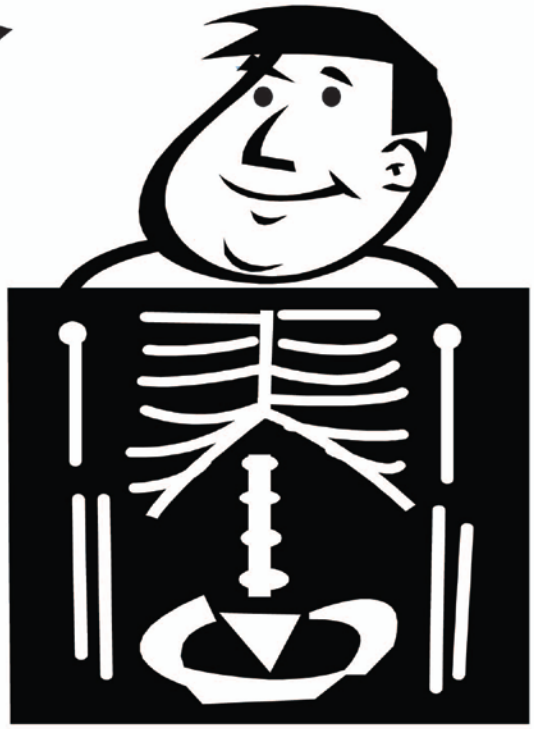
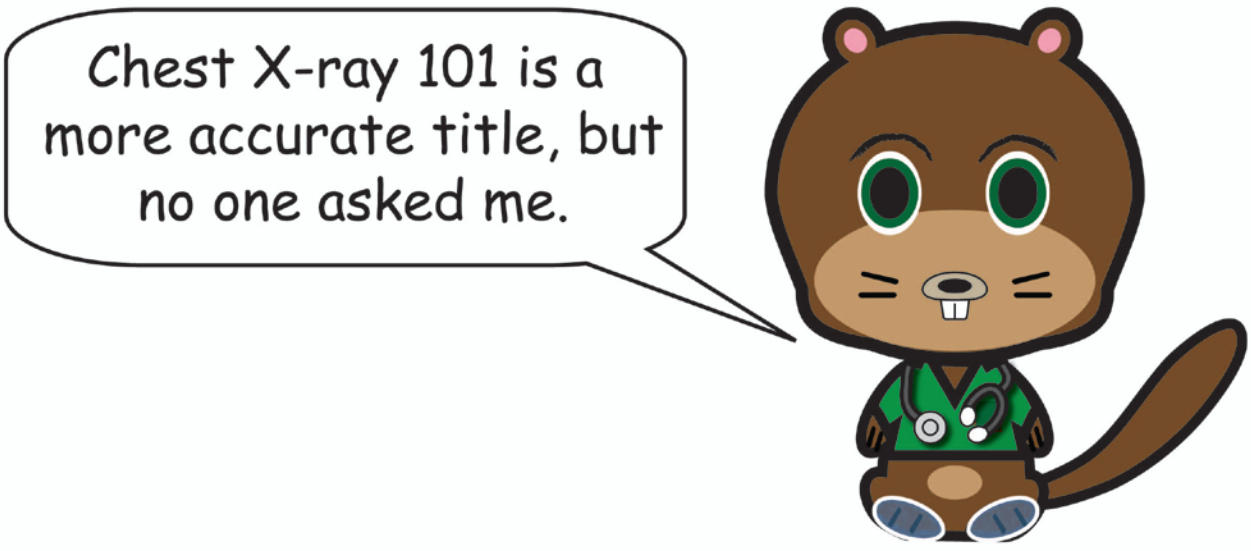
A "Doc Squirrel" and "Kid Cat" Adventure

X-Rayders!





By Stefan Tigges MD MSCR


Hey Cat, what you looking at?
A chest x-ray. I'm trying to figure out how to read these things.
Want some help?
Yes, if you can simplify this stuff.
Do you remember how an x-ray image is produced?
X-ray Source
Heart & Lungs
X-ray Cassette with photons (yellow circles)
X-ray Image
An x-ray beam is directed at a body part. The less dense the body part is, the more photons get through and the blacker the resulting image.
Air is Black
Fat is Gray
Soft Tissue is White
Bone is Whitest
Right. There are basically 4 different densities: air, fat, soft tissue and bone from least to most dense. On an x-ray image, air is the blackest and bone the whitest.
Air
Fat
Bone
Soft Tissue
Check out this knee x-ray, you can see all 4 radiographic densities.
How does that help me read an x-ray?

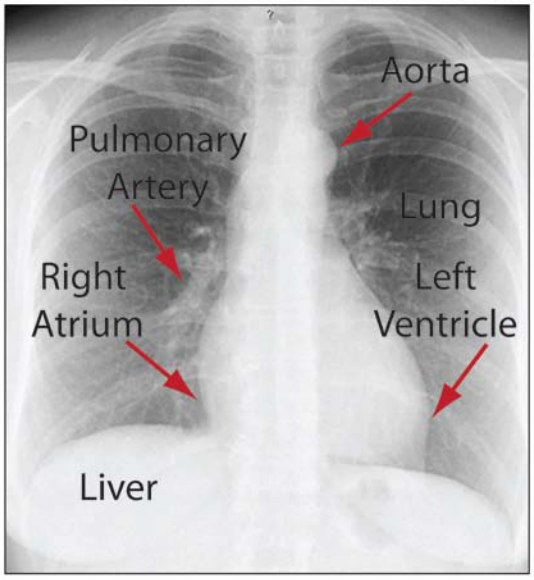
An x-ray is a 2 dimensional gray scale representation of the anatomy you learned in the first 2 years of medical school. For example, the bones on an x-ray correspond to the bones you memorized 2 years ago. With some training and practice, you can learn to recognize derangements in the normal anatomy.

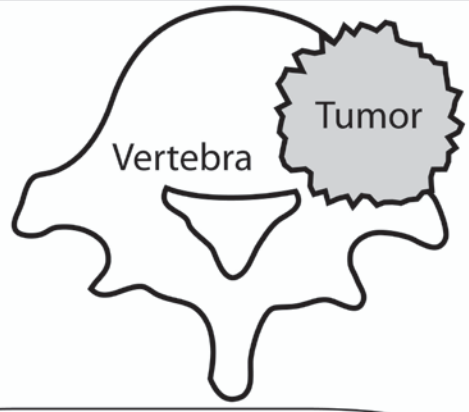
Can we really see all the anatomy we learned?

No, an x-ray is too crude. Fortunately, we have MRI and CT.

So what can we see on an x-ray?

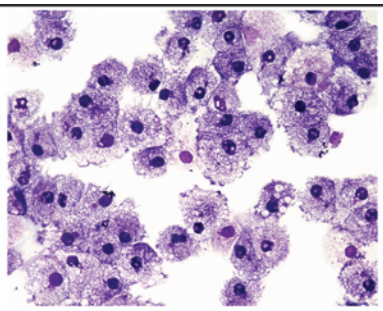
Some of the anatomy is visible, but you need to look in a textbook to really learn it.





How about recognizing pathology?

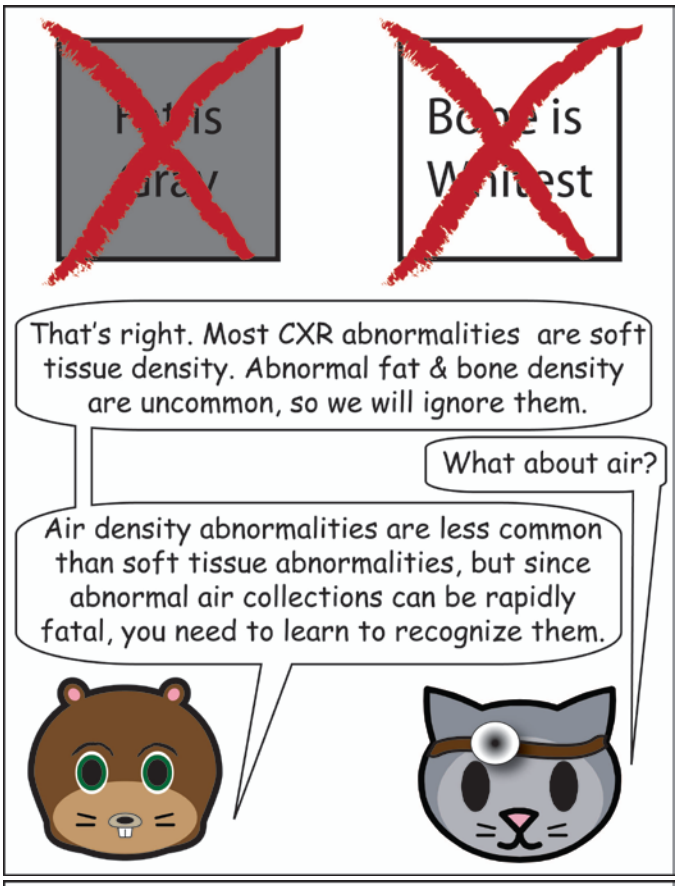
We recognize pathology when we see an x-ray density in an abnormal place. For example, we expect the spine to be bone density but if we see soft tissue in a vertebra, we must suspect a bone destroying tumor.

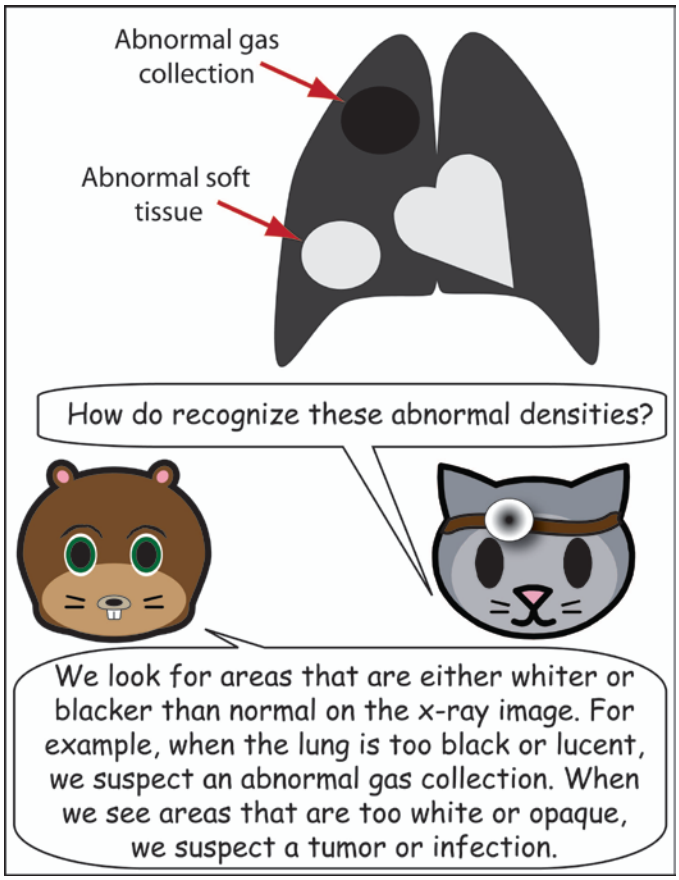


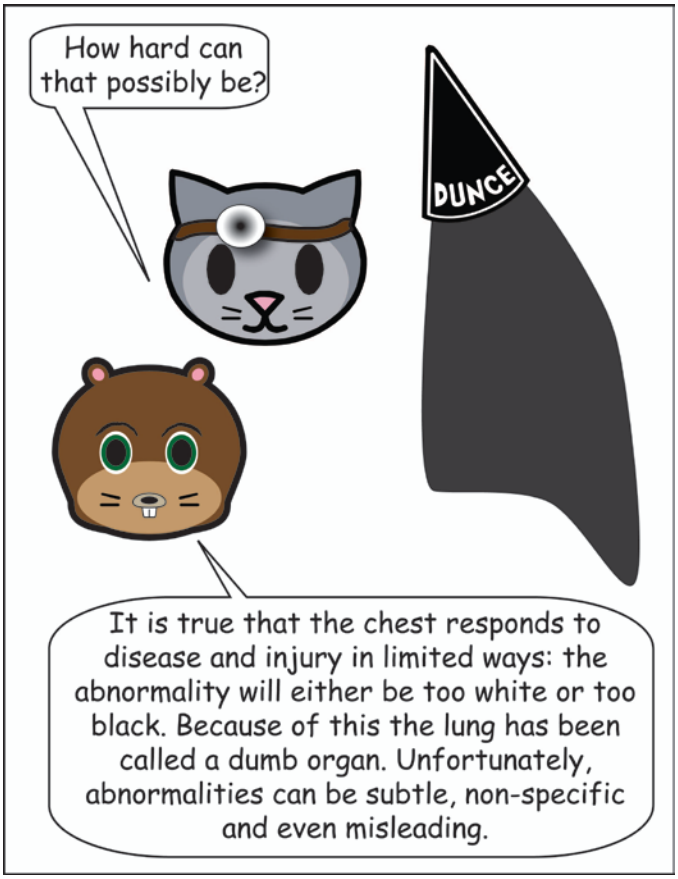
Sounds easy.

