Contemporary review: a clinically oriented interpretation of incidental radiological findings for common cardiovascular computed tomography scans

Apichaya Sripariwuth[1], Temphon Kruamak[1], Bo Xu[2]

[1]Department of Radiology, Faculty of Medicine, Naresuan University, Phitsanulok, Thailand; [2]Section of Cardiovascular Imaging, Robert and Suzanne Tomsich Department of Cardiovascular Medicine, Sydell and Arnold Miller Family Heart, Vascular and Thoracic Institute, Cleveland Clinic, Ohio, USA

Contributions: (I) Conception and design: A Sripariwuth, B Xu; (II) Administrative support: A Sripariwuth, T Kruamak; (III) Provision of study materials or patients: All authors; (IV) Collection and assembly of data: All authors; (V) Data analysis and interpretation: All authors; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Apichaya Sripariwuth, MD. Department of Radiology, Faculty of Medicine, Naresuan University, Phitsanulok-Nakhon Sawan 99 Moo 9, Tha Pho, Mueang Phitsanulok 65000, Thailand. Email: apichaya168@gmail.com.

Objective: The authors aim to provide a concise review for the interpretation and management of incidental findings encountered in common cardiovascular computed tomography (CT) scans.

Background: Cardiovascular disease represents the leading cause of death in the world. In recent years, CT has undergone remarkable technological advancements in image quality and safety; and therefore, CT angiography has become an increasingly important tool as a non-invasive imaging modality for patients with cardiovascular disease. Even though the images are focused on the heart and the great vessels, the adjacent structures, including the thyroid, the lungs, the breast, and bones are incorporated in the scan field of view (FOV), and may therefore present unexpectedly as incidental findings. This article provides a contemporary narrative review of the practical points related to the assessment and management of these common incidental findings, guided by contemporary guidelines.

Methods: We searched MEDLINE publications from 1971 through August 2021 using the following key words: incidental findings and cardiac CT angiography.

Conclusions: Incidental thyroid nodules (ITNs) with suspicious features should be evaluated with dedicated ultrasonography. Incidental solid and ground-glass pulmonary nodules smaller than 6 mm, and perifissural nodules, and cysts with a smooth thin wall do not routinely require further evaluation or follow-up. Other pulmonary nodules should undergo follow-up by dedicated interval CT, owing to their appearances and sizes. The solid component of a part-solid lesion is indicative of an invasive component; and therefore, a smaller nodule with characteristics of increased density necessitates further investigation. Mammography is still recommended for any incidental breast lesions if the patient does not have annual check-ups. Knowledge of incidental findings detected at cardiac CT is important to help guide appropriate interpretation and management.

Keywords: Pulmonary nodules; thyroid nodules; cardiac computed tomography (cardiac CT); cardiac imaging; cardiovascular disease

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Introduction

Computed tomography (CT) angiography is widely used to assess coronary artery disease (CAD) and aortic conditions. CT angiography has undergone remarkable technological advancements in image quality, paralleled by an increasing recognition that CT angiography should be more broadly performed, serving as a non-invasive imaging tool for patients with cardiovascular disease. Incidental findings in the lung are common in radiology (1-3). Incidental benign lesions for example can lead to increased medical investigation costs (4), and cause potentially unnecessary psychological burden for the patient (5). Conversely, an incidental malignant lesion can expose serious underlying illnesses or generate additional diagnostic tests, which can lead to more therapeutic interventions that result in potential benefits pertaining to early treatment of serious asymptomatic conditions, such as cancer (4,6). Therefore, expert interpretation of incidental findings is important, because the patients and the treating physicians rely on accurate interpretation to decide on how these findings should best be managed.

This article addresses several key issues faced by cardiovascular imaging physicians who are primarily trained in the field of cardiology. For these physicians without dedicated training in radiology, it is even more important to be aware of these incidental findings that radiologists will usually be aware of due to their dedicated training.

Multidetector CT angiography techniques and protocols for cardiac imaging

Calcium score

Calcium score (CAC) has become a widely used preclinical screening tool to help clinicians make decisions about whether preventive medical therapies should be instigated, while providing an assessment of the likelihood of an individual patient receiving a net benefit from the preventive pharmacotherapies (7,8). The typical age of a patient with elevated atherosclerotic cardiovascular disease (ASCVD) risk without ischemic symptoms ranged between the ages 45 to 75 years. The preclinical screening tool creates an Agatston calcium score that allows the physician to identify potential cardiovascular risk and then provide essential information to patients. The Agatston score, a summed score base on the calcified plaque area and the maximal density of individual calcified lesions, has been the CAC metric of choice, and applied to ECG-gated study acquired with 120 kilovoltage (kV) at 2.5–3 millimeter (mm) slice thicknesses (9). Coronary calcium scan acquisition is achieved without physical intrusion because there is no intravenous contrast dose used in the procedure. The field of view (FOV) is focused on the heart and the scan range encompasses the carina through to the apex of the heart. Therefore, common incidental findings for this scan acquisition are found in the imaged portion of thorax (*Table 1*).

