significant relationship was observed between sternal fat thickness and atherosclerotic plaque. The sternal fat thickness was greater in those with than in those without atherosclerotic plaques. The presence of atherosclerotic plaque was associated with aortic diameter. No statistically significant relationships were observed between the presence of atherosclerotic plaque and the amount and density of mediastinal fat, the aortosternal distance, and the aortopulmonary artery distance.

**Conclusion**: The risk of atherosclerosis increases not only with excess adipose tissue but also depending on many other parameters. While evaluating atherosclerotic risk and plaque development, patient age, sex, fat distribution, and other diseases should also be evaluated. It should be kept in mind that atherosclerosis is still an unexplained multifactorial parameter in development.

**Keywords**: Atherosclerosis, aorta plaque, mediastinal fat tissue, thoracic CT

## INTRODUCTION

Atherosclerosis is the most important cause of cardiovascular diseases such as myocardial infarction and stroke (1). According to the World Health Organization report, atherosclerosis is the main cause of death, accounting for 32% of all deaths (2). In the etiology of atherosclerosis, inflammatory risk factors such as hypercholesterolemia, diabetes, obesity, smoking, and hypertension are believed to initiate vascular chronic inflammation by affecting arterial wall cells (3).

Obesity is a preventable cause of disease and death in Western societies (4). Although general body fat excess increases the incidence of cardiovascular diseases, recent studies have shown that fat distribution is more important (5). The role of the perivascular adipose tissue in the formation of cardiovascular diseases has been revealed (6). The perivascular adipose tissue is thought to have local effects on blood vessels (7,8). Adipose tissue is considered to be the source of proinflammatory secretions. The perivascular adipose tissue activates macrophages, T cells, and proinflammatory cytokines (9). All these trigger inflammation, atherosclerosis, restenosis, and vascular smooth muscle cell proliferation (10).

On the basis of these findings, we aimed to question whether the mediastinal adipose tissue is also involved in thoracic aortic atherosclerosis. We aimed to elucidate the relationship between the amount and density of mediastinal adipose tissue, age, sex, and the presence of atherosclerotic plaque in the aorta.

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## MATERIAL AND METHOD

This retrospective study was conducted at Kırıkkale University, Faculty of Medicine, Radiology Department according to the principles of the Declaration of Helsinki. Thoracic computed tomography (CT) scans were retrieved from the digital database of the Radiology Department of Kırıkkale University, Faculty of Medicine. Ethics committee approval was obtained from Kırıkkale University Non-invasive Researches Ethics Committee (Date: 11.01.2023, Decision No: 2023.01.11). There was no need to obtain informed consent because the data were evaluated retrospectively.

### Subjects

This study was conducted retrospectively. The thoracic computed tomography (CT) images of 45 patients (21 men and 24 women) were retrieved from the hospital's Picture Archiving and Communication System (PACS) between January 2023 and November 2022. The patients were examined in two groups. There were 23 patients aged >60 years in group 1 and 22 patients aged <60 years in group 2. The patients' mean age was 71.78±6.24 years in group 1 and 44.77±10.43 years in group 2. The mean ages of the male and female patients were 59.67±15.33 years (range, 20–75 years) and 57.63±17 years (range, 24–89 years), respectively. Patients with histories of malignancy and thoracic surgery were not included in the present study.

### Thoracic CT Imaging and Analysis

All CT scans were obtained using routine thoracic CT imaging in the supine position. Contrast was used for the procedures. The images were acquired using a 64-slice CT scanner (Brilliance 64, Philips Medical System, Best, the Netherlands). All scans were obtained using the following parameters: tube voltage, 120 kV; effective tube mAs, 180; slice thickness, 1.25 mm; field of view (FOV), 350 mm; and image matrix, 972 × 972. The images were transferred to a workstation, and the raw data were reconstructed using bone algorithms. After scanning, the coronal, axial, and sagittal images were reconstructed with a slice thickness of 1.25 mm. The axial plane was often preferred. All cases included in this study were evaluated by the same radiology expert (P.Z.B.S.) on a high-resolution monitor.

### Measurements

The axial plane is often preferred for measurements. The measurements were manually performed from the image where the mediastinal fat tissue, located anterior compartment of the aorta and the pulmonary artery, is viewed widest. The anterior mediastinal fat tissue area was measured manually and recorded in millimeter squared (mm2). The density of the mediastinal fat tissue in Hounsfield units (HU) was measured by placing a 1-cm2 diameter of a region of interest (ROI) in the middle of the measured fat area. The diameter of the aorta and the distance from the anterior of the aorta to the sternum were measured. Moreover, the narrowest distance between the aorta and the pulmonary artery, and the subcutaneous fat tissue thickness from the anterior of the sternum in the same section were measured and recorded in millimeters. The presence and absence of atherosclerotic plaque in the aorta were also recorded.

### Statistical Analysis

The SPSS 21.0 software (IBM Inc., Chicago, IL) was used for the statistical analysis. The conformity of the data to the normal distribution was tested using the Shapiro-Wilk test. An independent-sample T test was used to compare normally distributed data. A chi-square test was also used. A p value of <0.05 was considered statistically significant.