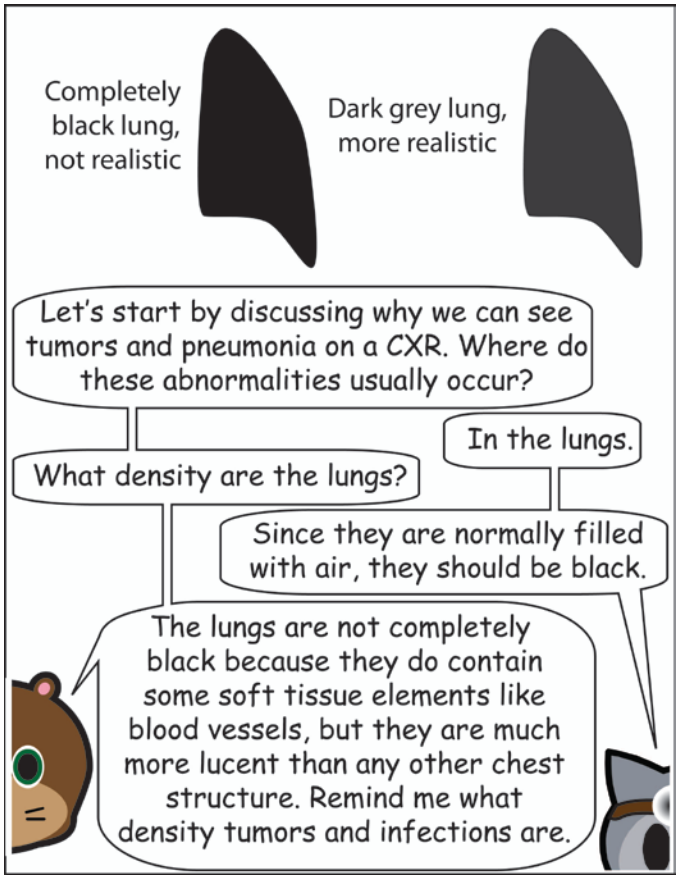
It turns out to be much harder than that but we will keep things simple. Let's go back to our 4 radiographic densities. What density would you expect most tumors and infections to be?

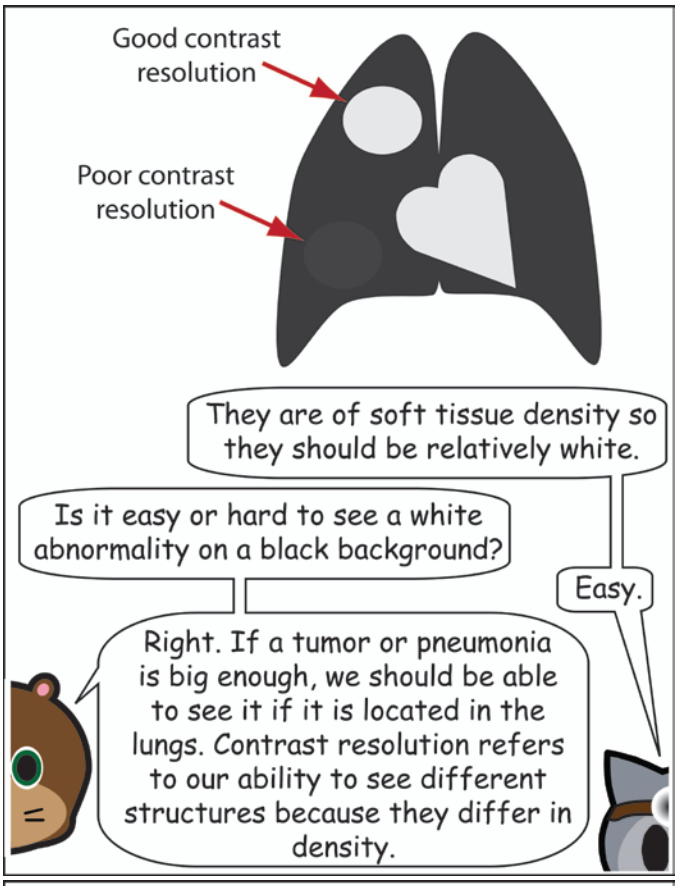
Tumors and infections are basically collections of cells, so I would expect them to be of soft tissue density.

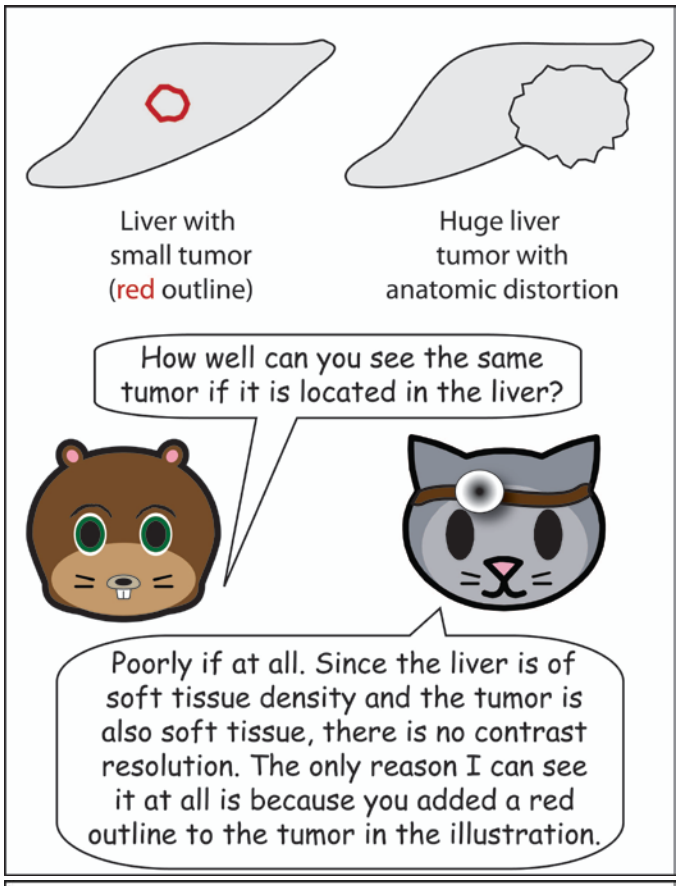

That's right. Most CXR abnormalities are soft tissue density. Abnormal fat & bone density are uncommon, so we will ignore them.
What about air?
Air density abnormalities are less common than soft tissue abnormalities, but since abnormal air collections can be rapidly fatal, you need to learn to recognize them.

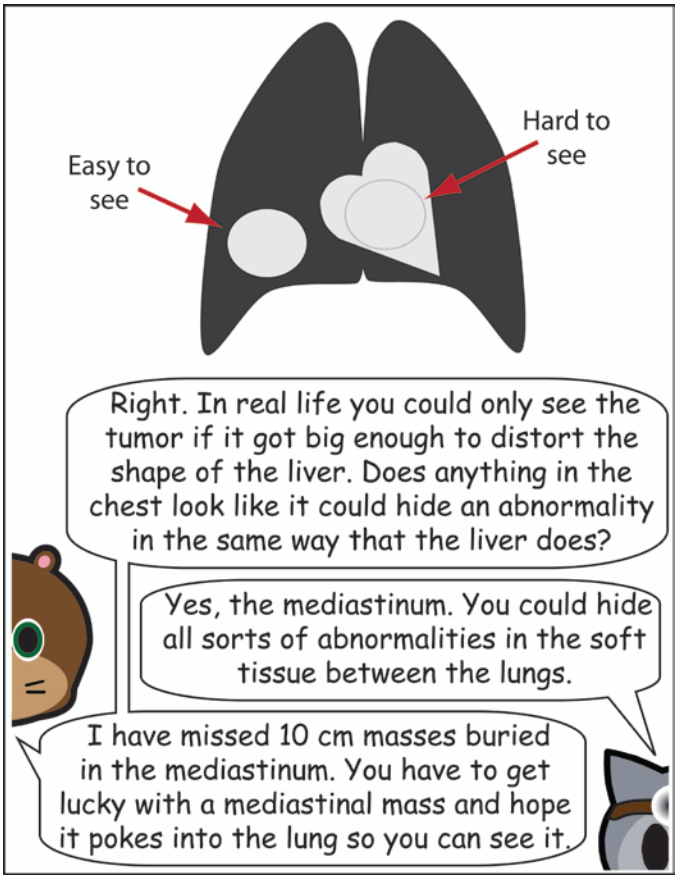

Abnormal gas collection
Abnormal soft tissue
How do recognize these abnormal densities?
We look for areas that are either whiter or blacker than normal on the x-ray image. For example, when the lung is too black or lucent, we suspect an abnormal gas collection. When we see areas that are too white or opaque, we suspect a tumor or infection.

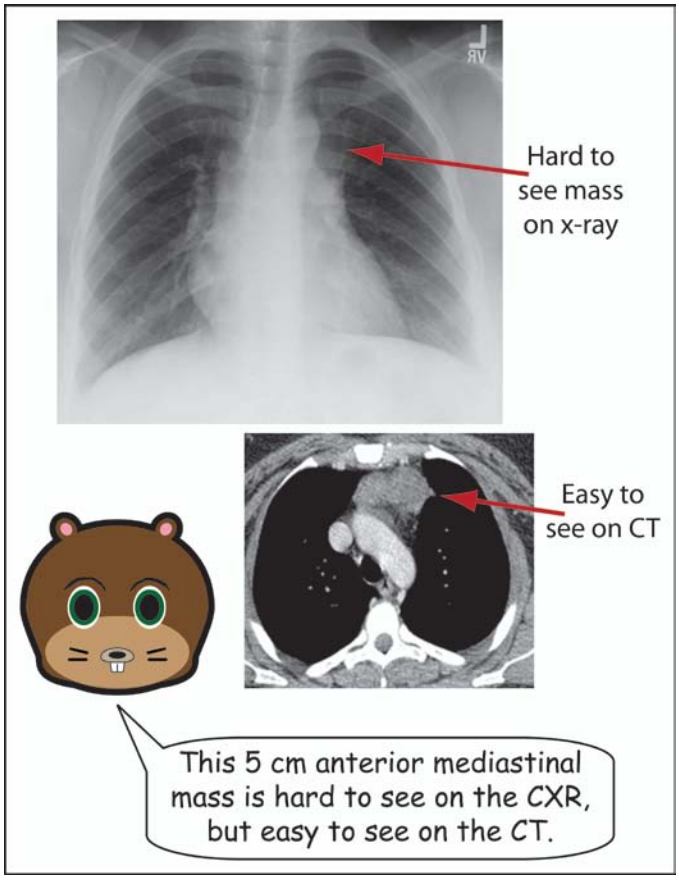

How hard can that possibly be?
DUNCE
It is true that the chest responds to disease and injury in limited ways: the abnormality will either be too white or too black. Because of this the lung has been called a dumb organ. Unfortunately, abnormalities can be subtle, non-specific and even misleading.

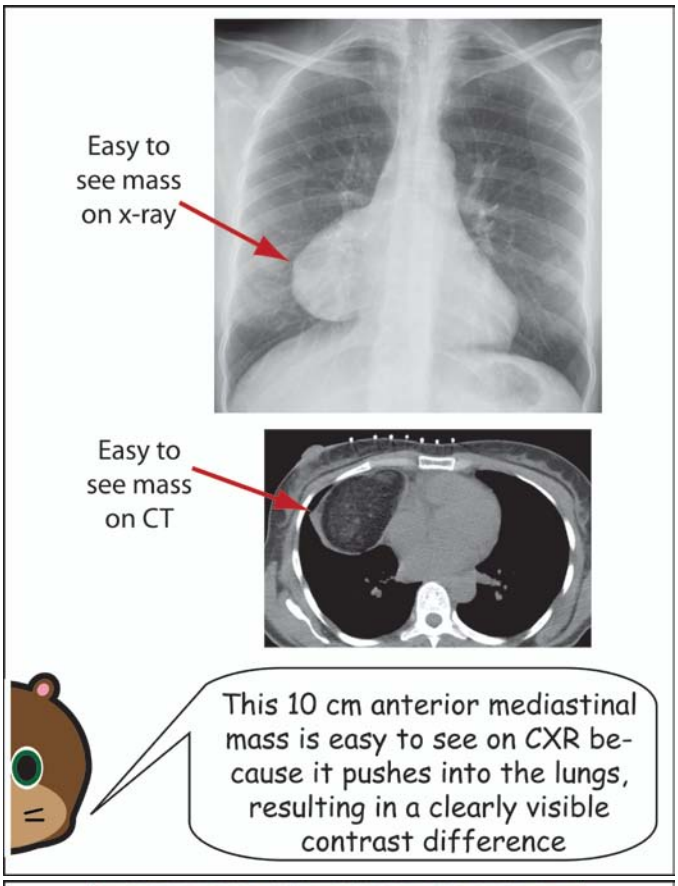

Completely black lung, not realistic
Dark grey lung, more realistic
Let's start by discussing why we can see tumors and pneumonia on a CXR. Where do these abnormalities usually occur?
In the lungs.
What density are the lungs?
Since they are normally filled with air, they should be black.
The lungs are not completely black because they do contain some soft tissue elements like blood vessels, but they are much more lucent than any other chest structure. Remind me what density tumors and infections are.