Coronary CT angiography

The 2019 European Society of Cardiology (ESC) guidelines for the diagnosis and management of chronic coronary syndromes recommend using coronary CT angiography as the main imaging modality to rule out CAD in patients who have non-diagnostic symptoms of obstructive CAD (class I recommendation, level B) (10). Conversely, the 2012 American College of Cardiology (ACC)/American Heart Association (AHA) guidelines for the diagnosis and management of stable ischemic heart disease recommend that a coronary CT be performed for patients who are unable to exercise. However, individuals who have equivocal exercise stress testing should have additional investigations. A prospective ECG-gated helical coronary CT with a multi-slice CT scanner is the standard technique (≥64 slices) (11). Various CT scanners and techniques have been created to improve the diagnostic accuracy for CAD findings, reduce contrast dose, and reduce radiation dose during the scan. The ECG-gated retrospective technique should be considered in patents with a high heart rate or an irregular heart rate; moreover, this method can be used to evaluate the cardiac and valve function (11). The FOV and scan range of this study are focused on the heart, an objective similar to the Agatston calcium score study. If the coronary CT angiography is performed to evaluate a coronary artery bypass graft; however, the FOV will need to be extended to the origin of internal mammary arteries, which are often only utilized as bypass grafts. Incidental findings in the imaged neck, breast, and thorax are encountered in this type of study (*Table 1*).

Transcatheter aortic valve replacement (TAVR) protocol

Developments in transcatheter-based therapies have provided an alternative therapeutic strategy for the non-surgical management of patients with severe symptomatic aortic stenosis. A CT is now the gold standard tool for

Table 1 Common cardiac CT examinations, protocols, and relevant incidental findings

Type of scan	Details of the protocol	Incidental findings
Calcium score	ECG-gated acquisition. Scan range: carina to base of heart. Estimated radiation dose (10): 1–3 mSv	Limited chest: pulmonary nodules; perifissural nodule; cystic lesions; fibrosis/scar; emphysema; mediastinal lymph node; hiatal hernia Breasts: calcifications Bone: vertebral hemangioma; enostosis (bone island); degenerative change
CT coronary angiography	Prospective/retrospective ECG-gated acquisition. Scan range: carina to base of heart; thoracic aperture to base of heart if patients underwent bypass graft. Estimated radiation dose (10): prospective ECG-gated technique: 2–4 mSv†. Retrospective ECG-gated technique: 8–18 mSv	Limited neck: thyroid nodule. Limited chest: pulmonary nodules; perifissural nodule; cystic lesions; fibrosis/scar; emphysema; mediastinal lymph node; hiatal hernia Breasts: calcifications Bone: vertebral hemangioma; enostosis (bone island); degenerative change
Transcatheter aortic valve replacement (TAVR) protocol	Retrospective ECG-gated acquisition (dynamic 4D imaging). Scan range: upper thoracic aperture to the lesser trochanter. Estimated radiation dose (11): 16–24 mSv	Limited neck: thyroid nodule. Limited chest: pulmonary nodules; perifissural nodule; cystic lesions; fibrosis/scar; emphysema; mediastinal lymph node; hiatal hernia Breasts: calcifications Bone: vertebral hemangioma; enostosis (bone island); degenerative change Abdomen‡: hepatic lesions; pancreatic lesions; renal stone; renal masses or cysts; gallstones; adrenal masses; adnexal masses

†, in select patients with a small body surface area and stable low heart rates, use of high-pitch dual source helical scanning and low tube voltage have been reported to be associated with extremely low radiation dose [e.g., less than 1 mSv (12)]. ‡, incidental lesions in the abdomen are not the focus of the current review. CT, computed tomography; ECG, electrocardiogram; mSv, millisievert.

preprocedural evaluation for TAVR (12), and it is also useful for post-procedural assessment and evaluation of potential complications (13). It is useful for assessing the aortic annular size and aortic annular plane, the quantity and distribution of calcium in the aortic valve, aortic valve morphology, device landing zone, and peripheral access (usually transfemoral) (13). The CT acquisition strategies and scanning protocols vary, reflecting the differences in scanners, imaging systems, and local expertise (11). Our institutional protocol requires performance of retrospective ECG-gated CTAs with 10 phases of reconstruction 0–100% (dynamic 4-dimensional imaging) from the carina through the apex of the heart and subsequently CTA from upper thoracic aperture to the lesser trochanter to include the thoracic and abdominal aorta, the iliac arteries, and common femoral arteries (*Table 1*).

Incidental findings

We searched MEDLINE publications from 1971 through August 2021 using the following key words: incidental findings and cardiac CT angiography.

Thyroid nodules

The incidental thyroid nodule (ITN) is defined as a nodule incidentally discovered, and not suspected to have occurred clinically, or previously known (14). ITNs are seen in up to 25% of CT scan (15). The malignancy rate of ITNs detected on CT is up to 10% (15).

There are no reliable signs that can differentiate between a benign thyroid nodule versus a malignant thyroid nodule on CT images (16,17). The largest diameter on axial CT images of thyroid nodules becomes the primary imaging feature (*Figure 1*) (15). Shetty *et al.* (16) reported patients aged ≤35 years, who had ITNs detected on CT, had a higher risk of malignancy. The American College of Radiology (ACR) incidental thyroid findings committee (14) recommend further evaluation with an ultrasound for patients who have certain clinical factors and imaging findings as shown in *Table 2*.

Pulmonary nodules

Several studies have reported that an incidental pulmonary nodule was the most common incidental finding for

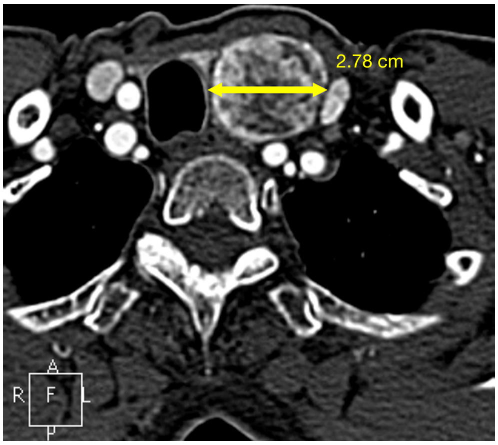

Figure 1 An axial CT image of thyroid gland in 61-year-old woman, showing the measurement of the largest diameter of a nodule in the left lobe of the thyroid gland, measuring 2.8 cm. A further ultrasound of thyroid is recommended in this patient. CT, computed tomography.

