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FREQUENCY OF INCIDENTAL EXTRA-CARDIAC FINDINGS IN PATIENTS UNDERGOING MULTI SLICE COMPUTED TOMOGRAPHIC (MSCT) ANGIOGRAPHY FOR DETECTION OF CORONARY ARTERY DISEASE

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All the authors contributed significantly to the research that resulted in the submitted manuscript.

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ABSTRACT

Objective: The purpose of this study was to evaluate the frequency of incidental extra-cardiac findings on MSCTcoronary angiography.

Methodology: Patients undergoing MSCT angiography were included. Coronaries were interpreted with limited field of view (FOV) reconstructions. Reconstruction using larger FOV were used to examine and detect extra-cardiac incidental findings. All extra-cardiac structures were reviewed systematically. Patients were divided in two groups on basis of age, younger $\leq$ 50 years and elderly >50 years.

Results: Out of 307 patients included in the study,87 (28%) had extra-cardiac incidental findings. Patients in the older age group i.e., more than 50 years were significantly ($p = 0.004$) more likely to have incidental findings. Most common finding was pericardial fat pad. Most of the findings were not of clinical significance. Only 2 pulmonary nodules were detected.

Conclusion: Extra-cardiac findings are commonly detected on MSCT cardiac scans especially in older patients with larger FOV reconstructions. Most of the findings are of minor clinical significance, only few are important. Routine screening of cardiac scans for extra-cardiac incidental findings is not mandatory.

Key Words: Incidental extra-cardiac findings, MSCT angiography, Cardiac CT

INTRODUCTION

Use of MultiSlice Computed Tomography (MSCT) has grown rapidly owing to its accuracy in the diagnosis of coronary artery disease.[1-3] This technology is also being used to noninvasively assess coronary stents, bypass grafts, valvular function, ventricular function, pulmonary embolism, and great vessel morphology.[4-5] Latest generation scanners allow high temporal and spatial resolution with less noise, producing superior image quality with minimal artifacts. The cross-sectional nature of MSCT creates images that include portions of the lungs, chest wall, mediastinum, and upper abdomen. Imaging of these areas leads to the potential for analyzing incidental findings.[6] Extra-cardiac findings sometimes account for the patient's main complaints, but usually the findings are incidental and unrelated to symptoms. Risk factors for coronary artery disease are well known. Some risk factors such as age, male sex, and smoking are also risk factors for pulmonary diseases like broncho genic carcinoma.[7] Smoking also plays a major role in emphysema.[8] Thus patients with coronary artery disease are more likely to have extra-cardiac incidental findings. For the heart and coronary imaging, the field of vision(FOV) for the scan is minimized to focus on the heart and pericardium optimizing spatial resolution and is called coned-down or limited FOV. However, images can be reconstructed from the raw data by using a larger FOV, which shows much more of the thorax. Haller et al reported that with typical cardiac MSCT settings, only 35.5% of the total chest volume was displayed, but when the same raw data were reconstructed with a maximal FOV 70.3% of the total chest volume was depicted.[9] The larger the field of view and the more views obtained, the greater are the variety and number of innocent and significantlesions detected.[9-11] Viewing of these adjacent areas leads to the potential for visualizing incidental findings that are not the intended target of the study yet may be clinically important.[6]

Extra-cardiac findings are made with relative frequency (10–60%) atcardiac computed tomography(CT) scans.[9,10,12-18] However, the incidental finding of pulmonary neoplasm has been made at rates as high as 1.2%.[15] We hypothesized that extra-cardiac incidental findings are frequent, that many are potentially clinically significant and findings are more common in older patients. As most screening-detected neoplasms are peripheral, we hypothesized that many innocent lesions and pulmonary neoplasms detected at cardiac CT would be missed with only limited-FOV reconstructions. The purpose of this study was to evaluate the frequency of incidental extra-cardiac findings on MSCT coronary angiography.