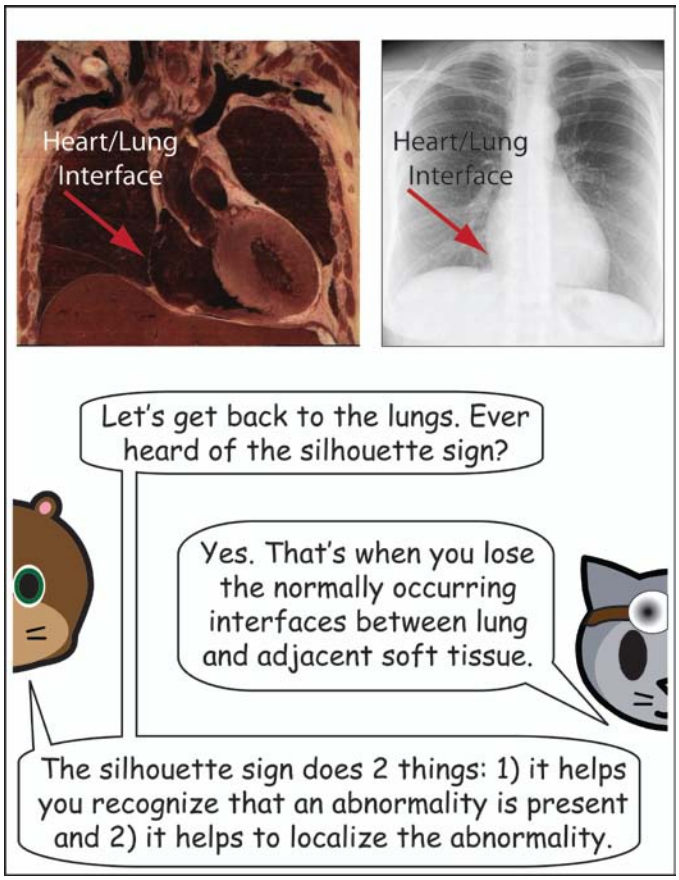

Good contrast resolution
Poor contrast resolution
They are of soft tissue density so they should be relatively white.
Is it easy or hard to see a white abnormality on a black background?
Easy.
Right. If a tumor or pneumonia is big enough, we should be able to see it if it is located in the lungs. Contrast resolution refers to our ability to see different structures because they differ in density.

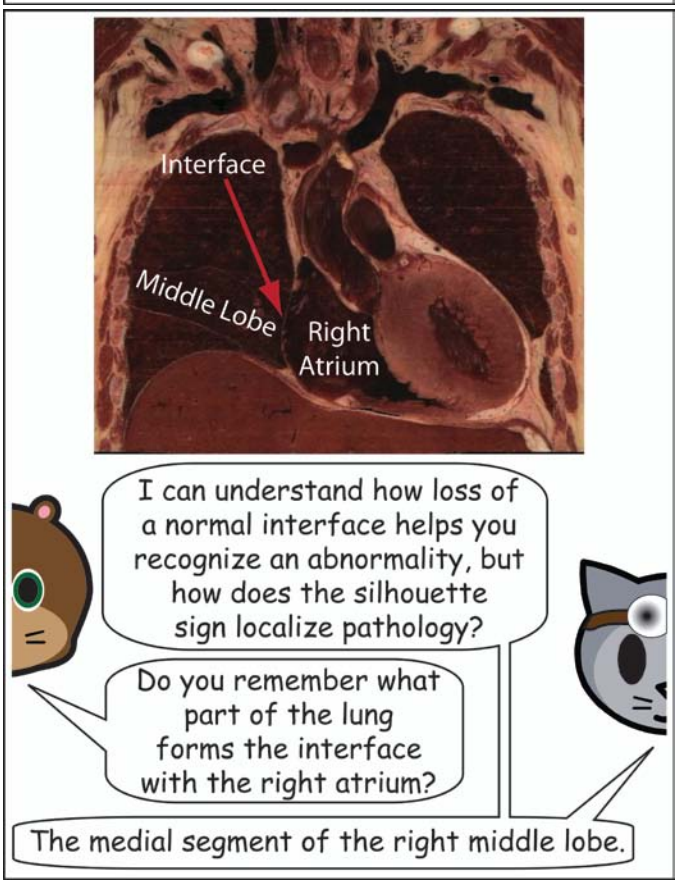

Liver with small tumor (red outline)
Huge liver tumor with anatomic distortion
How well can you see the same tumor if it is located in the liver?
Poorly if at all. Since the liver is of soft tissue density and the tumor is also soft tissue, there is no contrast resolution. The only reason I can see it at all is because you added a red outline to the tumor in the illustration.

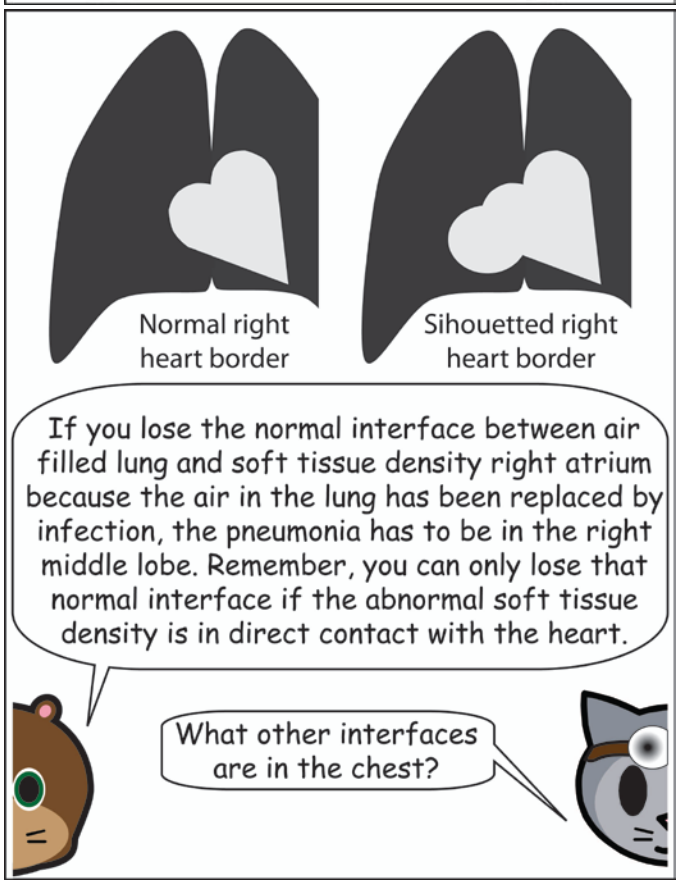

Easy to see
Hard to see
Right. In real life you could only see the tumor if it got big enough to distort the shape of the liver. Does anything in the chest look like it could hide an abnormality in the same way that the liver does?
Yes, the mediastinum. You could hide all sorts of abnormalities in the soft tissue between the lungs.
I have missed 10 cm masses buried in the mediastinum. You have to get lucky with a mediastinal mass and hope it pokes into the lung so you can see it.

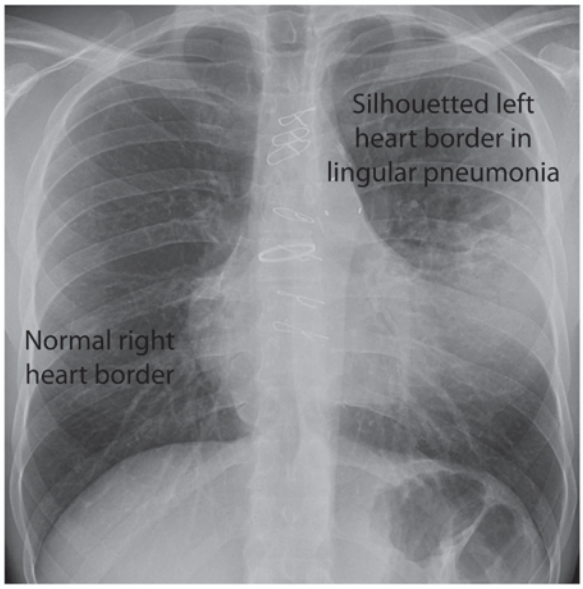

Hard to see mass on x-ray
Easy to see on CT
This 5 cm anterior mediastinal mass is hard to see on the CXR, but easy to see on the CT.


Easy to see mass on x-ray
Easy to see mass on CT
This 10 cm anterior mediastinal mass is easy to see on CXR because it pushes into the lungs, resulting in a clearly visible contrast difference

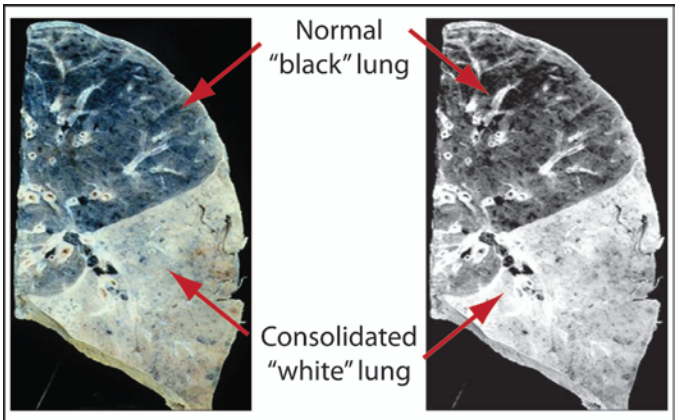

Heart/Lung Interface
Heart/Lung Interface
Let's get back to the lungs. Ever heard of the silhouette sign?
Yes. That's when you lose the normally occurring interfaces between lung and adjacent soft tissue.
The silhouette sign does 2 things: 1) it helps you recognize that an abnormality is present and 2) it helps to localize the abnormality.


Interface
Middle Lobe
Right Atrium
I can understand how loss of a normal interface helps you recognize an abnormality, but how does the silhouette sign localize pathology?
Do you remember what part of the lung forms the interface with the right atrium?
The medial segment of the right middle lobe.


Normal right heart border
Sihouetted right heart border
If you lose the normal interface between air filled lung and soft tissue density right atrium because the air in the lung has been replaced by infection, the pneumonia has to be in the right middle lobe. Remember, you can only lose that normal interface if the abnormal soft tissue density is in direct contact with the heart.
What other interfaces are in the chest?



The left ventricle projects into the lingula, so loss of the left heart border indicates that the abnormality is in the lingula. The lower lobes sit atop the diaphragm, so loss of the interface between lung and diaphragm localizes an abnormality to the lower lobe.



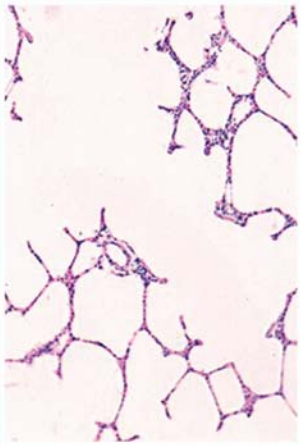
Gross Pathology X-ray

So what can cause increased lung density?

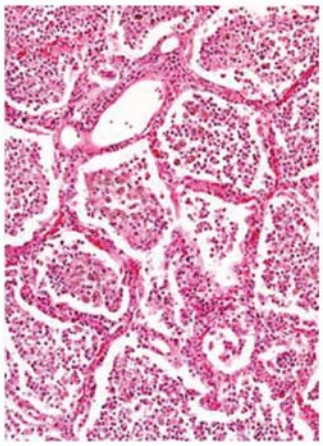
We will discuss 5 causes: consolidation, atelectasis, nodules/masses & effusion.

Let's start with consolidation.

Normal alveoli are air-filled, which is why lung is basically air density. Consolidation occurs when air is replaced with soft tissue and the lung turns white.



