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Incidental Noncardiac Findings at Coronary Computed Tomography Angiography

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What is already known on this topic?

- *Noncardiac findings are common in patients who underwent coronary computed tomography angiography imaging.*
- *In several patients, noncardiac findings might be related to the patient's complaints.*
- *Early diagnosis of noncardiac findings that are suspicious of a malignancy is crucial for patients' wellbeing.*

What this study adds to the existing knowledge?

- *Informing the reporting physicians about patients' complaints is of clinical importance.*
- *Expanding the field of view should be considered in patients with symptoms suggesting noncardiac origin.*
- *Coronary computed tomography angiography is an opportunistic method for assessing lung nodules in patients with a smoking history.*

Abstract

Objective: Coronary computed tomography angiography (CCTA) is one of the most used non-invasive imaging modalities for assessing obstructive coronary artery disease (CAD). Beyond the coronary arteries, CCTA also evaluates the structures adjacent to the heart and commonly diagnoses noncardiac pathologies. This study aimed to investigate the incidence and clinical significance of noncardiac findings in patients who underwent CCTA with the suspicion of obstructive CAD.

Methods: Patients who underwent CCTA between 2021 and 2024 were retrospectively included. Patients with prior diagnoses of noncardiac pathologies were excluded from the study. Noncardiac findings were assessed according to their clinical significance and/or relation to the patient's complaints.

Results: A total of 2208 patients were screened, and 2103 patients were included after excluding ineligible patients. Among 2103 CCTA imaging, 615 noncardiac findings were detected in 586 patients (27.8% of the study population). In 88 patients, noncardiac findings were possibly related to patient complaints, and only 5 patients among 88 patients demonstrated obstructive CAD. Hence, in 83 patients, noncardiac findings are considered the cause of complaints. Fifty-six findings were thought to be clinically significant and underwent further work-up. Among 56 patients, 3 patients were diagnosed with lung cancer, 1 patient with lymphoma, 1 patient with neuroendocrine carcinoma, 1 patient with peripheral nerve sheath tumor, and 1 patient with sarcoidosis.

Conclusion: The results demonstrated that CCTA is a feasible technique not only for assessing CAD but also for helping to differentially diagnose chest pain. In addition, incidental findings might be clinically significant and lead to early diagnosis of life-threatening conditions.

Keywords: Chest pain, computed tomography coronary angiography, noncardiac findings

Introduction

Coronary computed tomography angiography (CCTA) is the emerging non-invasive imaging modality for assessing coronary artery disease (CAD), particularly in patients with low-to-intermediate pretest probability. In addition to being an initial screening imaging tool, recent literature suggests that CCTA is also useful for assessing high-risk atherosclerotic plaques, procedural planning of percutaneous coronary intervention, assessment of saphenous vein grafts, and previously implanted coronary stents.[1,2] Hence, since the indications of CCTA are evolving, the number of patients undergoing CCTA is increasing exponentially. Unlike the other cardiac imaging modalities, CCTA also provides information about noncardiac pathologies, including lung, mediastinum, vascular, breast, and gastrointestinal pathologies, depending on the width of the field of view (FOV).

Previous studies have reported that noncardiac findings are common in patients undergoing CCTA imaging. Although these findings might be closely or remotely associated with the patient's primary complaints (e.g. diaphragmatic hernia, pneumonia), sometimes findings are entirely incidental (e.g. lung nodules, emphysema). Moreover, these findings might be benign in nature, but in several

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patients' findings, they are malignant, which requires further research and urgent therapy. However, the literature includes several studies that questioned the clinical importance of noncardiac pathologies from 2 points of view: first, the majority of these findings are benign in nature and do not impact patients' clinical management, and second, these findings increase cost and patients' radiation exposure during the follow-up.[3,4] Hence, the clinical significance of these findings still needs to be clarified. According to current literature, indications for adding a full thorax CT scan on top of the conventional CCTA are not clear, and considering the pooling data, it might be beneficial for selected patients.