METHODOLOGY

A prospective cross-sectional study was conducted at cardiac scan department of AFIC/NIHD Rawalpindi from May 2011 to July 2011.This study examined incidental extra-cardiac findings in all adult patients reporting for MSCT angiography for the diagnosis of coronary artery disease. Patients with Calcium scores of 400 Agatson or more, prior history of coronary artery bypass grafting (CABG), pediatric patients and those known to have extra-cardiac disease were excluded. All studies were performed on a 64 slice dual source-CT scanner (Somatom Definition, Siemens Medical Solutions). For calcium scoring, studies were performed with prospective gating and only limited FOV images were reconstructed at 3-mm intervals. Coronary MSCT angiography studies were performed with retrospective gating from below the transverse aortic arch through the base of heart with 0.6-mm detector collimation, 120 kV, 380 effective mAs and 0.33-second gantry rotation time. Images were reconstructed at 0.75mm intervals for cardiac interpretation of limited-FOV images and 3-mm intervals for large-FOV evaluation of the thorax. Contrast injection delay was determined with a test bolus. Injection of IV contrast medium (Ultravist, 370, Bracco) at a rate of 5 mL/s with total volume calculated on the basis of scanning time was followed by a 50 to 70mL saline flush. In each case images were reconstructed from the original data obtained. No additional scans were obtained. The large FOV extended from outer rib to outer rib and encompassed the entire lung parenchyma within the imaged portion of the thorax. Limited FOV covered the heart and 1cm from the farthest anterior, posterior, and lateral extent of the cardiac chambers, typically approximately 17–20cm. The images with the least motion artifact were selected for evaluation of lung, chest wall, and spine. All images were reviewed in standard soft-tissue (width, 300 H; center, 30 H), lung (width, 1,400 H; center, -500 H), and bone (width, 2,500 H; center, 800 H) window settings. All extra-cardiac findings were reported. The patients were divided in two groups under and over fifty years and the findings were compared. The scans were jointly reviewed by an experienced cardiologist and a radiologist.

Statistical calculations were performed using SPSS (version 16.0). Continuous variables were expressed as mean ± standard deviation, whereas frequencies were shown for nominal variables. Chi-square test was applied to find out the association between different age groups and incidental extra-cardiac findings. P-value <0.05 was considered as significant.

RESULTS

A total of 307 patients were included. Table 1 illustrates patient characteristics. A total of 87 (28%) patients had extra-cardiac findings. Patients in the older age group i.e., more than 50 years were significantly more likely to have extra-cardiac findings Table2.

Table 1: Patient Characteristics

Characteristic	Total Patients (n=307)
Age (years)	49 ± 11
Male Gender, n(%)	212(69%)
Female Gender, n(%)	95(31%)
With Extra-Cardiac Findings n (%)	87(28%)
Without Extra-Cardiac Findings n (%)	220(72 %)

Table 2: Extra-Cardiac Findings by Age Group

Type	Age ≤ 50 (n=160)	Age> 50 (n=147)
Without Extra-Cardiac Findings	126 (41.0%)	94 (30.6%)
With Extra-Cardiac Findings	34 (11.1%)	53 (17.3%)
P-value	**0.004**	

Table 3: Location of Extra-Cardiac Finding by Age Group

Type	Age ≤ 50	Age > 50
Normal	126 (41%)	94 (30.6%)
Pleural	5 (1.6%)	5 (1.6%)
Mediastinal	11 (3.6%)	17 (5.5%)
Bone	5 (1.6%)	6 (2.0%)
Pulmonary	12 (3.9%)	23 (7.5%)
Other	1 (0.3%)	2 (0.7%)
P-value	**0.098**	

Extra-cardiac findings were detected in all parts of thorax including mediastinum, pleura, lung parenchyma and bone etc. Table 3 shows location along with percentages of findings in both age groups.

Table 4 gives detail of different types of findings. Pericardial fat pad was the most common extra-cardiac finding. Pleural thickening was the most common finding in the pleura. Lymphadenopathy in 3 and mediastinal mass was detected in 1 patient. Examination of the lungs most frequently revealed fibrosis, chronic obstructive air ways disease, atelectasis, bronchiectasis and old pulmonary tuberculosis. Pulmonary nodules were detected in two patients. Examination of bones mostly revealed degenerative changes.