Air Filled Alveoli



Pus Filled Alveoli

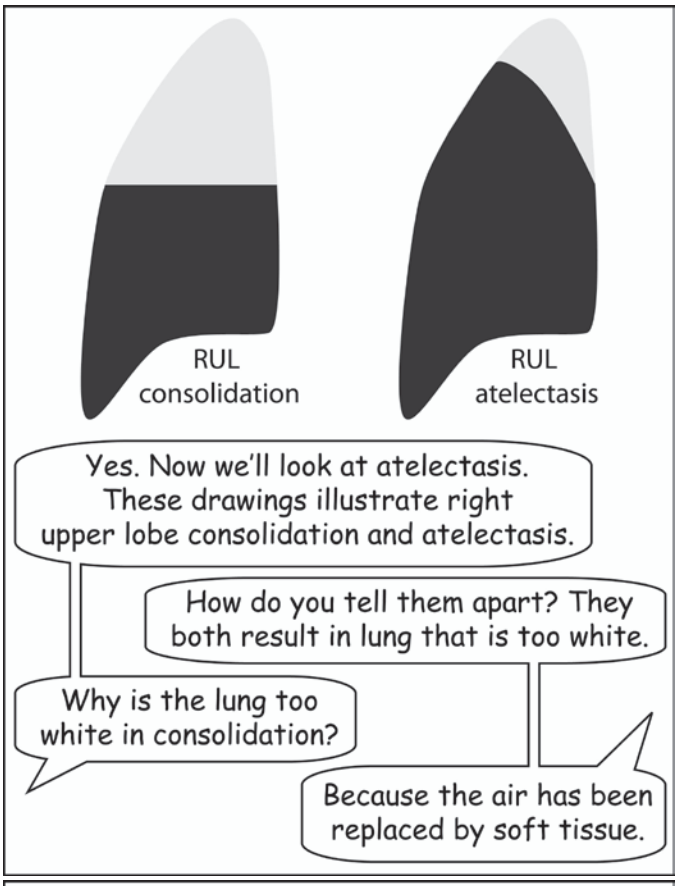
What types of soft tissue can get into alveoli?

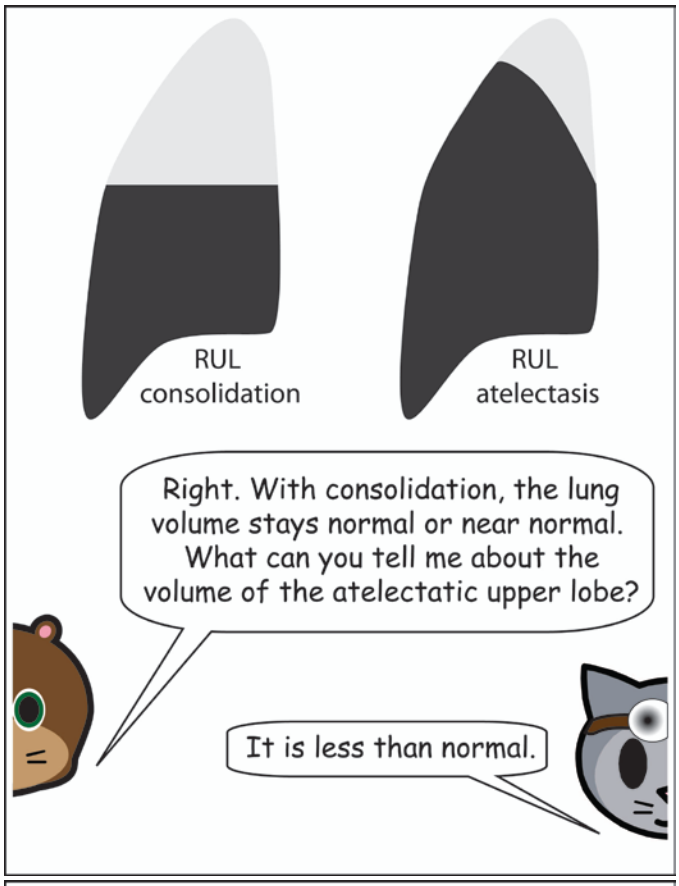
Many pathologic processes may replace air in the lung with soft tissue density. Pneumonia, bleeding, pulmonary edema from heart failure and certain cancers can all result in consolidation.

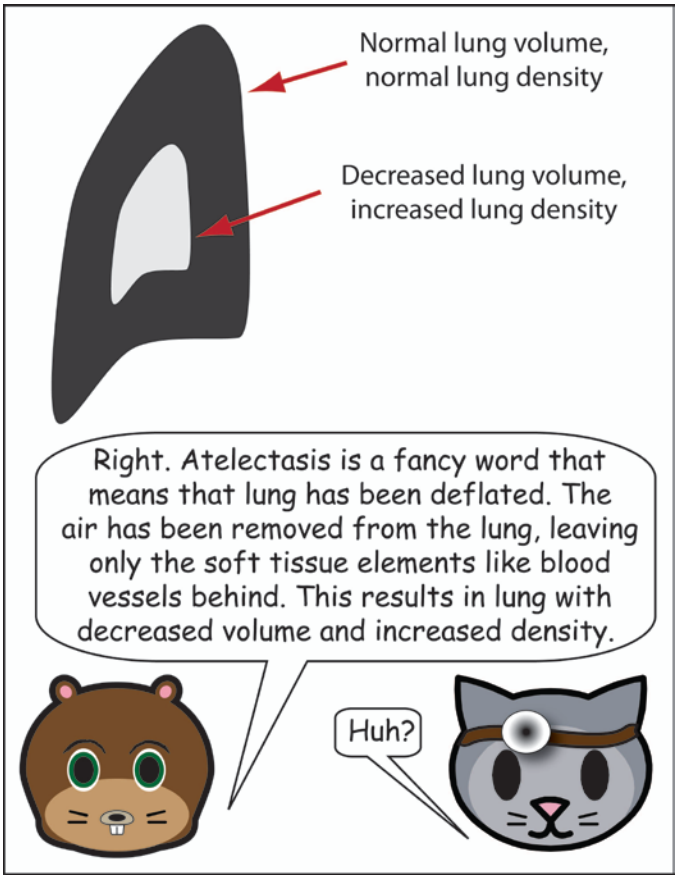
How do you figure out what caused the consolidation?

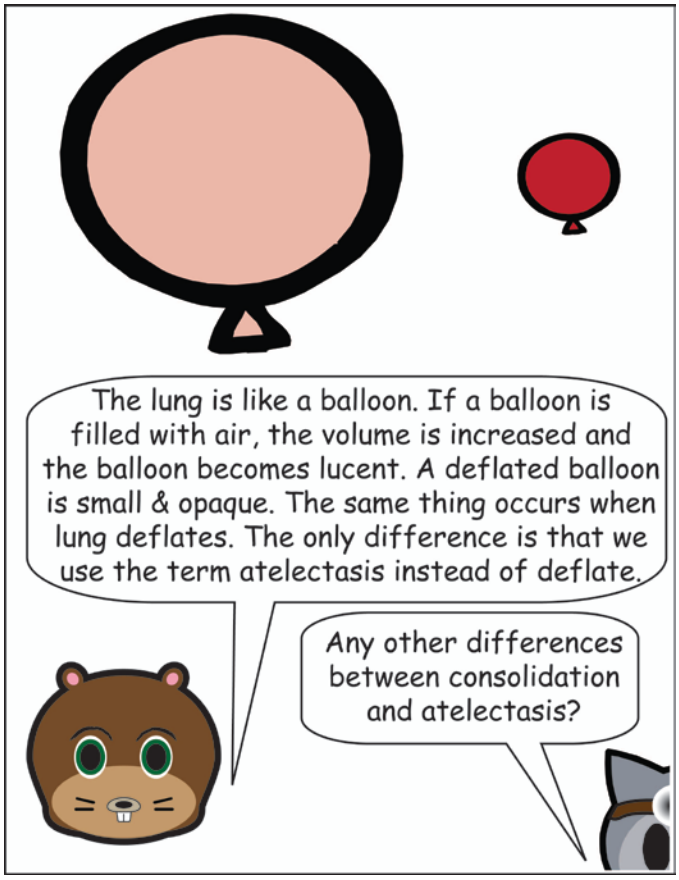
The clinical history is the key. A patient with consolidation, fever, an elevated white count and a productive cough likely has pneumonia.

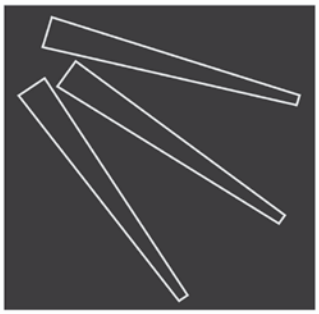
So that is what you meant by non-specific.


RUL
consolidation
RUL
atelectasis
Yes. Now we'll look at atelectasis. These drawings illustrate right upper lobe consolidation and atelectasis.
How do you tell them apart? They both result in lung that is too white.
Why is the lung too white in consolidation?
Because the air has been replaced by soft tissue.

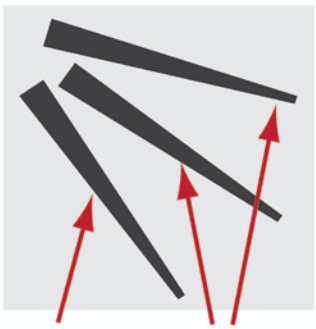

RUL
consolidation
RUL
atelectasis
Right. With consolidation, the lung volume stays normal or near normal. What can you tell me about the volume of the atelectatic upper lobe?
It is less than normal.


Normal lung volume, normal lung density
Decreased lung volume, increased lung density
Right. Atelectasis is a fancy word that means that lung has been deflated. The air has been removed from the lung, leaving only the soft tissue elements like blood vessels behind. This results in lung with decreased volume and increased density.
Huh?


The lung is like a balloon. If a balloon is filled with air, the volume is increased and the balloon becomes lucent. A deflated balloon is small & opaque. The same thing occurs when lung deflates. The only difference is that we use the term atelectasis instead of deflate.
Any other differences between consolidation and atelectasis?

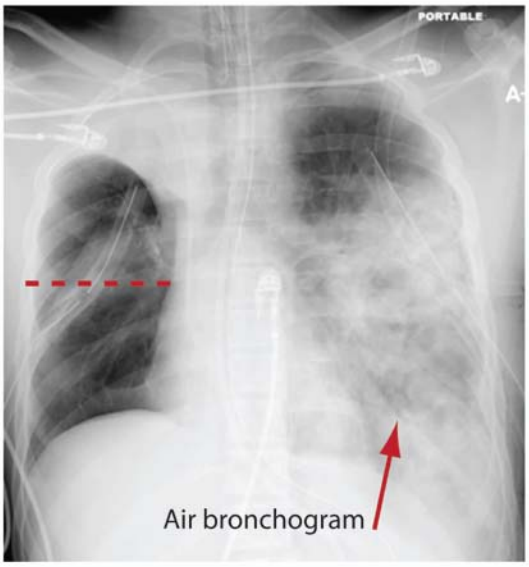


Normal lung, bronchi poorly visible



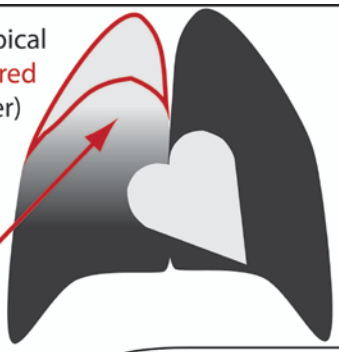
"Air bronchograms"

Consolidation may have a finding called air bronchograms. Normally, bronchi are poorly visible on an x-ray because the bronchi are too thin. But if the alveoli become filled with fluid, the air filled bronchi become visible against the soft tissue density background.



From: *Felson's Principles of Chest Roentgenology*

This CXR shows right upper lobe atelectasis. The dotted red line shows the normal inferior extent of the upper lobe. The left lower lobe is consolidated with normal volume and multiple air bronchograms (red arrow).



What causes atelectasis?