Table 2 Clinical factors and imaging findings of incidental thyroid nodules warranting further investigation with an ultrasound

Thyroid nodules with suspicious features
Abnormal lymph node
Calcification
Cystic component
Increased enhancement
Size >1.5 cm in short axis for jugulodigastric lymph node or size >1 cm for other lymph nodes
Local invasion by thyroid nodule
Patients do not have serious comorbidity or limited life expectancy and
Age <35 years and thyroid nodule size ≥1 cm†
Age ≥35 years and thyroid nodule size ≥1.5 cm†
Heterogeneous, enlarged thyroid gland

†, for multiple thyroid nodules, the criteria should be applied to the largest nodule.

cardiovascular CT examinations (18). Previous studies reported that the prevalence of significant pulmonary nodules such as lung cancer was up to 16% (19). Estimation of the probability of malignancy is essential for management. Both clinical parameters and features of pulmonary nodules are of importance. The Fleischner Society guidelines for pulmonary nodule management published in 2017 are widely adopted due to the precise recommendations based on patient risk, number of nodules, and nodule appearance (20). They also discuss the additional risk factors for malignancy; as a result, flexibility regarding follow-up imaging was added (20). The aforementioned guidelines are recommended for management of incidental pulmonary nodules found through CT imaging of patients aged >35 years with no history of cancers or immunodeficiency disorder. The management of incidental pulmonary nodules found in patients aged 35 years or younger should be individualized (20).

Evaluating the components of a pulmonary nodule is helpful for differentiating between benign and malignant lesions. Using both lung and soft-tissue window settings are recommended for nodule characterization (21). Attenuation measurement should be performed on the thinnest available non-sharp CT image (typically in the soft-tissue window), concentrating on the small region of interest and not only at a specific value point (20). The presence of fat [typically −40 to −120 Hounsfield units (HU)] within a lung nodule is sufficient to determine its benign nature (22). Visible calcification usually can be helpful for diagnosis. Presence of homogenous calcification, dense central calcification (bull's eye calcification), concentric rings of calcium (target calcification), and conglomerate foci of calcification involving a large part of the nodule (popcorn calcification) generally indicates a benign lesion (22). The Fleischner Society guidelines categorize nodules into solid and subsolid nodules (20). Subsolid nodule is a term used for nodules that appear partially invisible when viewed on thin sections with mediastinal (soft-tissue) window setting and a sharp filter (20). Solid nodules appear as homogenous soft-tissue components other than normal vascular or bronchial structures on CT images (*Figure 2A*) (20,23). The subsolid nodules could be further divided into either ground-glass nodules or part-solid nodules. Ground-glass opacity represents hazy attenuation in the lung; however, the bronchial and vascular margins (*Figure 2B*) are preserved (23). A part-solid (synonym: semisolid) nodule consists of both ground-glass and solid soft-tissue attenuation components (*Figure 2C*) (23). Solid and ground-glass pulmonary nodules smaller than 6 mm generally do not need further evaluation or follow-up. Other pulmonary nodules should be followed-up with a dedicated interval CT, based on their appearances and sizes (*Table 3*) (20).

For measurement of the nodule size, the diagnostic image should be displayed using the lung window setting with a

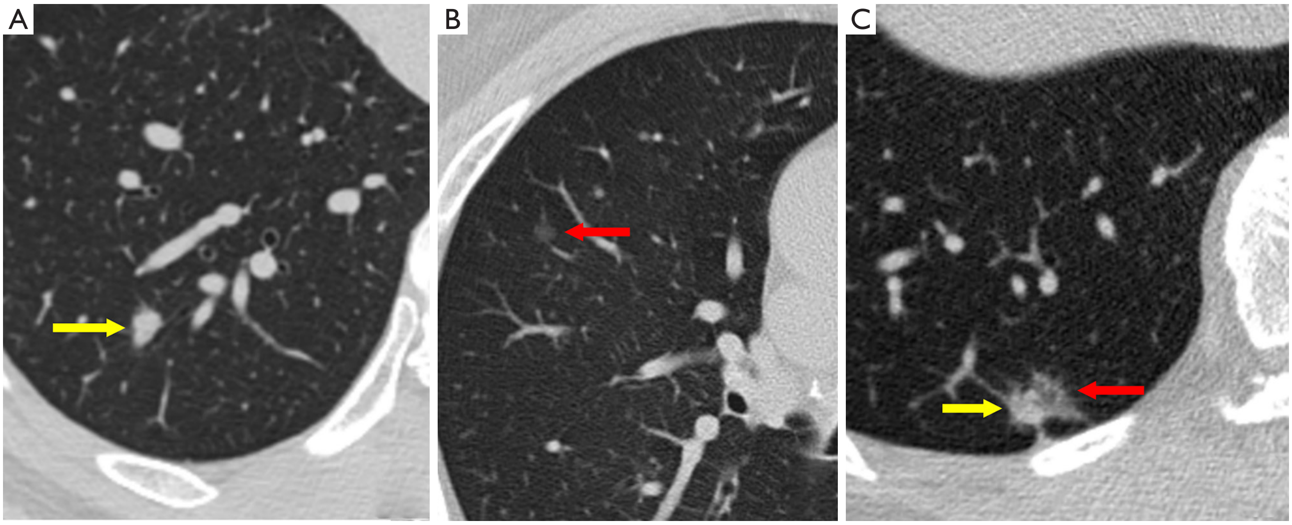

Figure 2 Axial CT images of pulmonary nodules. (A) Solid nodules appear as homogenous soft-tissue components (yellow arrow). (B) Ground-glass nodules represent regions of hazy attenuation in the lung, with preservation of bronchial and vascular margins (red arrow). (C) Part-solid nodules consist of both ground-glass (red arrow) and solid soft-tissue (yellow arrow) attenuation components. CT, computed tomography.