In this study, the primary aim was to demonstrate the incidence and clinical significance of noncardiac pathologies detected in CCTA images. An additional aim was to identify noncardiac findings that might be related to patients' complaints.

Methods

Study Design and Patient Selection

Patients who underwent CCTA imaging for the evaluation of suspected obstructive CAD between January 2021 and May 2024 were enrolled in the study. This is a retrospective observational study. The study protocol was approved by the institution's local ethics committee (Date: January 8, 2025, Number: 2025/51). Informed consent was obtained. Patients' comorbidities, clinical profile, and CCTA imaging indications were out of this paper's scope and, therefore, were not represented. Patients' age and gender were recorded. Patients with a prior diagnosis of noncardiac disease, recent thoracic surgery, under 18 years old, and CCTA imaging without good image quality were excluded from the analysis. Patients admitted to the emergency service and who underwent triple rule-out CT scans were also excluded from the study.

Coronary Computed Tomography Angiography Protocol

Coronary computed tomography angiography was performed using a 128-slice scanner (GE Revolution EVO), and the standard scanning parameters were 64 mm × 0.625 mm detector collimation, 350 ms rotation time, 120 kV tube voltage, and 40 mAs (400 mA × 0.1 s) tube current under electrocardiogram-gated dose modulation.

Image Assessment and Noncardiac Findings

The presence of noncardiac findings was assessed using CCTA images that focused primarily on the heart, as well as broad-field images that covered the entire scanned volume. Images were processed with standard algorithms for soft tissue and lung reconstruction from each scanner. The radiologist used various windowing parameters for soft tissue, lung, and bone to analyze the images, making additional manual adjustments when necessary. Figure 1 and 2 represent the examples of noncardiac findings.

Noncardiac findings were categorized based on whether they were a possible cause of chest pain or clini cally significant.

