The heart is also there! : Unexpected cardiac findings on chest CT

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Learning objectives

The heart is an important part of every chest CT. Unexpected cardiac findings can sometimes indicate serious or life threatening disease. A detailed study of the heart may help us diagnose these entities that may have clinical significance, and can provide important information to clinicians.

The objectives we propose to attend are:

• Emphasize the importance of analyzing the heart on chest CT
• Describe the most common incidental findings in the heart on chest CTs performed for other reasons.
Background

Introduction:

Chest CT is one of the most widely used imaging tests in the initial evaluation of any thoracic disorders.

Although the heart occupies a central position in all these studies, it is usually not given adequate attention by the radiologist, at times, even excluding it from the systematic review of thoracic structures.

However, cardiac disorders can often complicate or coexist with extracardiac disease and may often remain unsuspected or underevaluated.

Traditionally, the detailed study of the heart has been hampered by image degradation due to motion artifacts.

However, in recent years, improvements in CT technology, and specifically the development of subsequent MDCT, with high spatial and temporal resolution, have markedly shortened scanning times, and now provide images of the heart during routine chest CT examination that are much less degraded by cardiac motion artifacts.

All this opens the possibility to a detailed and systematic evaluation of the cardiac structures in any chest CT.

There are many cardiac findings that can be found in a thoracic CT; sometimes these findings will be related to the patient’s current disease, while in others, will simply be incidental findings or anatomic variants.

In this poster, we describe some of the most common but unexpected cardiac findings, seen in the course of routine enhanced and non-enhanced chest CTs, performed for any clinical indication.

Intracavitary thrombi:
Thrombi occur in the context of blood stasis and/or disorders of cardiac motility, being the most common cause of intracavitary mass and a quite frequent and unexpected finding in routine thoracic CT.

It is important to diagnose them, since they are a treatable cause of embolism.

On contrast-enhanced studies, cardiac thrombus can usually be readily identified as a filling defect or intracavitary non-enhanced mass. Fig. 1 on page 9 On non-contrast studies is sometimes visible as an area of decreased attenuation.

The most frequent location is the left atrium, generally in patients with atrial fibrilation and/or mitral stenosis, being often found attached to the atrial walls, posing differential diagnosis with tumour pathology.

We must not forget the atrial appendages, since they are a very common location. Fig. 2 on page 9

As for the ventricles, thrombi are more frequent in the LV, in the context of ischemic cardiomyopathy; Fig. 3 on page 10 while on the RV, they are going to be associated to deep venous thrombosis of the lower extremities, central catheters or tumoral extension.

**Cardiac tumors/metastases:**

Cardiac tumors are very rare entities, with the metastatic involvement being more frequent (20-40 times more frequent) than primary tumours. Fig. 4 on page 11 Fig. 5 on page 12

Lung, breast, esophagus, lymphoma and melanoma Fig. 6 on page 13 are the most commonly seen metastases in the heart, due to their high prevalence, and in the case of lung and esophagus cancer, to their close proximity.

The visceral pericardium is involved in about 90% of these patients. Fig. 7 on page 14

Of the primary tumours 80% are benign, being the most common the myxoma, which is up to 50% of all cardiac masses. Fig. 8 on page 15

On chest CT are normally seen as atrial located (75% left and 20% right), rounded, circumscribed and weakly enhanced solitary masses, usually adhered to the interatrial septum. Fig. 9 on page 16 They can pose differential diagnosis with intracavitary thrombi. Fig. 10 on page 17
Other less common benign cardiac tumors are: lipoma, fibroma, hemangioma, fibroelastoma and teratoma among others.

Primary malignant tumors are very uncommon, and of them, 95% are sarcomas and 5% lymphomas.

**Pericardium:**

Pericardial alterations are a very common unexpected finding on chest CT, especially in the emergency department. These findings are usually related with patient's symptoms.

The most frequent casual finding is pericardial effusion. **Fig. 11** on page 18

In the basal conditions, there is a small amount of liquid in the pericardial cavity, ranging between 15-50 ml. This amount may increase in several situations, such as cardiac and renal failure, infections, traumatisms or neoplasms.

Chest CT allow us to evaluate not only the amount of liquid, but also its density value, helping us focus a probable etiology.

We talk about pericardial thickening when the pericardium is more than 2 mm thick.

A smooth thickening suggests an inflammatory process, such as acute pericarditis. **Fig. 12** on page 19 Enhanced CT may reveal a thickening and enhancement of the pericardial layers, usually associated with pericardial effusion.

On the other hand, a nodular thickening, with or without pericardial effusion, suggests neoplastic etiology. **Fig. 13** on page 20 **Fig. 14** on page 21 Even so, we must remember, that the majority of the pericardial effusions in oncological patients are a result of other factors such as infections, heart failure, chemotherapy or radiotherapy, rather than tumor involvement.