high-spatial-frequency (sharp) algorithm and contiguous thin sections (≤1.5 mm, typically 1.0 mm) (24,25). The measurement should be performed on the transverse section, unless the maximal dimensions lie in a coronal or sagittal plane, which should be documented in the report (21). Volumetric measurement is also used to assess nodule growth, but can be limited by variations in CT interpretation software package versions (25,26). Nodules smaller than 3 mm should generally not be measured due to accuracy limitation, and can be described as "micronodules" (23). All measurements should be expressed to the nearest whole millimeter. The size of the solid nodule and ground-glass nodule should be recorded as the average of the maximal long-axis diameter and the maximal short-axis diameter, perpendicular to the long-axis measurement for nodules smaller than 10 mm. For larger nodules, recording both the long-axis dimension and the short-axis dimension is recommended.

The recommended approach for spiculated nodules is to measure only the solid core (*Figure 3*). The part-solid nodule measurement requires evaluation of both the overall presence of lesions and the solid component in the nodules (*Figure 4*). The overall size is approached in the same manner as solid nodules. The solid component should be measured in the maximal diameter and should be reported if larger than 3 mm (22,24).

The measurements at follow-up CT should be acquired with similar techniques and orientations. They can be made through the centroid of the nodules, which may not be at the same anatomic level. Nodule growth should be determined by an increase in size of 2 mm or more for the overall size or the solid component of a part-solid nodule (21). Potential growth must be assessed in the context of the time interval between serial CT examinations. The accuracy of growth assessment improves with increasing intervals between examinations (27); and therefore, all prior studies should be used for comparison. Recommendations for management of incidental pulmonary nodules from Fleischner Society (21,22,28) are summarized in *Table 3*. The initial short-term follow-up recommended for part-solid nodules 6 mm or larger is important. The resolution of part-solid nodules is reassuring to patients and physicians. Stable pure ground-glass nodules likely represent adenomatous hyperplasia (29). Persistent part-solid nodules with a solid component smaller than 6 mm typically are adenocarcinomas in situ or minimally invasive adenocarcinomas (28). The solid component of a part-solid lesion is indicative of an invasive component. A decrease in the size of the nodule on follow-up, accompanied by an increased density, does not always indicate a benign lesion; however, careful recognition of the appearance of the nodule is important to avoid misinterpretation, diagnosis, and unwarranted treatment (28).

Table 3 Summarized recommendations for management of incidental pulmonary nodules from the Fleischner Society

Type	Definition
Solid nodule (single)	
Size <6 mm	No suspicious morphology → no routine F/U
	Suspicious morphology[a] → optional F/U CT chest at 12 months
Size 6–8 mm	At incomplete CT → follow up with complete CT in 3–12 months or as early as possible if suspicious morphology[a]
	Initial F/U at 6–12 months and reassessment of clinical risk[b] and if. Low risk and benign morphology at 12–18 months → discontinuing F/U; High risk, suspicious morphology, or uncertain stability → F/U at 18–24 months
Size >8 mm	At incomplete CT → further complete CT should be performed as early as possible
	F/U CT at 3 months, work-up with PET/CT, tissue sampling, or combination
Solid nodule (multiple)[c]	
Size <6 mm	Low risk → No routine F/U
	High risk → F/U CT chest at 12 months may be considered
Size ≥6 mm	Low risk → no routine F/U
	High risk → F/U CT chest at 12 months may be considered
Subsolid nodule (single)	
Ground-glass, size <6 mm	No suspicious morphology → No routine F/U
	Close to 6 mm with suspicious morphology[d] or other risk factor → optional F/U CT chest at 2 and 4 years
Ground-glass, size ≥6 mm	Large lesion (especially >10 mm) and/or bubbly lucencies → initial F/U at 6 months
	F/U at 6–12 months and then every 2 years thereafter until 5 years
Part-solid, size <6 mm	No routine F/U
Part-solid, size ≥6 mm	F/U at 3–6 months: persistent lesion → yearly F/U for 5 years. Part-solid nodules with a solid component ≥6 mm → F/U at 3–6 months. Nodule with suspicious morphology (i.e., lobulated margin or cystic component), growing solid component, or a solid component >8 mm → PET/CT biopsy, or resection
Subsolid nodule (multiple)	
Size <6 mm	F/U at 3–6 months and if. Stable → F/U at 2 and 4 years. Progression → management base on dominant lesion
Size ≥6 mm	Management decision should be based on the most suspicious nodule[e]

This table is modified and adapted from ref (20) with permission from Radiological Society of North America. [a], suspicious morphology of solid nodule included located in upper lobe, contour irregularity or spiculation. [b], high clinical risk included, old age and heavy smoking (≥30 pack-years and quitting within 15 years). [c], use clinical risk and the most suspicious nodule (which may not be the largest) as guide to management. [d], suspicious morphology of ground-glass nodule included spiculation and fissure distortion. [e], interval growth of a solid component that is ≥6 mm, spiculated margins, interval increase in density, and a new microcystic component are some of the most important features used to defined the most suspicious lesion. mm, millimeter; F/U, follow-up; CT, computed tomography; PET, positron emission tomography.