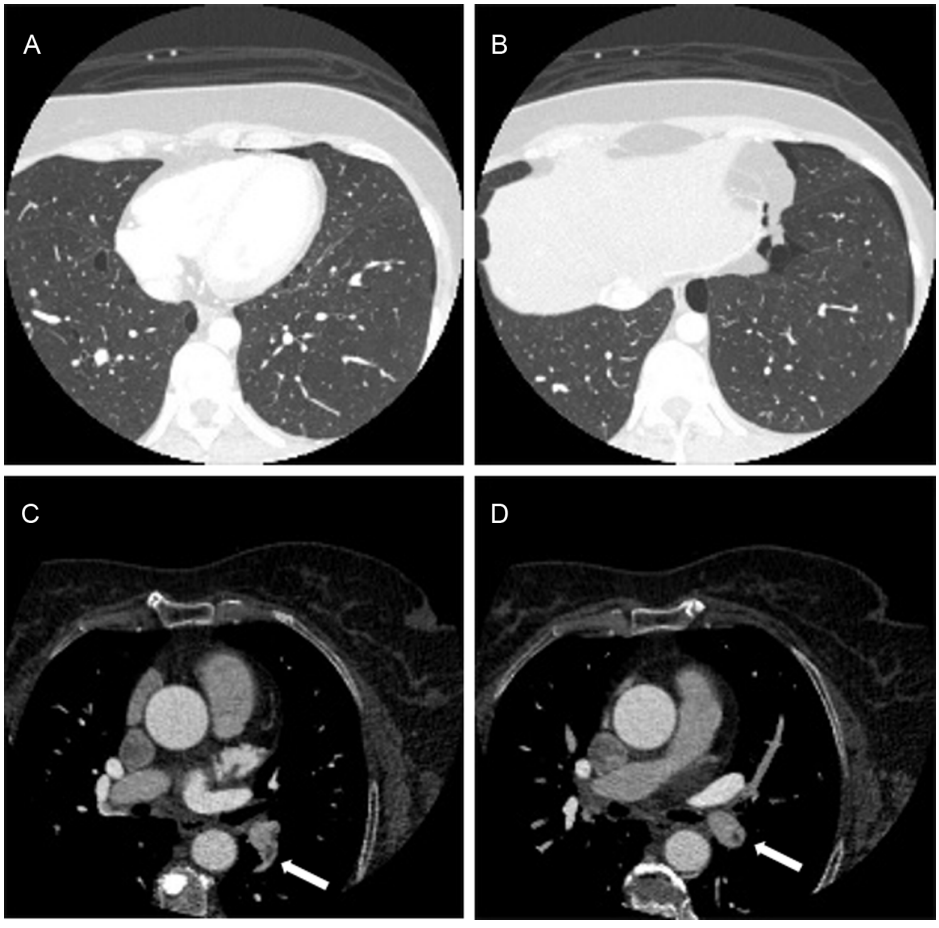

Figure 1. Two examples of noncardiac findings identified on axial CCTA. (A and B): Multiple cysts predominantly in the subpleural and perifissural lung with pneumothorax diagnosed as Birth-Hogg-Dube syndrome after clinical consultation. (C and D): Acute pulmonary embolism in the left lower lobe pulmonary artery (white arrow). CCTA, coronary computed tomography angiography.

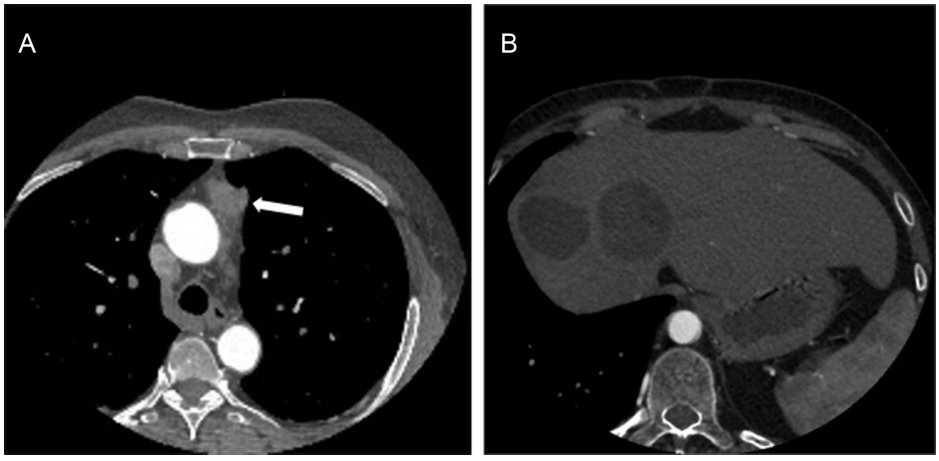

Figure 2. Two examples of noncardiac findings identified on axial CCTA. (A) Anterior mediastinal mass with soft tissue density (white arrow). This lesiion was confirmed to be enuroendocrine tumor after surgical resection. (B): Two hydatid cysts at the level of the liver. CCTA, coronary computed tomography angiography.

Noncardiac findings that are in the differential diagnosis of chest pain are thought to be a possible cause of chest pain in patients without obstructive CAD. Noncardiac findings that caused symptoms or necessitated further investigation, monitoring, or treatment were accepted as clinically significant.

Assessment of Lung Nodules

Follow-up recommendations for lung nodules were made to clinicians in line with the 2017 Fleischner Society guidelines.[5] The assessment of the lung nodules was performed on wide-field images reconstructed with a standard lung algorithm. Pulmonary nodule size was measured by calculating the average of the longest diameter and its perpendicular short-axis diameter. Measurements were obtained from the same image plane—axial, coronal, or sagittal—depending on which orientation demonstrated the largest dimensions, in accordance with the 2017 Fleischner Society guidelines. The lung nodules were categorized into ground glass nodules, part solid nodules, and solid nodules.