A calcified pericardium may be secondary to a chronic inflammatory or infectious process, trauma or surgery. **Fig. 15** on page 22

Congenital absence and pericardial cysts are the 2 major congenital abnormalities of the pericardium.
Pericardial cysts are uncommon benign congenital lesions, asymptomatic and with no clinical impact in most cases. They are usually found incidentally during routine chest x-ray, CT or echocardiography. 75% of them are located at the right cardiophrenic angle. Fig. 16 on page 23.

The second most frequent congenital anomaly is the total or partial absence of pericardium. The interposition of lung between aorta and main pulmonary artery is the most specific finding on chest CT.

**Myocardial infarction:**

In the setting of classical symptoms of acute myocardial infarction (MI), a prompt correct diagnosis is usually confirmed by typical electrocardiographic changes and elevation of cardiac enzymes. However, the presentation of acute MI is often atypical, especially in women.

Although contrast-enhanced chest CT is not currently in general clinical use for the evaluation of MI, it has found a leading role in the diagnosis of entities that have clinical presentations overlapping those of MI, such as pulmonary embolism and aortic dissection.

For these reasons, everyday in the emergency department, there are several patients with acute MI, that are evaluated with contrast-enhanced CT, looking for other causes. Fig. 17 on page 24 Fig. 18 on page 25 Fig. 19 on page 26

Acute MI is detectable on contrast-enhanced chest CT, as an area of diminished ventricular myocardial enhancement (subendocardial or transmural) in the coronary artery distribution of the infarct. Fig. 20 on page 27 Fig. 21 on page 28

**Aneurysms and pseudoaneurysms:**

The walls of the heart are normally smooth in contour.

A focal bulge in the ventricular wall frequently indicates an aneurysm or pseudoaneurysm.

Differential diagnosis between the two entities is difficult since they have many characteristics in common, the diagnosis often being made during surgery.
Pseudoaneurysm are usually an acute complication of myocardial infarction, as the result of a contained myocardial rupture.

On chest CT are usually seen as focal saccular dilatations of the left ventricle, with a narrow neck and myocardial disruption.

On the other hand, true aneurysms, are a chronic complication of myocardial infarction, due to a progressive dilatation of the ventricular wall, in a discinetic segment. Chest CT show a sacular dilatation, normally with a wide neck and entire myocardium, that may be thinned or calcified. Fig. 22 on page 29

**Coronary disease:**

Nowadays, the development of the MDCT allows the study of the whole heart in just one apnea, obtaining high spatial and temporal resolution images. Besides this, gating techniques using the ECG signal to control scanning, improve temporal resolution, minimize imaging artifacts caused by cardiac motion and optimize the radiation dose.

For all this, Cardiac CT angiography has opened new horizons in the non-invasive diagnosis of the heart pathology, allowing a detailed study of the entire coronary tree.

Even so, chest CT without gating techniques, can also provide very useful information about the coronary arteries.

Calcified plaques, specially in young people with cardiovascular risk factors, could be a relevant finding on chest CT, and the first evidence of coronary atheroesclerosis. Fig. 23 on page 30

However routine chest CTs will not allow us to quantify the grade of atherosclerosis or the existence of significant obstruction associated.

Coronary aneurysms are an uncommon finding. They are normally due to atheroesclerosis and more rarely in the context of Kawasaki disease.

Coronary pseudoaneurysms are generally iatrogenic, due to interventional procedures. Fig. 24 on page 31

**Heart valves:**
Mitral annular calcium is common in elderly individuals. It is a degenerative phenomenon and a very common incidental finding, as there are no symptoms or hemodynamic abnormalities usually associated. Fig. 25 on page 32

Caseous calcification of the mitral annulus, also called liquefactive necrosis, is a chronic degenerative process of the mitral valve fibrous ring. It is a common disorder in the elderly, mainly seen in women, and it is a frequent asymptomatic incidental finding.

On chest CT, this entity appears as a round or semilunar mass with an hypo- or hyperdense center and a calcified peripheral rim. Fig. 26 on page 33

The differential diagnosis includes mainly infected or abscessified mitral calcification, calcified tumor, and hydatid cyst.

On the other hand, aortic valve calcification is normally symptomatic and in all cases involves some grade of stenosis. Fig. 27 on page 34

The degenerative process of the tricuspid valve is uncommon and less extensive than degenerative changes of the other valves.