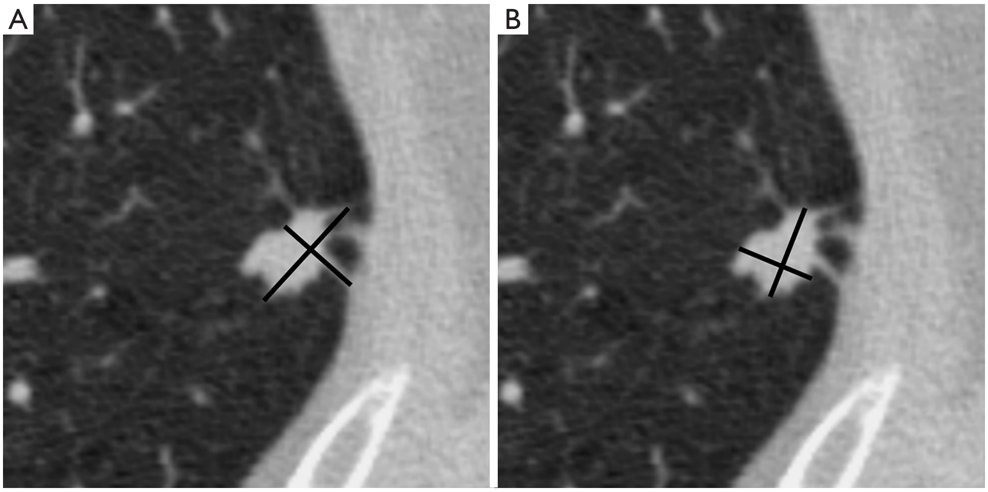

Figure 3 Axial CT images of a spiculated lung nodule. (A) The incorrect method is measured maximal diameter that included spiculation (cross line) causing overestimation of nodule size. (B) The recommended approach is to measure only the solid core (cross line). CT, computed tomography.

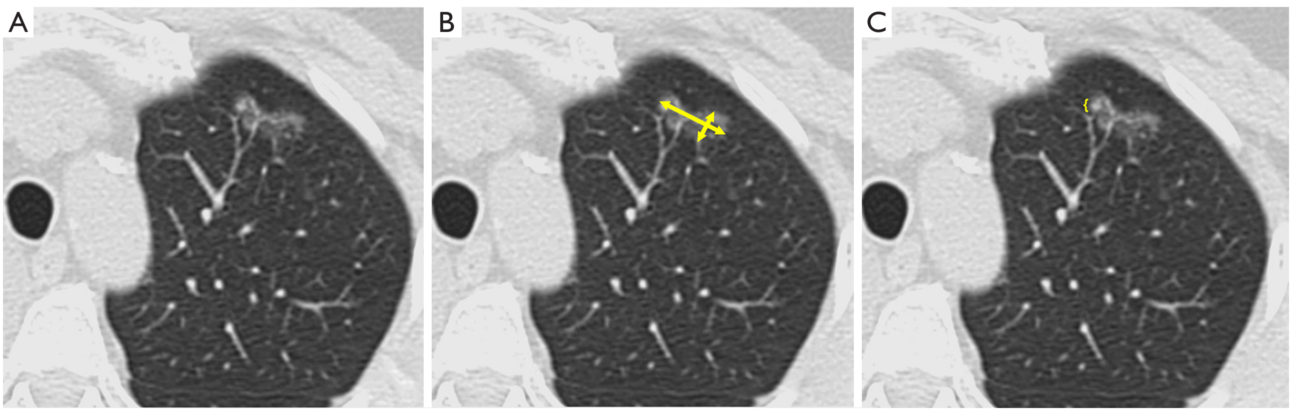

Figure 4 The assessment of an incidental part-solid nodule on CT image. (A) Axial CT images of a part-solid nodule in the left upper lobe. (B) The overall part-solid nodule is measured in the same way as solid nodules. The longest diameter is measured, and the short-axis dimension is also recorded (arrow). (C) The maximal diameter of a solid component should be measured (left curly bracket) and reported if >3 mm. CT, computed tomography.

Perifissural nodules

Even though data on perifissural nodules on cardiac CT are limited, perifissural nodules are common findings on chest CT (30). Perifissural nodules are used to describe small solid nodules which are commonly seen on CT images adjacent to pleural fissures, representing intrapulmonary lymph nodes (20). There is generally no routine need for a follow-up CT for perifissural nodules, which have a triangular or lentiform morphology with a smooth contour, sharp margins, and a fine linear septal extension to the pleura (20). If perifissural nodules have certain features, including a round, irregular, or spiculated morphology; or an abnormal fissure (i.e., retracted, displaced, bowed, or transgressed fissure), follow-up CT at 6–12 months is suggested (20,28).

Cystic lesions

Cystic lesions with a thin (usually <2 mm) smooth wall are benign cysts (28). Cystic lesion associated with primary lung cancers demonstrate suspicious features including a mural