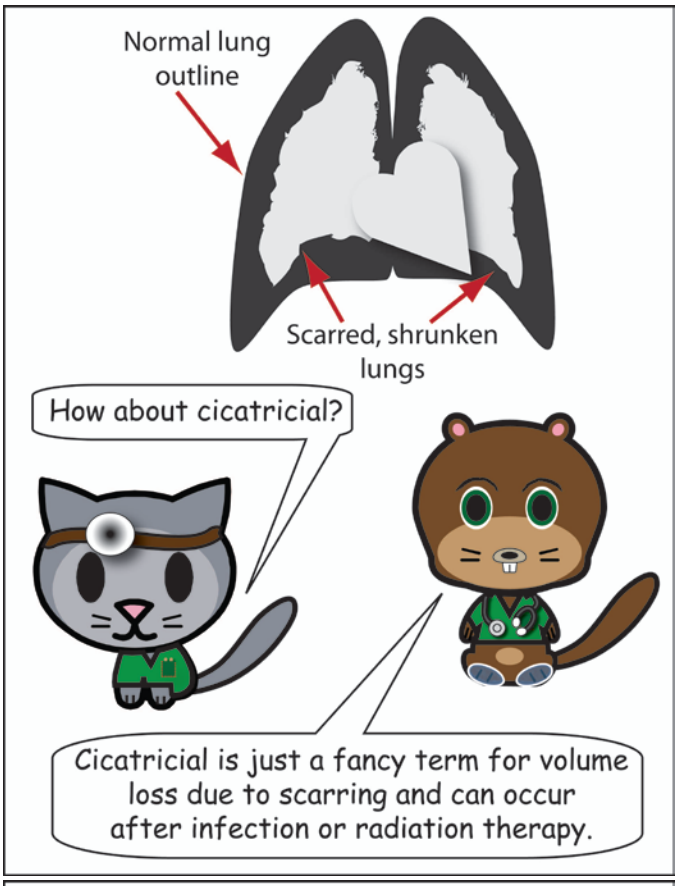
The 4 types of atelectasis are: 1) passive, 2) adhesive, 3) cicatricial and 4) obstructive.

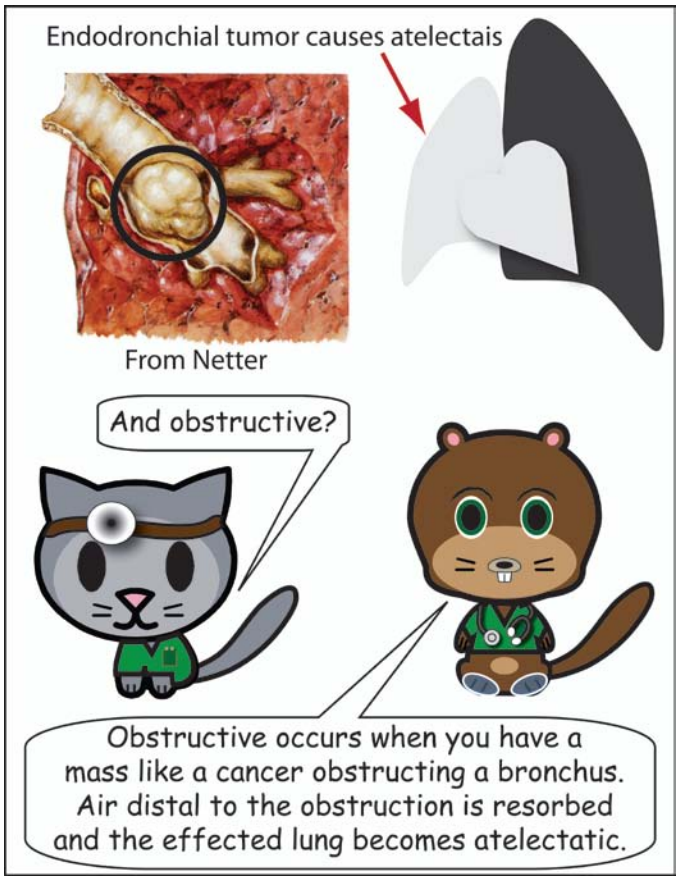
Please explain...

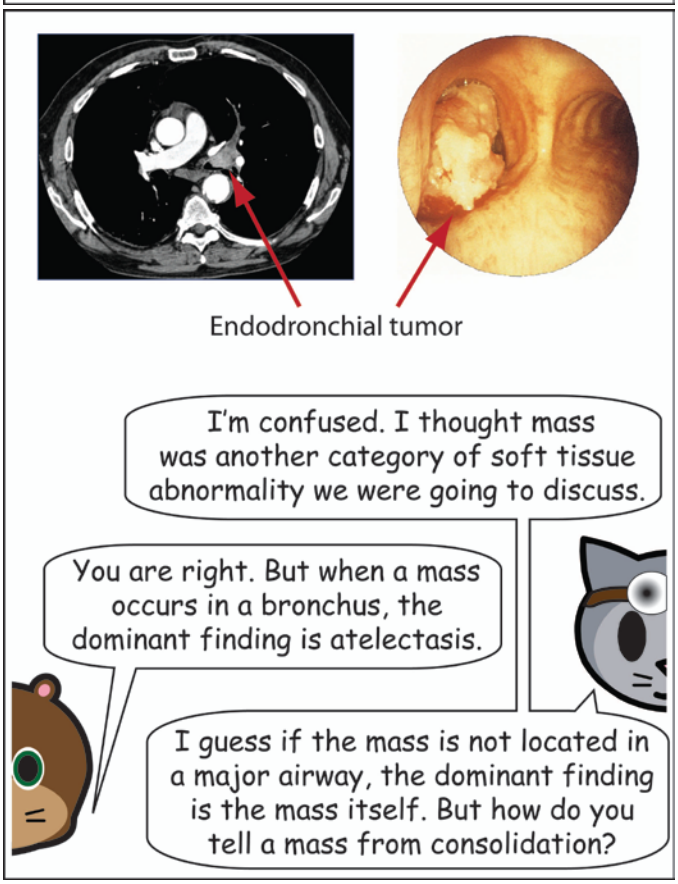
We'll start with passive. Whenever you have a mass or a pleural effusion pushing on lung, the lung volume decreases.

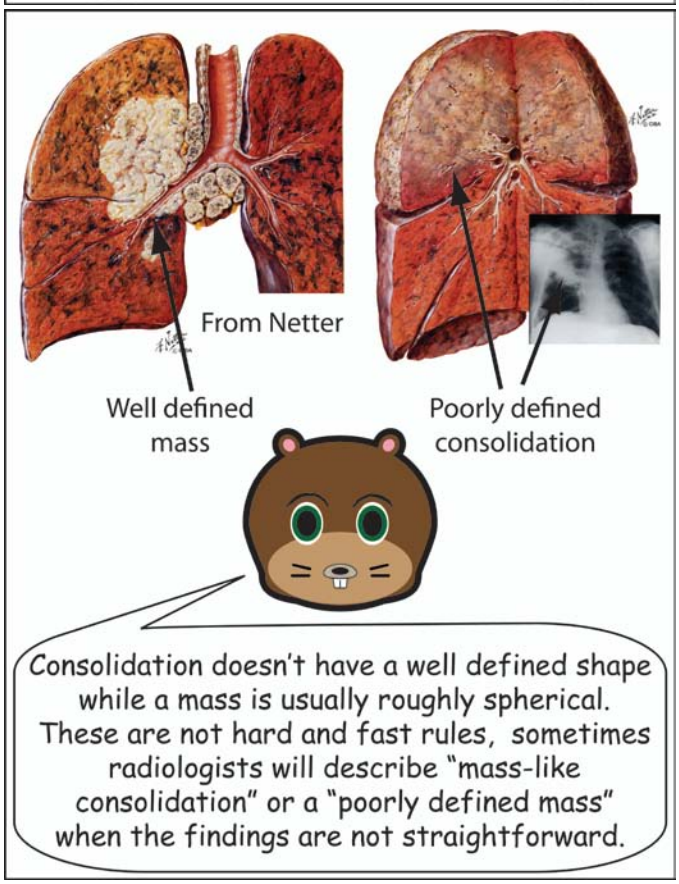
Adhesive atelectasis sounds as if the alveoli are glued shut.

That's close. Adhesive atelectasis results when there is inadequate surfactant. The best example is respiratory distress syndrome of the newborn. In this premature infant, the lungs have diffusely increased density and lung volumes are low.


Normal lung outline
Scarred, shrunken lungs
How about cicatricial?
Cicatricial is just a fancy term for volume loss due to scarring and can occur after infection or radiation therapy.


Endodronchial tumor causes atelectais
From Netter
And obstructive?
Obstructive occurs when you have a mass like a cancer obstructing a bronchus. Air distal to the obstruction is resorbed and the effected lung becomes atelectatic.

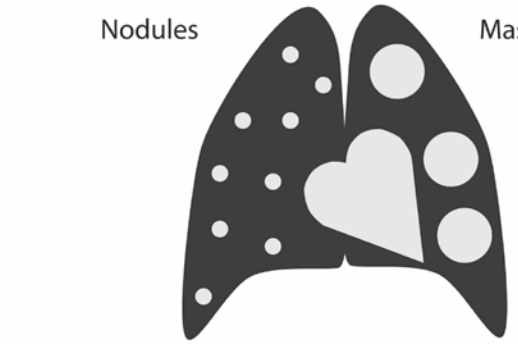

Endodronchial tumor
I'm confused. I thought mass was another category of soft tissue abnormality we were going to discuss.
You are right. But when a mass occurs in a bronchus, the dominant finding is atelectasis.
I guess if the mass is not located in a major airway, the dominant finding is the mass itself. But how do you tell a mass from consolidation?


From Netter
Well defined mass
Poorly defined consolidation
Consolidation doesn't have a well defined shape while a mass is usually roughly spherical. These are not hard and fast rules, sometimes radiologists will describe "mass-like consolidation" or a "poorly defined mass" when the findings are not straightforward.

http://lane.stanford.edu/tobacco/index.html

What causes a mass?

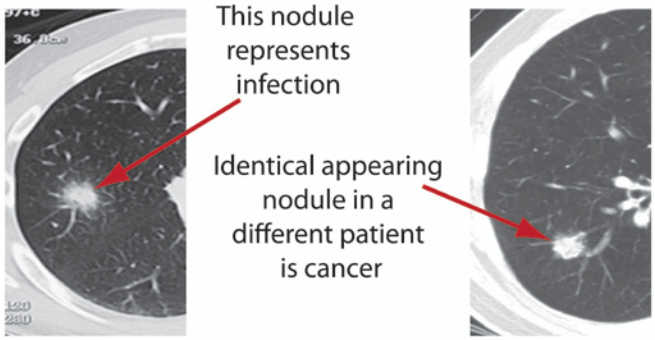
Most masses will be neoplasms, but the history is important. A 5 cm mass in a 50 year old smoker is probably lung cancer, but in a 5 year old, an unusually well defined pneumonia or a congenital anomaly is the likely etiology.



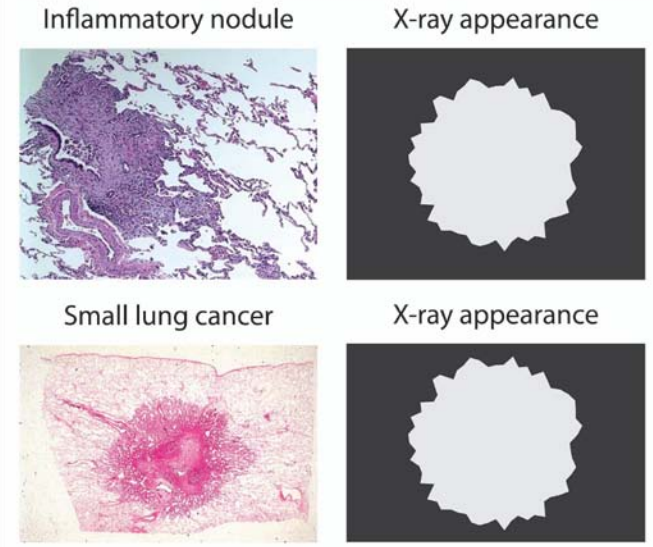
What is the difference between a nodule and a mass?

Both are roughly spherical soft tissue densities. The only difference is size: a mass is over 3cm in size while nodules are less than 3 cm.

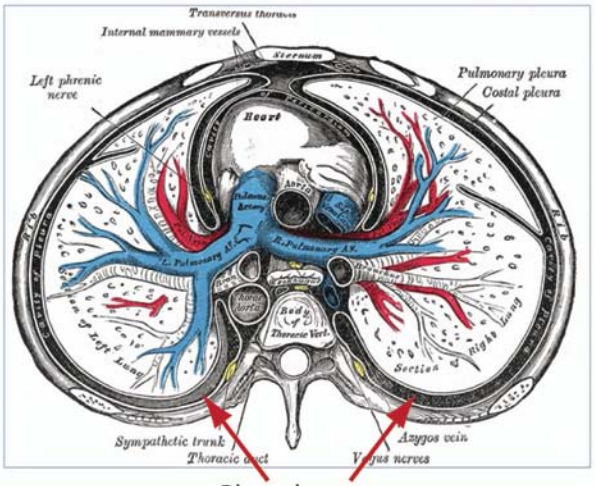
If nodules get bigger than 3 cm, do they turn into masses?



Yes. In fact the differential diagnosis for nodules is similar to masses. Cancer and infection as well as other etiologies should be considered, and often we have to figure out what is going on with a CT scan, even though a CT may not always give us the answer either. Again the history is key: if there is a known malignancy or a smoking history, metastases or a lung cancer are most likely, but if the patient has fever and a white count, we have to favor infection.