The papillary fibroelastoma is a rare tumor that involves tipically the cardiac valves (80% aortic and mitral). It is normally asymptomatic so it can be an incidental finding. Clinical presentations may also result from systemic embolization of the tumor or thrombi on its surface.
Fig. 1: Unexpected left appendage thrombus in a 84-year-old woman with dyspnea and high D dimer, suggestive of pulmonary embolism. CT pulmonary angiography shows a non-enhanced rounded mass in the left appendage. We can also see a global cardiomegaly and bilateral pleural effusion.

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Fig. 3: Left ventricular thrombus in a 72-year-old man with history of myocardial infarction and lung adenocarcinoma. Contrast enhanced chest CT shows a non-enhanced mass in the apex of the left ventricle attached to a thinned and calcified myocardium area.
Fig. 4: Myocardial metastases in a 64-year-old man diagnosed of oropharyngeal tumor. Contrast enhanced chest CT shows multiple low density ovoid lesions diffusely distributed in the myocardium.

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Fig. 5: Myocardial metastases in a 64-year-old man diagnosed of oropharyngeal tumor. Contrast enhanced chest CT shows multiple low density an ovoid myocardial lesion in the apex of the left ventricle.

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Fig. 6: Metastatic melanoma in a 51-year-old woman. Contrast enhanced axial CT shows a large enhanced mass within the right atrium.

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Fig. 7: Pericardial involvement as a late manifestation of lymphoma. Contrast-enhanced axial chest CT scan shows focally thickened and enhanced pericardial layers around the heart apex. Note a small left pleural effusion.

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Fig. 8: Left atrial myxoma in a 78-year-old man in study for general syndrome, constipation, chest and abdominal pain. Contrast enhanced chest CT demonstrates an ovoid and smooth mass with foci enhancement inside the left atrium, attached to the intertribal septum.

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Fig. 9: Left atrial myxoma in a 57-year-old woman studied for a right kidney tumor. Contrast enhanced chest CT shows a round, smooth and homogeneous mass in the left atrium. The mass is attached to the interatrial septum.

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**Fig. 10:** Large and symptomatic left atrial myxoma in a woman with suspected pulmonary embolism. Thoracic CT angiography shows a non-enhanced, oval and smooth mass in the left atrium. Note also the bilateral pleural effusion and a middle lobe atelectasis.

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Fig. 14: Coronal enhanced chest CT shows pericardial metastatic involvement in a patient with esophagus cancer. Note the pericardial nodular thickening and enhancement.

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Fig. 15: Chronic calcific tuberculous pericarditis in a 70-year-old man in study for lung adenocarcinoma. Contrast enhanced CT shows a thick and calcified pericardium with pericardial effusion. Note the extensive pleural effusion.

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Fig. 20: Large myocardial infarction in territory of left anterior descending coronary in a 56-year-old man with chest pain and normal electrocardiogram. Chest CT angiography demonstrates a large subendocardial area of decreased enhancement mainly in apical and septal location.

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Fig. 21: Large myocardial infarction in territory of left anterior descending coronary in a 56-year-old man with chest pain and normal electrocardiogram. Chest CT angiography demonstrates a large subendocardial area of decreased enhancement mainly in apical and septal location. Note the involvement of the free wall and papillary muscle.

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Fig. 22: True left ventricular aneurysm after a large myocardial infarction. Axial oblique enhanced Chest CT shows a left ventricular dilatation with a thinned and calcified myocardium

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**Fig. 23:** Axial oblique enhanced chest CT shows a calcified left anterior descending coronary in a 40-year-old man with cardiovascular disease risk factors, studied for hemoptysis and cough.

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Fig. 24: Iatrogenic right coronary trombosed pseudoaneurysm in a 29-year-old man with recurrent atrial thrombus. Contrast enhanced chest CT show a right atrioventricular smooth and non-enhanced mass, attached to the free wall

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Fig. 25: Non-enhanced chest CT shows a degenerative mitral annular calcification in asymptomatic 78-year-old woman.

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**Fig. 26:** Liquefactive necrosis of the mitral ring in a 89-year-old woman studied for microcytic anemia and high tumor markers. Contrast enhanced chest CT show a calcified ring shaped mass in the mitral valve

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**Fig. 27:** 54-year-old woman with moderate aortic stenosis. Contrast enhanced chest CT shows a calcified aortic valve.

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Imaging findings OR Procedure details

4, 6 and 64 slices MDCTs were used to perform the exams.

Studies included contrast enhanced and non-enhanced routine chest CTs with a 3 mm slice thickness; and thoracic CT angiographs with 1.25 mm slice thickness, normally performed in the emergency department.
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Conclusion

Studying the heart in chest CTs performed for other reasons, may reveal unexpected findings that can sometimes result in significant pathology.

Therefore, we mustn't forget the heart in the systematic reading of chest CTs.
References