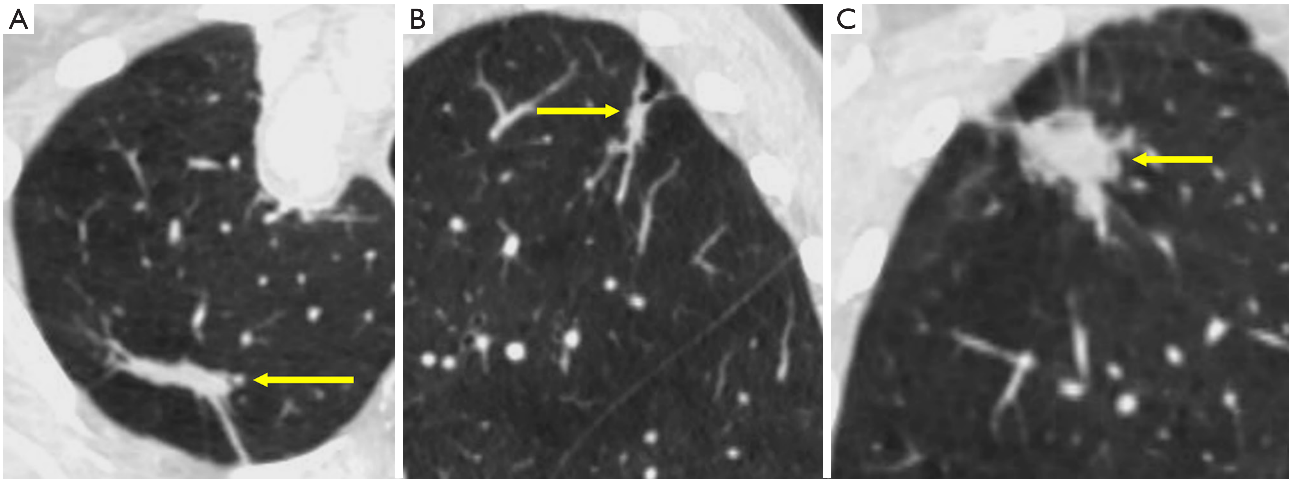

Figure 5 CT images of fibrosis/scar at the right upper lobe. (A) Axial and (B) sagittal reconstruction planes show pleural-based configuration, and elongated shape, straight margins, and presence of similar adjacent opacities are suggestive of a scar (arrow). Note that the fibrosis mimics a spiculated nodule on the coronal plane (arrow) (C). CT, computed tomography.

nodule, or new microcysts in a solid or subsolid nodule, and progressive or asymmetric wall thickening (28).

Fibrosis/scar

Fibrosis and scar sometimes mimic spiculated nodules. Pleural-based configuration, and elongated shape, straight, or concave margins, and presence of similar adjacent opacities are suggestive of a scar (20). Assessment with multiplanar reconstructions is helpful (*Figure 5*), but in most cases, the scar is benign. Tuberculosis is the most common cause of lung lobe scars in developing country (31); whereas, idiopathic pulmonary fibrosis is the most common cause in developed country (32). Lung scar carcinoma is very rare, as first described by Friedrich in 1939 (33). A recent study showed that scar-tissue changes, such as enlargement and surrounding ground-glass opacification, can possibly be early signs of lung cancer that has developed from an existing scar (34). Thus, all regions of scars/fibrosis should be compared with prior CT studies, if available.

Emphysema

Emphysema is characterized by permanently enlarged air-spaces distal to the terminal bronchioles with destruction of alveolar walls (35). Emphysema is usually classified into three subtypes, based on the anatomic distribution or the areas of lung destruction: (I) centrilobular and proximal acinar; (II) paraseptal and distal acinar; and (III) panlobular or panacinar and whole acinar (23,24). The appearances on CT imaging as a result of emphysema include focal or regional areas of low attenuation, usually without a definite visible wall (36). A prior study found the presence of coronary lesions on coronary CT significantly correlated with the presence of pulmonary emphysema (37) and emphysema-like lung conditions (38).

Mediastinal lymph nodes

Normal mediastinal lymph nodes are generally considered to be up to 10 mm in short axis diameter (*Figure 6*) (39). Prior studies (40,41) demonstrated mediastinal lymphadenopathy ≤15 mm usually resulted from a benign etiology. The features of benign lymph nodes include well-demarcated, smooth borders, uniform and homogeneous attenuation, and a central fatty core (42). The absence of these features raises suspicion for a clinically concerning condition such as lymphoma. The current American College of Radiology (ACR) Incidental Findings Committee recommendations for managing incidentally detected mediastinal lymph nodes on CT (43) suggest that generally no further work-up for lymph nodes with short axis diameter ≤15 mm with benign features (43) is required. For lymph nodes larger than 15 mm, management is dependent on etiology, and in any case of uncertainty, it should be correlated with the patient's clinical history, to assess the need for potential further

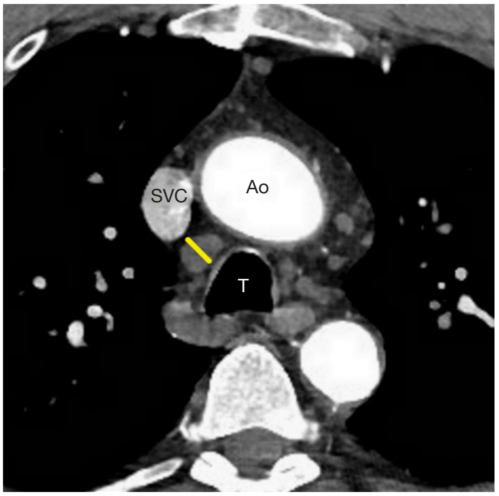

Figure 6 Computed tomography angiography, which demonstrates a normal right lower paratracheal lymph node. The lymph node was measured in the short axis (yellow line). Ao, aorta; SVC, superior vena cava; T, trachea.

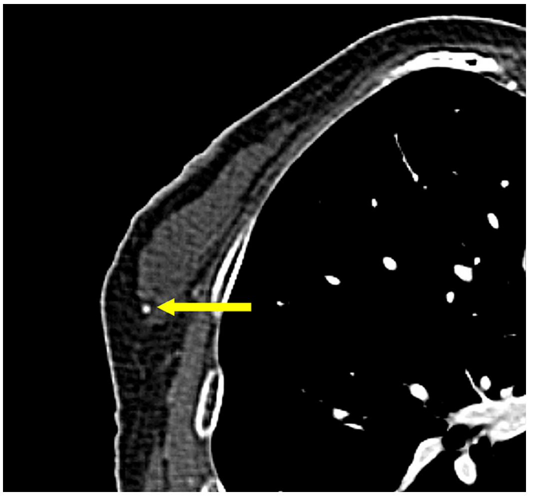

Figure 7 An axial CT imaging showing micro-calcification of the right breast (arrow), which is benign in nature. CT, computed tomography.