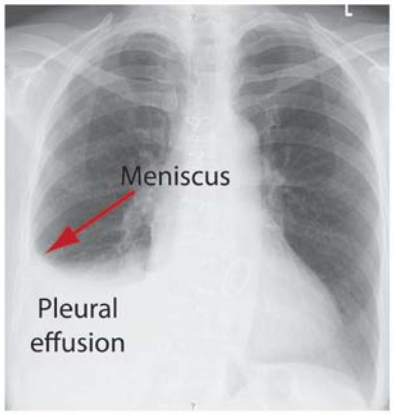
These 2 nodules look very different histologically, but may look identical on an x-ray. Both are of soft tissue density on a background of air filled lung.



Pleural space

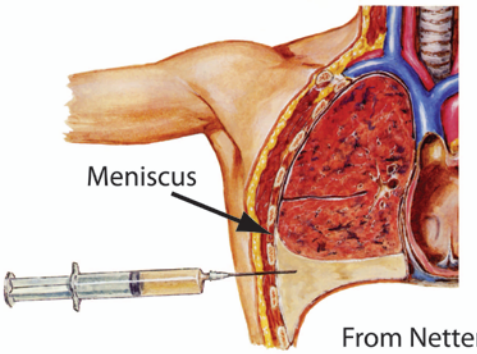
That leaves pleural effusion.

All of the abnormalities we have considered until now involve the lungs. A pleural effusion is a fluid collection in the potential space between the visceral and the parietal pleura.



How can we recognize a pleural effusion?

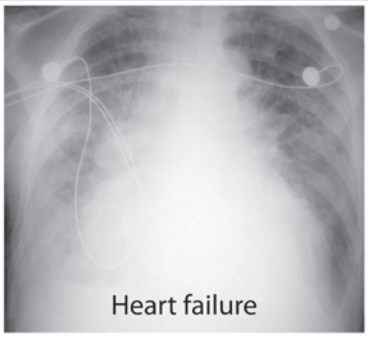
A pleural effusion must conform to the anatomy of the pleural space. Effusions tend to be peripheral and have a characteristic meniscus appearance on an upright CXR.



From Netter

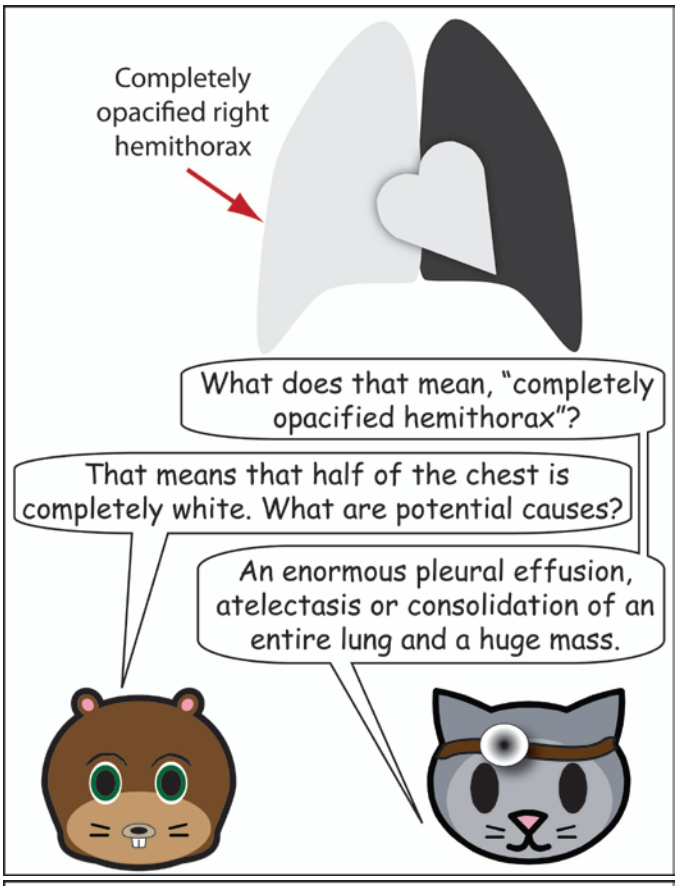
What causes an effusion?

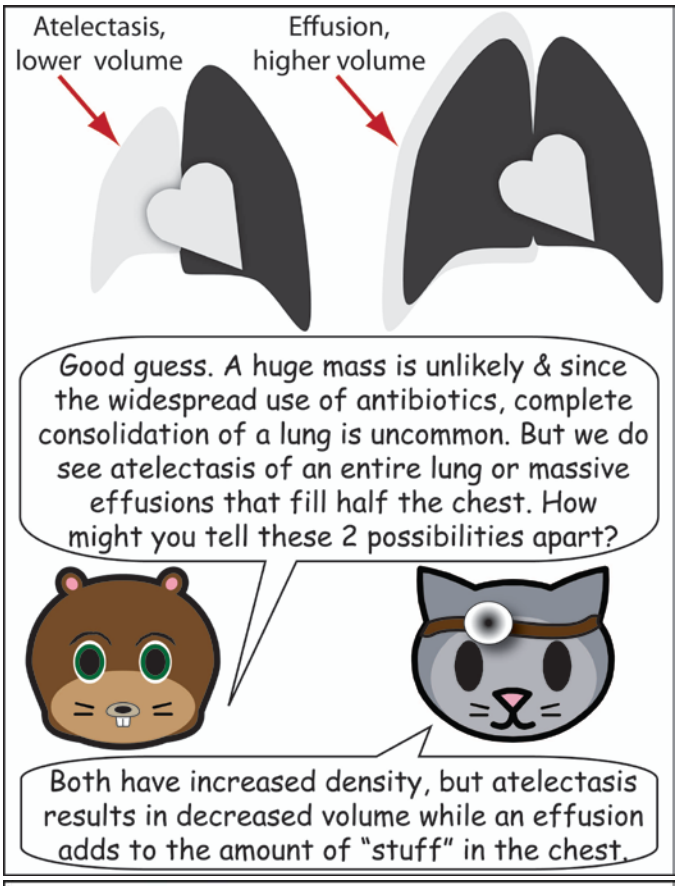
The pleural space is as dumb as the lungs! Cancer, infection and heart failure are some possibilities. The history is often the key to narrowing the differential. Definitive diagnosis may require sending fluid to pathology.

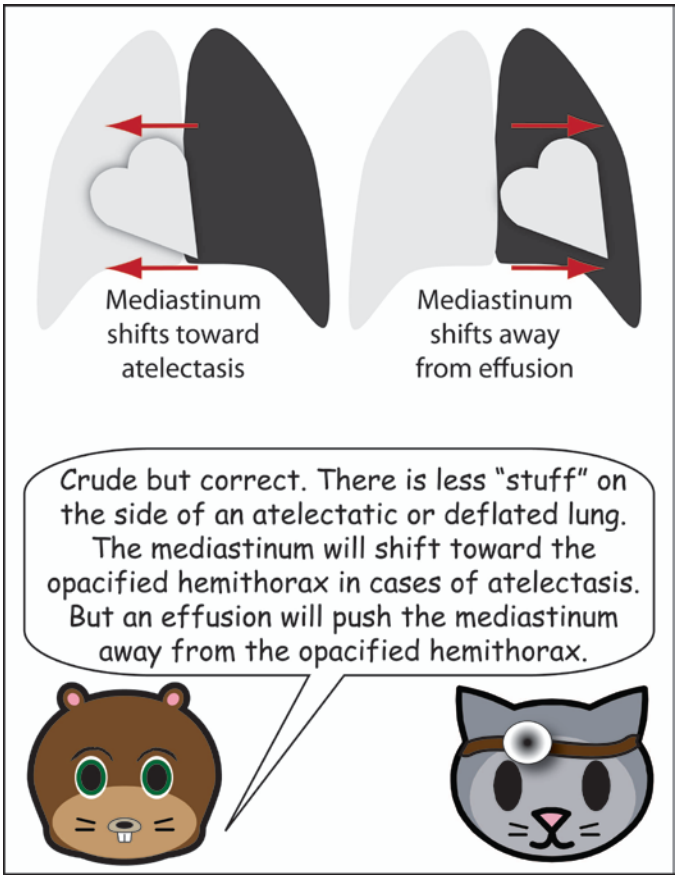


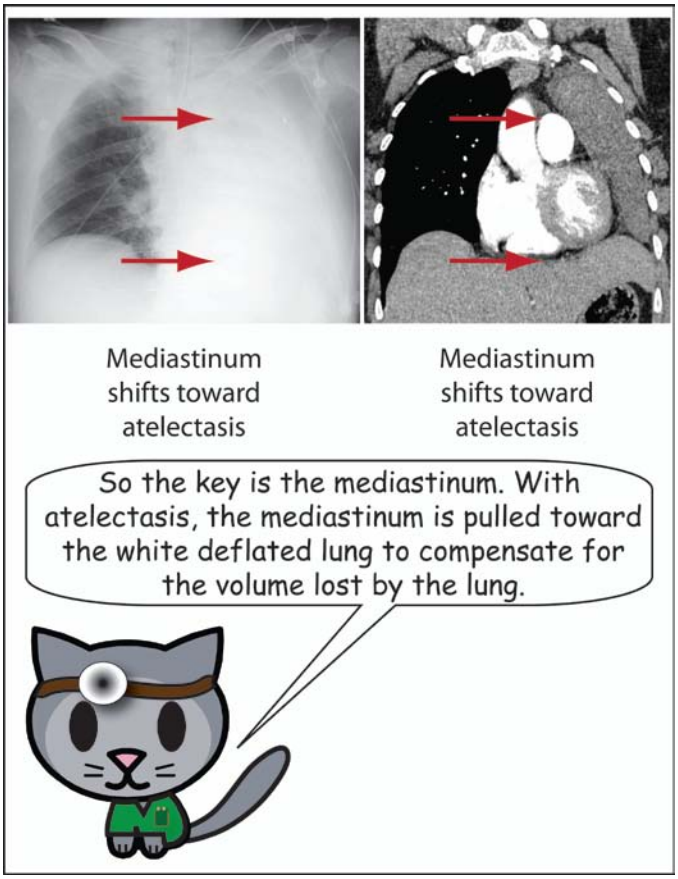
It seems like you can't distinguish radiographically between any cause of increased soft tissue density on a CXR.

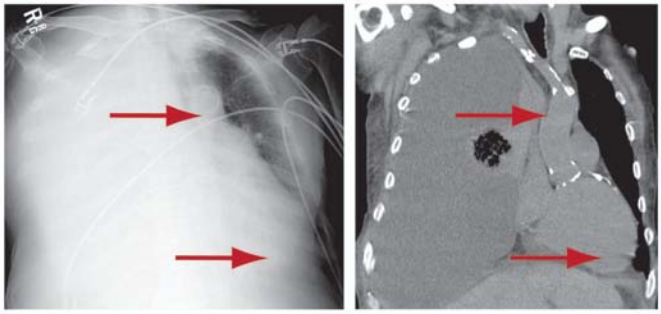
Don't despair, all is not lost. Even without a history, certain x-ray patterns are sufficiently characteristic to enable a specific diagnosis. For example, bilateral symmetric perihilar opacity with small bilateral effusions is almost invariably due to left heart failure. In fact before we go on, we must consider a classic differential diagnosis: the completely opacified hemithorax.


Completely opacified right hemithorax
What does that mean, "completely opacified hemithorax"?
That means that half of the chest is completely white. What are potential causes?
An enormous pleural effusion, atelectasis or consolidation of an entire lung and a huge mass.


Atelectasis, lower volume
Effusion, higher volume
Good guess. A huge mass is unlikely & since the widespread use of antibiotics, complete consolidation of a lung is uncommon. But we do see atelectasis of an entire lung or massive effusions that fill half the chest. How might you tell these 2 possibilities apart?
Both have increased density, but atelectasis results in decreased volume while an effusion adds to the amount of "stuff" in the chest.


Mediastinum shifts toward atelectasis
Mediastinum shifts away from effusion
Crude but correct. There is less "stuff" on the side of an atelectatic or deflated lung. The mediastinum will shift toward the opacified hemithorax in cases of atelectasis. But an effusion will push the mediastinum away from the opacified hemithorax.

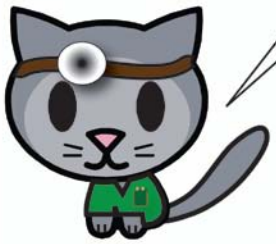

Mediastinum shifts toward atelectasis
Mediastinum shifts toward atelectasis
So the key is the mediastinum. With atelectasis, the mediastinum is pulled toward the white deflated lung to compensate for the volume lost by the lung.