## RESULTS

We found no significant differences in demographic and clinical data between the groups ($p > 0.01$). Among the patients aged >60 years (group 1) and <60 years (group 2), statistically significant differences in fat density ($p=0.023$), sternal fat thickness ($p=0.021$), and aortic diameter ($p=0.001$) were found. No statistically significant differences in aorta sternum distance ($p=0.143$), mediastinal fat area ($p=0.745$), and distance between the aorta and pulmonary artery ($p=0.861$) were found.

When the relationship between sex and age and the presence of atherosclerotic plaque was investigated, no relationship was found between sex and the presence of atherosclerotic plaque ($p=0.423$). However, age was associated with the presence of atherosclerotic plaque ($p=0.001$). A statistically significant relationship was observed between sternal fat thickness and atherosclerotic plaque ($p=0.044$). The sternal fat thickness was greater in those with than in those without atherosclerotic plaques, with a mean sternal fat thicknesses of 13.01 and 17.53 mm, respectively. A statistically significant relationship was observed between the presence of atherosclerotic plaque and aortic diameter ($p=0.001$), which was 33.78 mm in those with atherosclerotic plaque and 26.84 mm in those without atherosclerotic plaque. The presence of atherosclerotic plaque was associated with aortic diameter. No statistically significant relationships were observed between the presence of atherosclerotic plaque and the amount ($p=0.483$) and density of mediastinal fat ($p=0.108$) , the aortosternal distance ($p=0.977$), and the aortopulmonary artery distance ($p=0.796$).

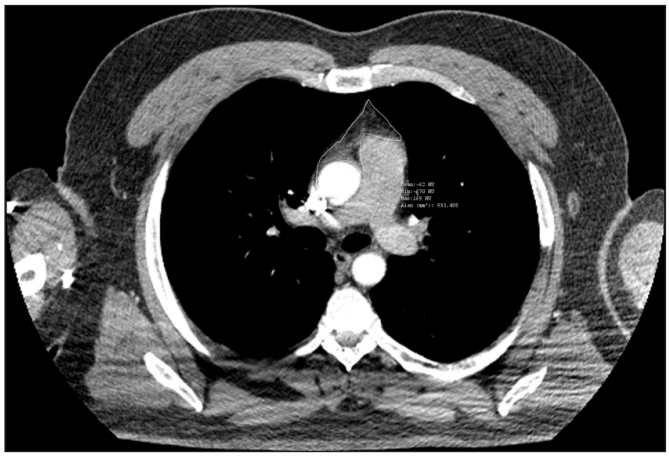

**Figure 1.** The figure shows the area of mediastinal fat tissue.

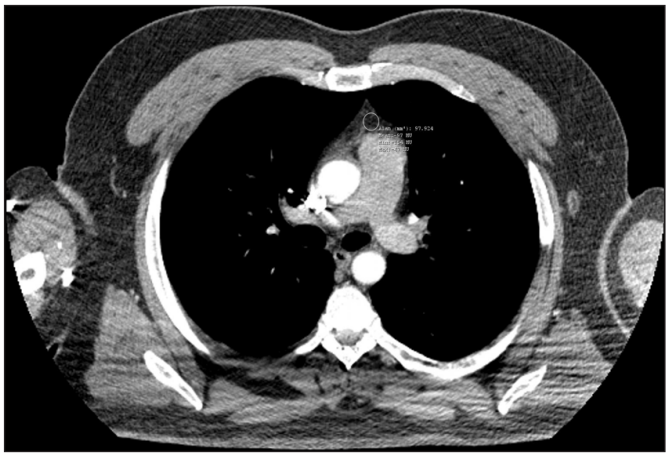

**Figure 2.** The measurement of fat dansity is shown.

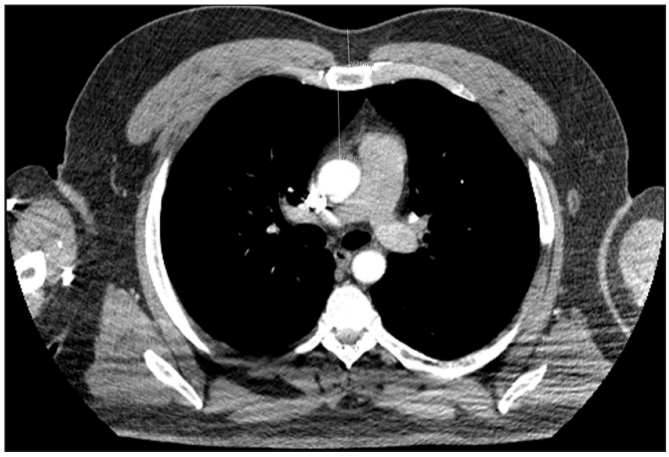

**Figure 3.** The measurements of the distance from the anterior of the aorta to the sternum and the subcutaneous fat tissue thickness from the anterior of the sternum in the same section are shown.