Statistical Analysis

Statistical analysis was performed using SPSS version 23 (IBM SPSS Corp.; Armonk, NY, USA). Normally distributed quantitative variables are expressed as means and standard deviations, while non-normally distributed data are presented as medians and interquartile ranges. To assess statistical significance, Student's *t*-test, Mann–Whitney *U*-test, or chi-squared test as appropriate are used. A difference was considered statistically significant with a 2-sided *P*-value of <.05 (Figure 3).

Results

Between January 2021 and May 2024, 2208 CCTA imaging were performed. Among those, 43 patients with previous cardiothoracic surgery, 30 patients with insufficient image quality, 24 patients with prior diagnosis of lung nodules, 6 patients with liver disease, and 2 patients with gastrointestinal pathologies were excluded. The final analysis included 2103 CCTA imaging, and among those, 615 noncardiac findings were detected in 586 patients (27.8% of the study population). Figure 3 represents the study flowchart, Table 1 represents patient characteristics, and Table 2 represents the distribution of noncardiac findings.

There was male dominance in the study population and the mean age was 50 (43-58) years.

Noncardiac Findings Associated with Patients' Complaints

Eighty-eight patients with noncardiac findings (4% of the study population) were deemed a possible cause of chest pain: 23 patients with pneumonia, 3 patients with acute pulmonary embolism, 2 patients with anterior mediastinal mass, 1 patient with peripheral nerve sheath tumor, 1 patient with pneumothorax, 55 patients with significant hiatal hernia, and 3 patients with gallstone. Among 88 patients, there were 5 patients with obstructive CAD; and hence, the imaging findings in the remaining 83 patients (3.9% of the study population) were considered a possible cause of chest pain.

Clinical Significance

Among 586 patients, 56 patients with noncardiac pathologies were deemed clinically significant (2.6% of the study population); 8 of 8 breast lesions, 16 of 91 lung nodules, 1 of 1 pneumothorax, 3 of 9 adrenal gland adenomas, 2 of 2 anterior mediastinal masses, 12 of 55 hiatal hernias, and 14 of 28 mediastinal lymph nodes were considered clinically significant and underwent further investigation/therapy. There were 2 patients with anterior mediastinal masses who were eventually diagnosed with 1 neuroendocrine tumor and 1 lymphoma. Fourteen of 28 patients with mediastinal lymphadenopathies were suspicious of a serious medical condition and underwent further investigation; eventually, 1 patient was diagnosed with sarcoidosis and 1 patient with lymphoma.

Twelve of 55 hiatal hernias required further follow-up and underwent gastroscopy. Three of 9 adrenal gland adenomas underwent abdominal MRI scans. One patient with a liver cyst hydatid and 3 patients with gallstones underwent medical treatment or surgery.

There were 91 patients with lung nodules; 80 patients with solid nodules, 2 patients with part-solid and 9 patients with ground glass nodules. Among 80 solid nodules, 40 nodules were smaller than 6 mm, 31 nodules were between 6 mm and 8 mm and 9 nodules were over 8 mm. Among ground glass nodules 3 nodules were smaller than 6 mm and 6 nodules were over 6 mm. Three patients were eventually diagnosed with lung cancer following the further work-up.

Discussion

The principal findings of the study are i) noncardiac findings are very frequent in patients undergoing CCTA imaging, ii) in several patients, these noncardiac findings are not incidental and might