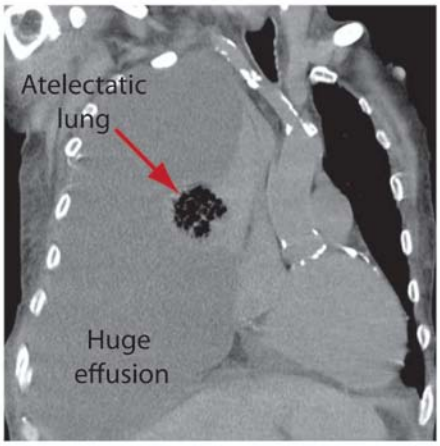


Mediastinum shifts away from effusion

Mediastinum shifts away from effusion

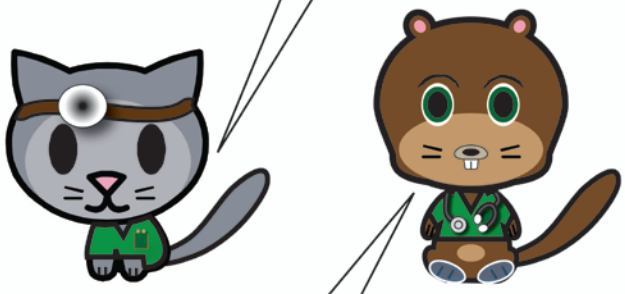
An effusion results in increased material in the opacified hemithorax and pushes the mediastinum away from the opacification.





Correct. There is one fine point I want to add so that you don't get confused. In both of these cases the lung ends up deflated. When there is shift to the opacified hemithorax, the lung is deflated because of endobronchial obstruction with a net loss of volume on that side. With a massive effusion, the volume of fluid is so great that the mediastinum is pushed to the opposite side at the same time that the lung is deflated by the fluid. This is an example of passive atelectasis.

How often do you see complete opacification of a hemithorax?



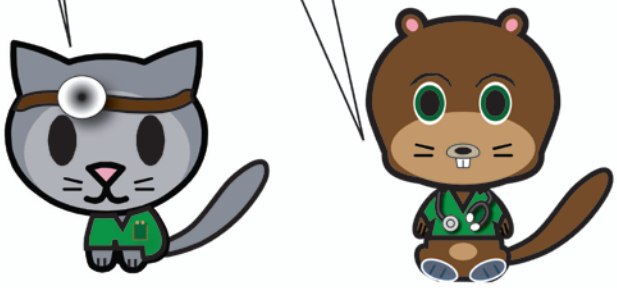
In our practice we see it about once a week. The reason we want to distinguish between an effusion and obstructive atelectasis is that treatment is different. In cases of obstructive atelectasis, the obstruction can often be removed, especially if it is a mucous plug. An effusion is treated with thoracentesis. Unfortunately, cancer is a frequent cause of both obstructive atelectasis and massive effusions.

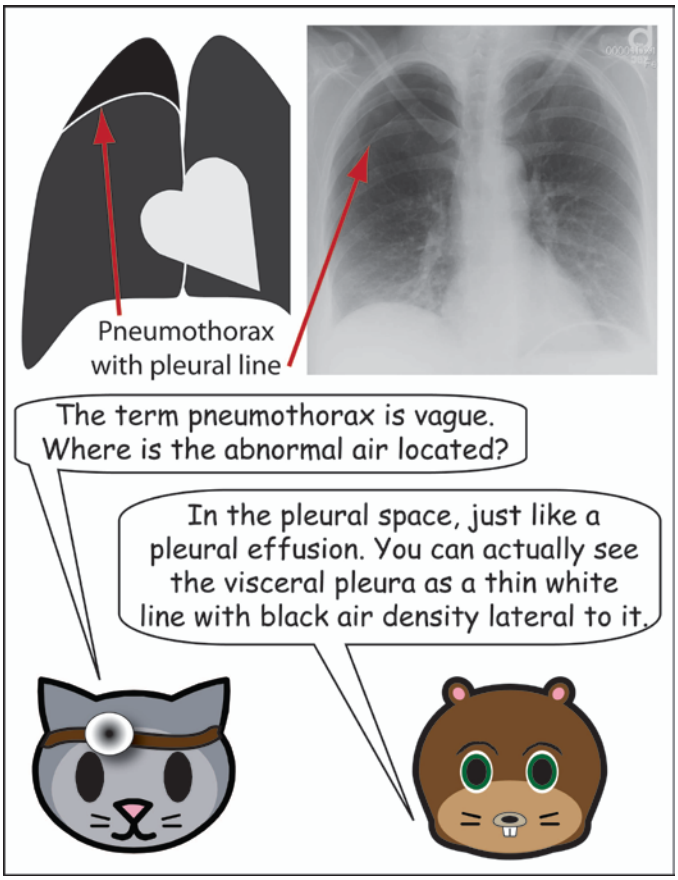
Can we move on to decreased density?

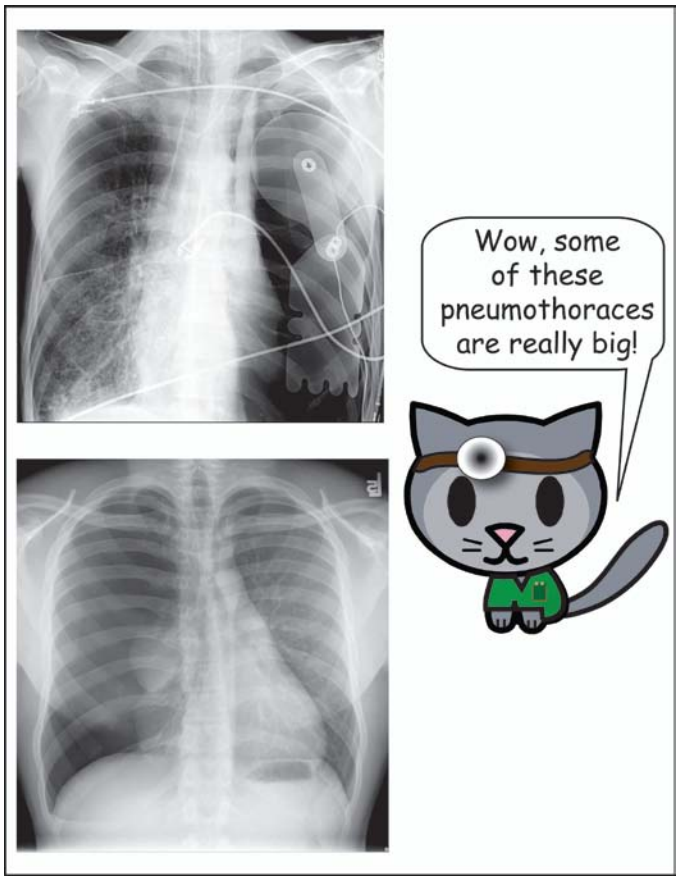
Yes. What do you think causes the density of the chest to be abnormally decreased?

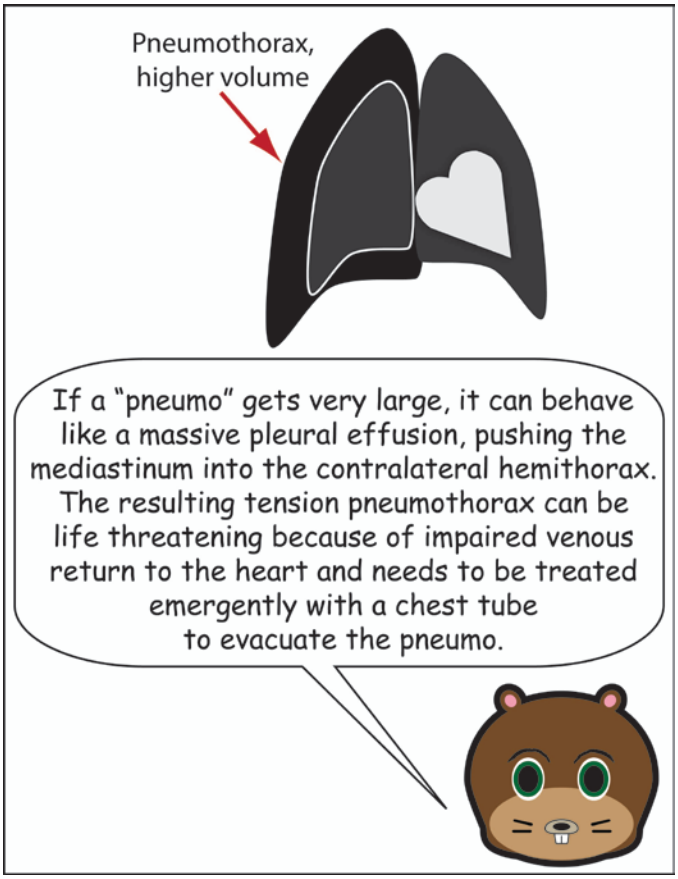
Too much air making the chest too black.

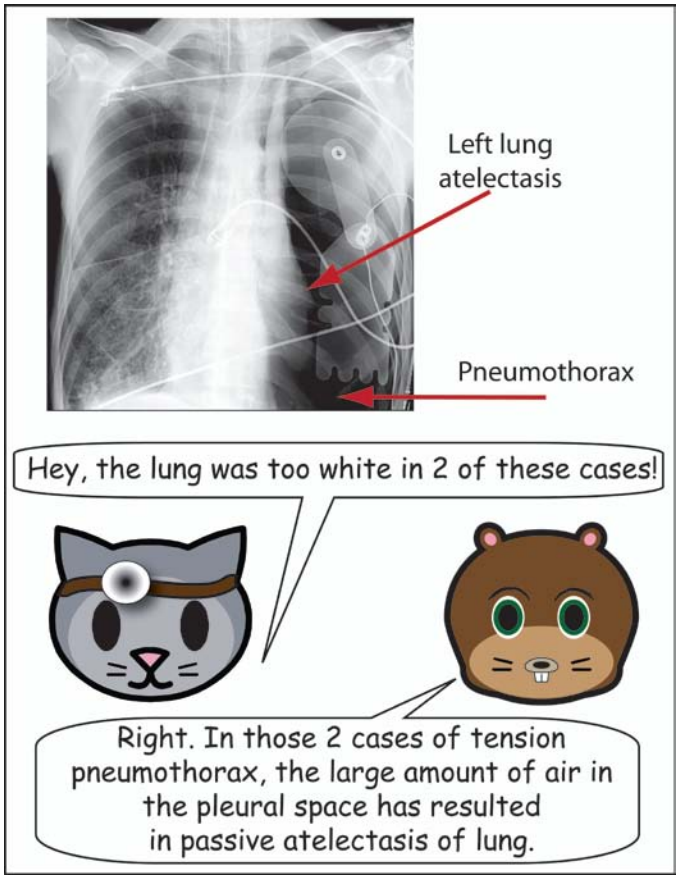
Correct. We will discuss 4 types of abnormal air collections:
1) pneumothorax, 2) pneumomediastinum, 3) pneumopericardium and 4) pulmonary cavitation.
We'll start with pneumothorax.




Pneumothorax with pleural line
The term pneumothorax is vague. Where is the abnormal air located?
In the pleural space, just like a pleural effusion. You can actually see the visceral pleura as a thin white line with black air density lateral to it.


Wow, some of these pneumothoraces are really big!


Pneumothorax, higher volume
If a "pneumo" gets very large, it can behave like a massive pleural effusion, pushing the mediastinum into the contralateral hemithorax. The resulting tension pneumothorax can be life threatening because of impaired venous return to the heart and needs to be treated emergently with a chest tube to evacuate the pneumo.

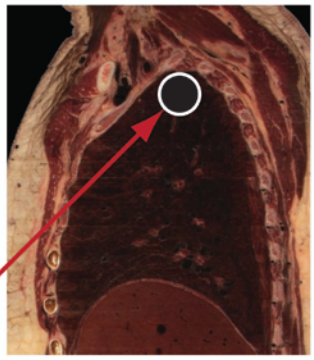

Left lung atelectasis
Pneumothorax
Hey, the lung was too white in 2 of these cases!
Right. In those 2 cases of tension pneumothorax, the large amount of air in the pleural space has resulted in passive atelectasis of lung.

All of these examples look pretty easy.

When a pneumothorax is big or when the patient is upright, a pneumothorax is easy to spot. Small pneumos may be difficult to see and even large pneumothoraces may be virtually invisible if the patient is supine.

Why don't we have all chest x-rays obtained in the upright position?

Most people that have pneumothoraces are in the ICU and their x-rays are obtained with the patient supine. Getting upright chest x-rays on intubated patients is difficult.



So how do we recognize a pneumothorax in these patients?

Well, you may get lucky and see a thin white pleural line with adjacent black air.