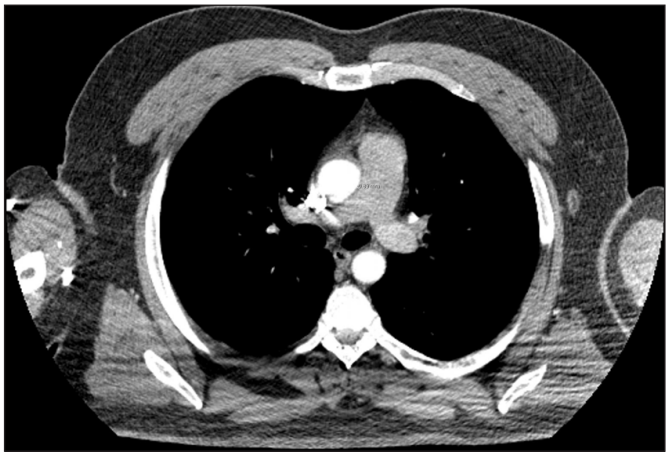

**Figure 4.** The figure shows the narrowest distance between the aorta and the pulmonary artery.

## DISCUSSION

Obesity is a state of abnormal accumulation of fat in the body. Obesity and accompanying metabolic conditions are known to be risk factors of cardiovascular diseases (11). However, this has not yet been clarified. Some studies have shown that the epicardial and perivascular fat areas can directly contribute to the development of cardiovascular complications with a local effect (12,13). Systemic inflammation and adipokine production from adipose tissue have been pointed out to be responsible for the negative effects of adipose tissue on the vessel wall (14). In addition, metabolites, cytokines, and hormones secreted into the environment by the adipose tissue may affect the liver and cause changes in lipoproteins. This causes coagulation and inflammatory factors to prepare the vessel wall for its atherogenic environment (15). In addition, adipose tissue-derived factors have been shown to affect the gene expression and cell function in endothelial cells, arterial smooth muscle cells, and macrophages (13). Therefore, the adipose tissue is an endocrine and metabolic organ that influences the systemic inflammatory state and affects metabolism (16,17). In light of this information, we aimed to determine whether an interaction exists between the presence of aortic artery plaque and the fat ratio and density in the anterior mediastinum. In our study, when the relationships of the presence of atherosclerotic plaque with the amount of mediastinal fat, fat density, and aortosternal distance were examined, no statistically significant differences were observed between those with and without atherosclerotic plaques. We found no correlation between the presence of atherosclerotic plaque and the amount of mediastinal fat. We did not find a similar study in the literature that investigated the relationship between the mediastinal adipose tissue and the aorta. However, examination of the literature provided the understanding that not only the presence of adipose tissue but also the distribution of adipose tissue in the body differs in the development of atherosclerosis, and different mediators are released from adipose tissue in different places (14,18-20). Our results may be related to mediastinal adipose tissue properties or can be explained by the fact that many other factors influence the development of aortic atherosclerosis. This may be a new finding, as the mediastinal adipose tissue and its mediators have not yet been studied. Further studies are needed on this subject.

According to our study, the sternal fat thickness was lower, the aortic diameter was larger, and the presence of atherosclerotic plaque was more pronounced in the patients aged >60 years. We found that the aortic diameter was larger in those with atherosclerotic plaques. In our study, we observed that the sternal fat thickness was greater in those without atherosclerotic plaques. Aging, decreased endothelial cell function, increased collagen deposition, fibrosis, and hardening of the arteries reshape the arterial walls and facilitates the development of atherosclerosis before (21,22). Our results on aging are consistent with the reports in the literature, but the relationship between adipose tissue thickness in the sternum and atherosclerosis is interesting. This condition can occur with age-related dysregulation of lipid metabolism in subcutaneous adipocytes that occurs with aging and a decrease in the ability of subcutaneous adipocytes to act as lipid stores (23,24). Further research is needed on age-related changes in mediastinal fat tissue and thoracic subcutaneous fat distribution.

This study has several limitations. One of these is the small number of patients. Larger case series are needed for better results. If biochemical blood inflammation parameters and lipid profiles are added to the comparison, more detailed research results can be obtained. In addition, pathologies such as the presence of diabetes and hypertension could not be excluded in our study. A clearer contribution to the literature can be made by excluding other pathologies that cause systemic inflammation.

## CONCLUSION

Atherosclerosis is one of the most common inflammatory diseases. Obesity and perivascular fat trigger inflammatory mediators. Increases in the mediators and inflammatory cells in the body can cause atherosclerosis. However, the risk of atherosclerosis increases not only with excess adipose tissue but also depending on many other parameters. While evaluating atherosclerotic risk and plaque development, patient age, sex, fat distribution, and other diseases should also be evaluated. It should be kept in mind that atherosclerosis is still an unexplained multifactorial parameter in development.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** The study was carried out with the permission of Kırıkkale University Non-invasive Researches Ethics Committee (Date: 11.01.2023, Decision No: 2023.01.11).

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients**.**

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

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