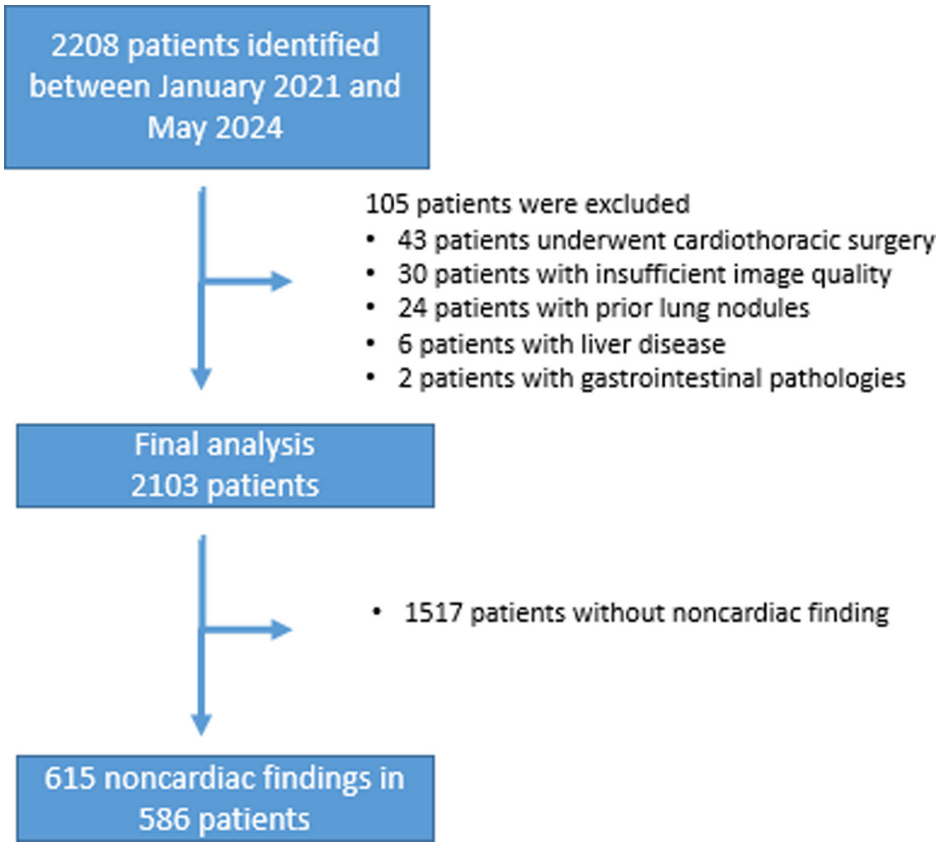

Figure 3. The study flowchart

be related to the symptoms of the patients and finally, iii) although the majority of these incidental findings are benign, several findings require close follow-up and can lead to early diagnosis of a malignancy.

Coronary computed tomography angiography was first indicated in patients with a low pretest probability of CAD. By then, the indications were expanded, and now, it is the most utilized imaging modality in patients with suspected CAD. In addition to visualizing coronary arteries, the imaging view includes several parts of the thoracic cavity and abdomen depending on the FOV. Therefore, CCTA imaging enables the diagnosis of noncardiac findings in this area. In the analysis, noncardiac findings are detected in approximately one-quarter of CCTA images. Studies in the literature reported a broad range of changes in the prevalence of noncardiac findings, primarily due to inclusion criteria. Williams et al[3] reported a 38% prevalence of noncardiac findings, which is higher than the results. A meta-analysis of 13 studies reported a 41% prevalence, which is also higher than the results. However, the majority of these findings are lung pathologies, which are strongly associated with smoking status and age of the patients.[6]

Table 1. Patient Characteristics

	Noncardiac Finding Absent (n = 1517)	Noncardiac Finding Present (n = 586)	*P*
Age, years, median (IQR)	55 (46-65)	50 (43-58)	<.001
Male (%)	57.3	61	.040

This discrepancy regarding the prevalence of noncardiac findings is probably due to the exclusion of patients with previously diagnosed noncardiac diseases, relatively young age, and lower smoking rates in the study cohort in comparison to previous reports.