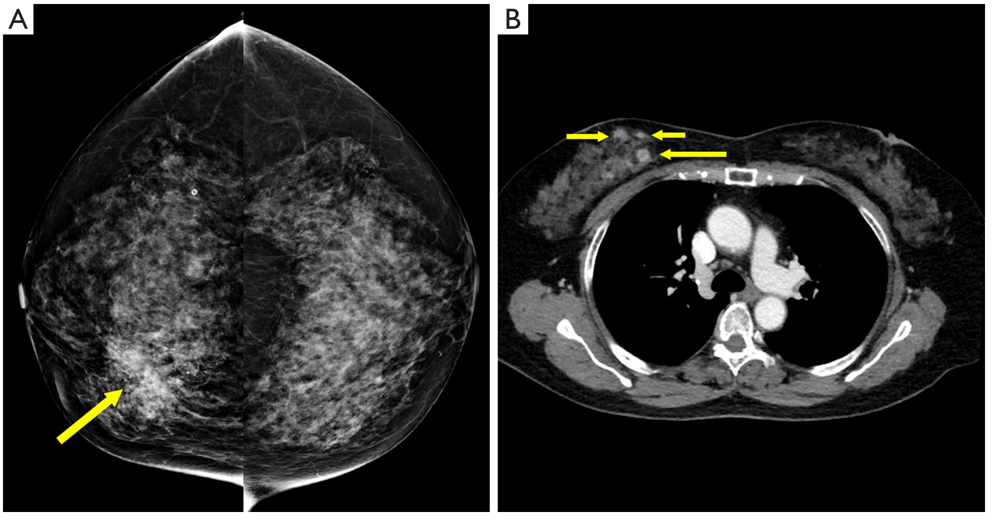

Figure 8 An annual check-up mammogram, craniocaudal view (A) of a 61-year-old woman, showing a group of pleomorphic microcalcifications (arrow) in an ill-defined mass at the inner region of the right breast. CT imaging (B) revealed multiple small masses (arrow) at the inner region of right breast with no significant demonstrable calcification. Pathologic findings confirmed poorly differentiated invasive mammary carcinoma. Courtesy of Dr. Pimlada Chatpitanrat. CT, computed tomography.

evaluation (43).

Breast lesions

Given the limited spatial resolution of current CT scanners (0.5–0.625 mm on the z-axis; approximately 0.5 mm on the x- and y-axes) almost all breast calcifications detected on CT are benign (*Figure 7*) (44); in comparison, there is a high probability that malignant calcifications will be smaller than 0.5 mm) (*Figure 8*). In recent years, many studies have attempted to demonstrate the significant malignant features of incidental breast lesions on CT, usually combining lesion

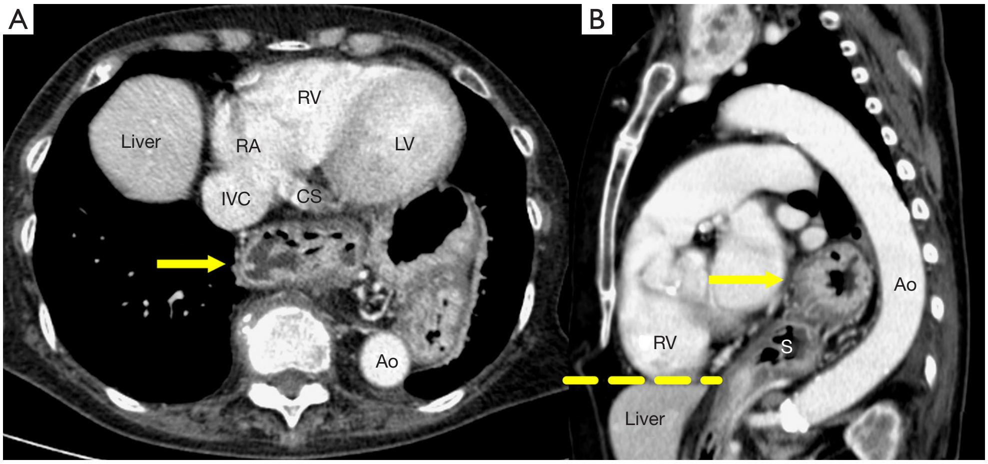

Figure 9 A patient's chest radiograph showed an abnormal retro-cardiac mass, which turned out to be a large hiatal hernia on CT imaging. (A) An axial CT imaging showing a retrocardiac mass containing air and fluid (arrow). (B) Sagittal CT imaging demonstrating the retrocardiac mass (arrow) was in continuation with the stomach (S) that lies below the diaphragm (yellow line), consistent with a hiatal hernia. CT, computed tomography; RA, right atrium; RV, right ventricle; LV, left ventricle; CS, coronary sinus; IVC, inferior vena cava; Ao, aorta; S, stomach. Courtesy of Dr. Thatchai Hantrakul.

morphology and pattern of enhancement based on dynamic CT technique (45,46). Cardiac protocols mainly focus on the arterial phase and is generally not enough for evaluating enhancement of the breast lesion (47). CT scans may occasionally allow for a precise diagnosis of a previously unsuspected breast lesion, but mammography is usually required for definitive diagnosis (46).