Table 4: Frequency of Extra-Cardiac Findings by Type

Extra-Cardiac Findings (n=87)					
Type	**Description**	**Frequency**	**Type**	**Description**	**Frequency**
Pleural	Bilateral Pl. Effusion	1	**Pulmonary**	Bleb	2
	Pleural Thickening	9		Chronic obstructive airways disease	5
Mediastinal	Aortic Calcification	1		Bronchiectasis	5
	Lymphadenopathy	3		Old PulmonaryTuberculosis	3
	Mediastinal mass	1		Consolidation	1
	Pericardial effusion	1		Fibrosis	10
	Peri-cardial fat pad	22		Pneumonia	1
Bone	Degenerative changes	8		Pulmonary nodule 1 cm diameter	2
	Depressed sternum	1		Pulmonary septal thickness	1
	Osteoporosis	1	**Other**	Eventration	1
	Spine osteophytes	1		Liver calcification	1
Pulmonary	Atelactasis	5		Raised diaphragm	1

DISCUSSION

Incidental findings are common in CT practice, so it is not surprising that lesions are found incidentally during cardiac imaging examinations. Extra-cardiac findings are common at cardiac CT. Depending on the patient population incidental findings are made from 10–60% of cardiac CT scans.[9,10,12-18] We detected extra-cardiac findings in 28% of patients. Patients in our older age group were significantly more likely to have extra-cardiac incidental findings than younger age group. Findings have variously been classified as minor or major depending upon their clinicalsignificance[9]. Most of the findings in our study were of minor nature and were not of serious clinical significance. Most common finding was pericardial fat pad. Numerous incidental findings have been reported, a common and potentially important one being pulmonary nodule. The frequency of the incidental finding of pulmonary nodules at cardiac CT has been reported to range from 5% to 20% and that of pulmonary neoplasm around 1.2%.[9,10,12,14,17] We detected pulmonary nodule in 2 patients only. Both the nodules were 1 cm in size. These patients were given advice to have follow up with pulmonologist for further work up and follow up. Relatively low number of pulmonary nodules could be due to an overall younger cohort in our study. We detected pulmonary tuberculosis in three of our patients which is due to higher prevalence in our population. Similarly findings related with diseases of infective aetiology like bronchiectasis, consolidation/ pneumonia, fibrosis and atelectasis were commonly detected. Examination of bone, however, mostly revealed degenerative conditions.

Detection of small number of significant ormajor findings and detection mostly of non-significant or minor findings raises the question: Should we look for incidental findings? Cardiologists are of the opinion that the cardiac MSCT examinations should be specifically tailored to cardiac/coronaryartery disease and that review of images withlarge FOV is unnecessary. American College of Cardiology guidelines state "During a cardiac CT examination, the standard use of a small field of view (e.g., limited lung fields) precludes a complete evaluation of the entire thorax.The patient and the referring physician should understand that the focus of the cardiac CT examination is the detection of cardiac disease, and the scan does not encompass the entire lung field".[19] Detection and interpretation of extra-cardiac findings are not part of American College of Cardiology level 1 training. Additionally identification of extra-cardiac structures is not considered a necessary skill for interpretation of cardiac CT scans.[20] Some cardiologists havestated that detection of incidental findings is not only cumbersome but also may lead to more harm than benefit.[21] It is an ongoing debate in cardiology whether radiologists should read cardiac CT scans in their entirety for non-cardiac findings. Budoff et al argued that the

risks of follow-up may outweigh the benefit of detection of important findings[21]. This contrast in perception becomes glaring with comparison of the American College of Radiology guidelines for performance of cardiac CT with the guidelines of the American College of Cardiology.[22] The American College of Radiology requires that interpreters of cardiac CT scans also meet guidelines for interpreting diagnostic CT scans or have experience with at least 100 thoracic CT or CTA examinations and assess for and document important extra-cardiac findings in a diagnostic report. The American College of Cardiology does not make competence to interpret extra-cardiac structures a requirement.[19] Budoff et al have concluded: "We have reviewed all the relevant literature and sought to determine the potential benefits and harms of specifically over reading CTA for non-cardiac pathology. The weight of the evidence suggests that it is most prudent to not specifically reconstruct and re-read CTA scans for lung nodules. If a non-cardiac abnormality is visualized by the primary interpreter of the cardiac CT, appropriate referral or follow-up is prudent".[21] Supporting these conclusions, radiation oncologists Smitt and Mehta showed that although incidental findings were frequently found(20% of 132 radiation-planning CT scans), just three patients had important findings, and only one patient with neck adenopathy had potentially benefitted from detection[23].

CONCLUSION

We concluded that extra-cardiac findings are commonly detected on MSCT cardiac scans especially in older patients with larger FOV reconstructions. Most of the findings are of minor clinical significance. A number of non-cardiac findings might have been missed in conventional conned down or small FOV reconstructions. Only few of the findings, however, were important, including possible asymptomatic malignancies. Routine screening of cardiac scans for extra-cardiac incidental findings is not a must.

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