Despite the expanding indication of CCTA imaging, in daily practice, it is mostly reserved for patients with low pre-test likelihood of CAD in whom the symptoms are mostly atypical. In such patients, differential diagnoses include several noncardiac pathologies, including gastrointestinal, lung, and musculoskeletal disorders that cause chest pain. Coronary computed tomography angiography enables the assessment of the tissues adjacent to the heart, which might be the potential underlying cause of the symptoms. In this regard, CCTA is superior to other non-invasive methods such as myocardial perfusion scintigraphy or treadmill exercise tests. In this study, in 4% (88 patients) of the study population, noncardiac findings are clinically relevant and included in the differential diagnosis of chest pain or equivalent symptoms. Obstructive CAD was detected in 5 of 88 patients, and hence, in 83 patients, noncardiac findings are possibly associated with patients' clinical condition. Laskowski et al[7] reported that in 101 patients with atypical chest pain, CCTA demonstrated 13 possible noncardiac findings, which are in line with the results. Karius et al[8] also reported a 7.9% prevalence of relevant noncardiac findings in patients with atypical chest pain. The results are in line with the previous reports. The results indicate that in patients with noncardiac chest pain in whom CAD could not be ruled out, expansion of cardiac FOV might be beneficial, particularly in patients with symptoms suggesting noncardiac origin.

The clinical significance, cost-effectiveness, and management strategies of noncardiac findings are still not clarified. Most findings include chronic parenchymal lung diseases and nodules,

Table 2. The Frequency of Noncardiac Findings

System	Finding	Frequency
Lung		
	Nodule/mass	91
	Pneumonia	23
	Emphysema	62
	Bronchiectasis/bronchiolitis	30
	Atelectasis	42
	Fibrosis/scarring	21
	Pulmonary cyst	8
	Intertitial lung disease	4
Mediastinum		
	Lymphadenopathy	28
	Calcified lymph nodes	5
	Anterior mediastinal mass	2
Pleura		
	Plaque	7
	Pleural effusion	19
Vascular		
	Atheroma	61
	Pulmonary embolism	3
	Subclavian artery stenosis	2
Breast		
	Breast lesion	8
Esophagus		
	Hiatus hernia	55
Liver		
	Hemangioma	22
	Liver cyst	36
	Fatty infiltration	21
	Vascular malformation	5
Surrenal gland		
	Adenoma	9
Others		51
	Mosaic perfusion, pneumothorax, nonfibrotic hypersensitivity pneumonia, splenic infarction, pulmonary edema, elevated left hemidiaphragm, pancreatic lesion, peripheral nerve sheath tumor, gallstone, liver cyst hydatid, gynecomastia	
	No. of noncardiac findings	615
	No. of patients with noncardiac findings	586

musculoskeletal pathologies, and hiatal hernias. Among those, pulmonary nodules are the primary concern of follow-up strategies since they might be the precursor of primary lung cancers. In this study, there were 51 patients with pulmonary nodules that required follow-up. In addition to lung nodules, 8 breast lesions were detected and referred for breast ultrasonography and/or mammography. Likewise, 55 hiatal hernias were detected, which might be associated with gastroesophageal reflux and referred to a gastroenterologist, and 12 patients underwent endoscopic evaluation. Among those patients, after further investigations, 3 patients were diagnosed with lung cancer. Although a cost-effectiveness analysis was not performed, CCTA enabled the early diagnosis of 3 lung cancers, which is significantly valuable for the patients. In this respect, CCTA might have its merits regarding the early diagnosis of noncardiac disease.

In conclusion, as much as CCTA is valuable for the diagnosis of CAD, the demonstration of noncardiac pathologies is also important and may shed light on the clarification of patients' complaints. Furthermore, identification of early stages of malignancy is possible and may lead to life prolongation. Therefore, the radiologist should be aware of the expanding cardiac FOV in selected patients, which might be beneficial for patients' further management. Informing the reporting physicians about patients' clinical history and complaints leads to a better assessment of CCTA imaging. Individualization of expanding the FOV can lead to early diagnosis of noncardiac disorders and prevent life-threatening conditions.

Data Availability Statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics Committee Approval: Ethical committee approval was received from the Ethics Committee of İstanbul University-Cerrahpaşa (Approval no: 2025&51; Date: January 8, 2025).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in this study.

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Declaration of Interests: The authors have no conflict of interest to declare.

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