Hiatal hernia

Most hiatal hernias are found incidentally. A hiatal hernia frequently occurs in individuals aged 50 years and above, and any individual who is overweight. These clinical features are also the same risk factors for CAD (48,49). Some people with hiatal hernias may experience chest pain or chest discomfort, which may mimic ischemic heart disease (50). A hiatal hernia appears as a retrocardiac mass, with or without air-fluid levels, which can be traced from the esophagus to the stomach (*Figure 9*). The management of the hiatal hernia depends on the patient's symptoms, ranging from observation to medical therapies to potentially surgery in patients with severe symptoms and large hernias.

Vertebral hemangioma

Vertebral hemagiomas are the most common primary tumors of the spine; and usually, incidental findings are often found on CT and MR imaging (51,52). Most vertebral hemangiomas are small and asymptomatic (51). A coarse, vertical trabecular pattern (corduroy or polka-dot appearance) is identified in the vertebral body and may extend into the pedicles and laminae (*Figure 10*) (51). Extension of the lesion into the paraspinal soft tissue and spinal canal may be evident, and result in radiographic abnormalities that mimic a malignant neoplasm (51).

Enostosis

Enostosis, also known as bone island, is commonly found incidentally on imaging studies. However, this benign lesion may mimic osteoblastic metastasis (52). Enostosis is considered to be homogenous with a density similar to cortical bone on CT, for it is composed of compact bone while sclerotic metastasis may show less-homogenous internal attenuation than cortical bone (*Figure 11*) (53). It is challenging to differentiate between a small single enostosis from a sclerotic metastasis using CT. without multifocal identifiable lesions. On serial imaging, as many as 31% of enostosis will change in size (54). If the diameter of the growth is less than 25% in size over 6 months, a biopsy should not be required; however, if there is an increase of 50% or greater in 1 year (53), a biopsy should be considered (55).

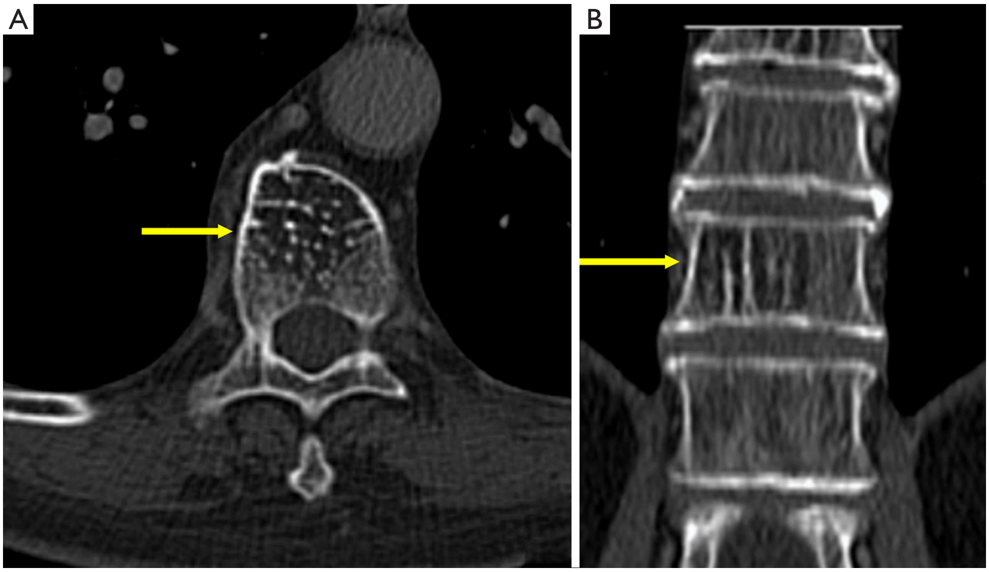

Figure 10 A patient with the typical appearance of a vertebral hemangioma. (A) Axial CT imaging demonstrating corduroy or polka-dot appearance in the vertebral body (arrow). (B) Coronal CT imaging demonstrating a coarse, vertical trabecular pattern lesion (arrow) in the vertebral body, consistent with a vertebral hemangioma. CT, computed tomography.

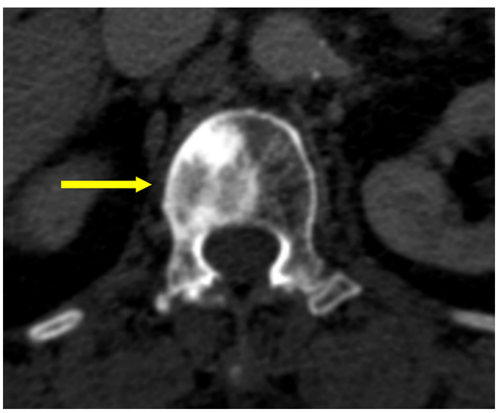

Figure 11 An axial CT imaging showing an inhomogeneous sclerotic lesion in the vertebral body (arrow), concerning for osteoblastic metastasis. Courtesy of Dr. Kantheera Leesmidt. CT, computed tomography.

Degenerative changes of spine

Degenerative changes of the spine affect the physical well-being of most individuals in the later stages of their life. There are several conditions that have a direct impact on the quality of life of older patients, such as disc height reduction, osteophyte, endplate sclerosis, and especially for older patients. These common but debilitating conditions can be considered as normal stages of aging (56). If these findings were discovered in younger patients, they should be reported because they may highlight underlying clinical conditions (56).

Summary

We provide a contemporary review of CT techniques and protocols for cardiac imaging and how to interpret common incidental findings. Once an examination is performed, the optimal approach to evaluation of incidental findings is to view and evaluate all available data, and then apply sound clinical judgment, in the best interest of each patient. Discussions regarding the recommendations from guidelines and clinical practice in this article should be adapted according to local standards of care, expertise, and patient populations.

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Footnote

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