What if you are unlucky?

We have to remember where the abnormal air will go. In an upright CXR, where does the pleural air go?

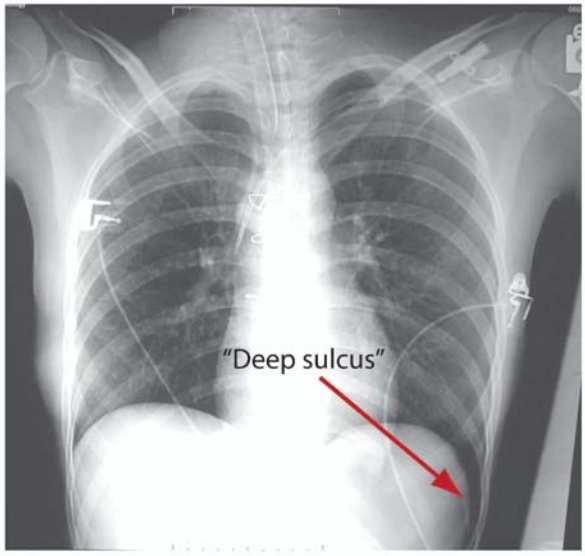
It goes to the highest point in the chest, so it will end up at the apex of the thorax.

Correct, but what if the patient is supine?

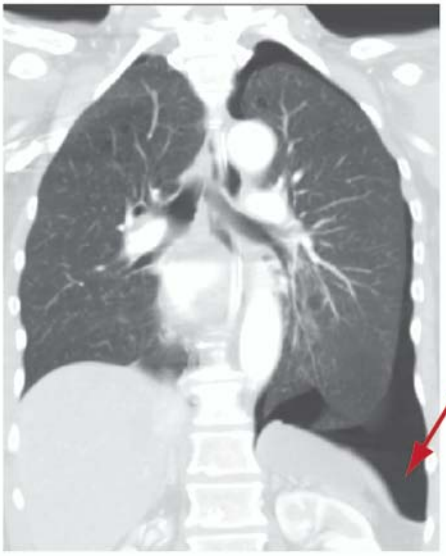
On this anatomic specimen, it looks like the highest point is over the diaphragm, so that is where I expect the air to go.

Right, so what we look for on a supine x-ray is a "deep sulcus sign". The pleural air causes the effected lateral costophrenic sulcus to be more lucent and deeper than normal.

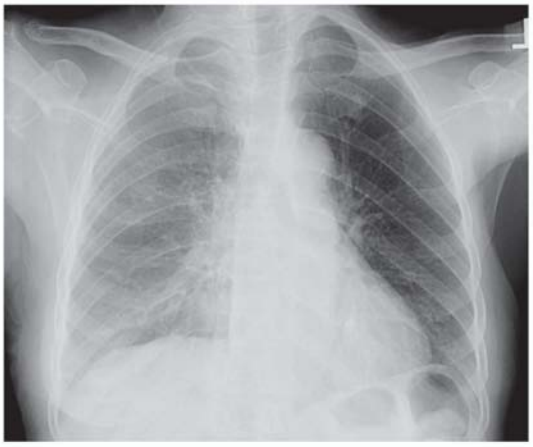
That is subtle.



Look at the left sulcus, see how it is blacker and deeper than the right sulcus. This person developed a left pneumothorax following the left line placement.

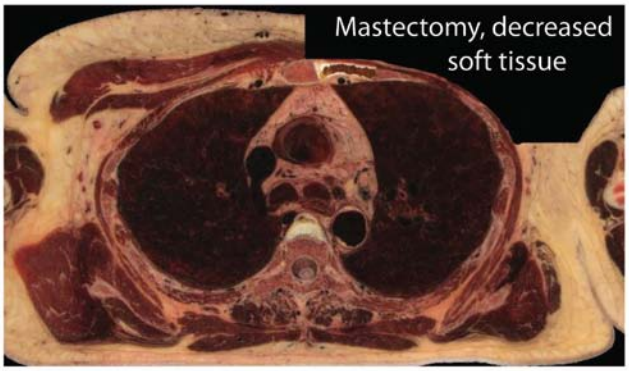


This coronal CT shows that in a supine patient, most of the air in the pleural space collects near the diaphragm.



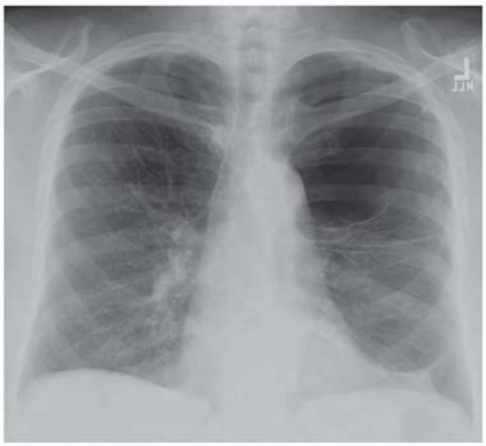
There are more pitfalls we need to cover. What do you think of this case?

The left hemithorax is too lucent, so I suspect a left sided pneumothorax.



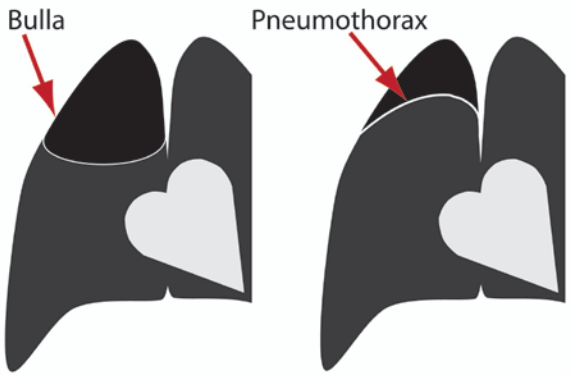
You are right; the left hemithorax is too lucent, but the patient does not have a pneumo. She underwent a mastectomy for breast cancer and the decreased left chest wall soft tissue resulted in the relative lucency of the left chest.

Tricky!



How about this case?

There is too much air at the left lung apex, but it doesn't look like other pneumos we have seen.



Right. This is an example of a bulla, which is a thin walled, well defined greater than 1 cm area where normal lung has been destroyed and replaced by air. A bulla is contained within the lung and its' roughly spherical shape help distinguish it from a pneumo. Often there will be smaller bullae in the other lung. If you mistake a bulla for a pneumo and recommend placing a chest tube into the bulla, a bronchopleural fistula may result. The surgeons will hate you.

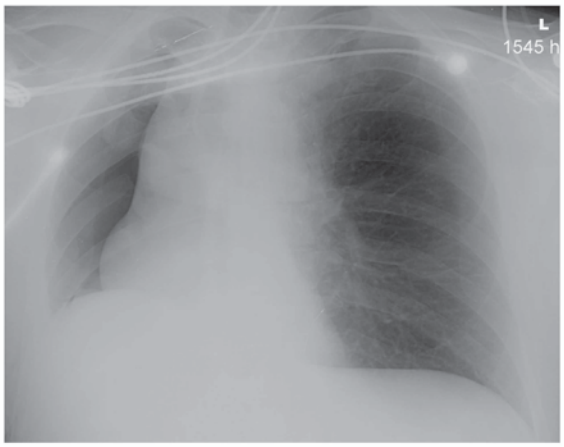
What do you think of this upright CXR?

There is an abnormal lucency at the left lung base. That is the wrong place for a pneumo, a pneumo on an upright CXR should be apical.

Another pitfall. This person had prior right lung surgery that resulted in pleural scarring. As a result, the pleural space is loculated, trapping the pleural air around the right diaphragm.

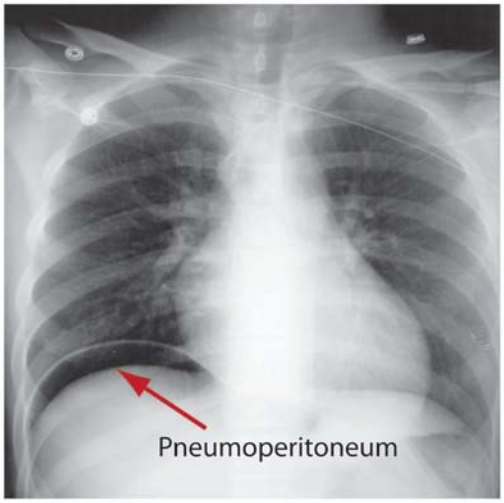
No fair.

How about the next case?



The entire right hemithorax is too black. But in this case the volume of the right chest is abnormally small. A pneumo usually results in increased volume.

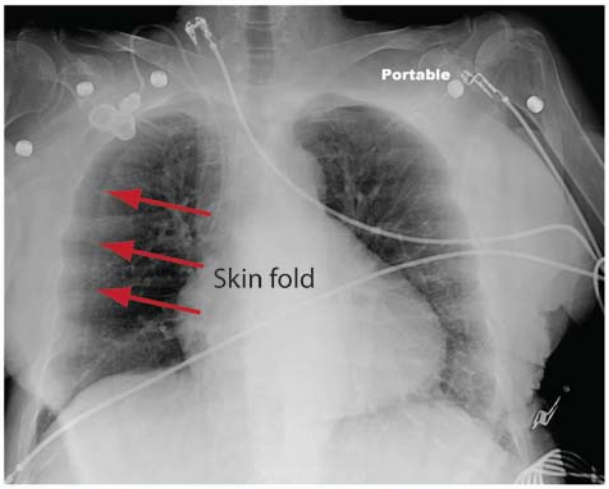
This person just underwent a right pneumonectomy. The only thing left in the right chest is air. The volume is decreased because the contents of the right chest have been removed.



And this one...

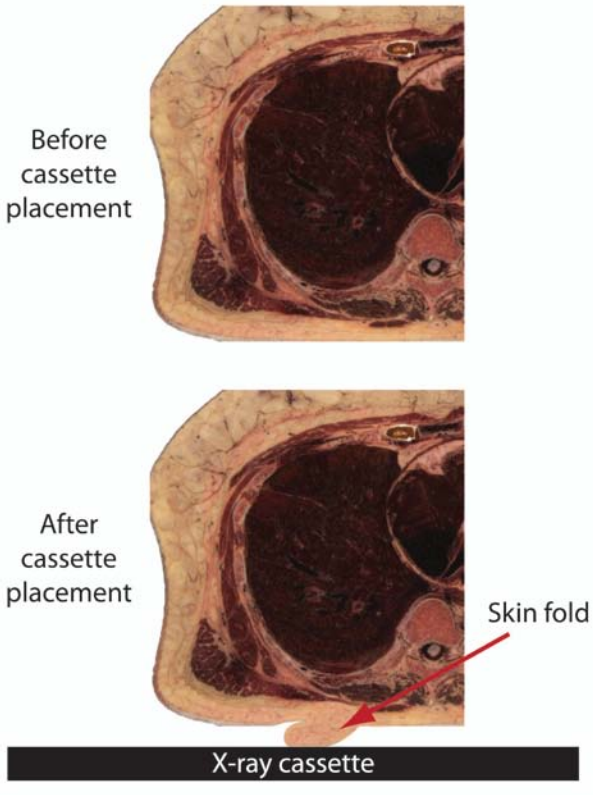
That's just free air under the diaphragm.

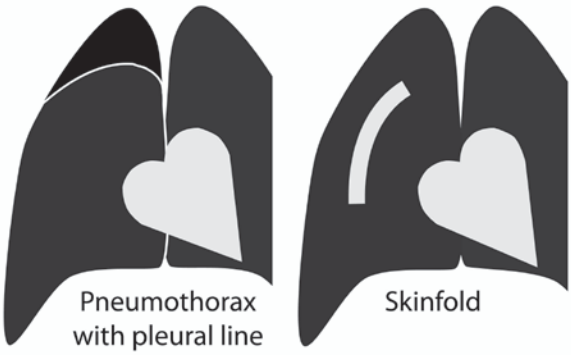
Correct, you don't want to confuse that with a subpulmonic pneumothorax. The diaphragm is thicker than a visceral pleural line. One more...



That has got to be a right pneumothorax!

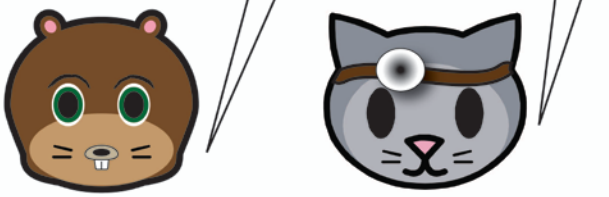
Nope, that is a skin fold. When the technologist slides an x-ray cassette behind a patient, occasionally redundant skin gets heaped up. On an x-ray, the resulting skin fold can mimic a pleural line, but there are differences.

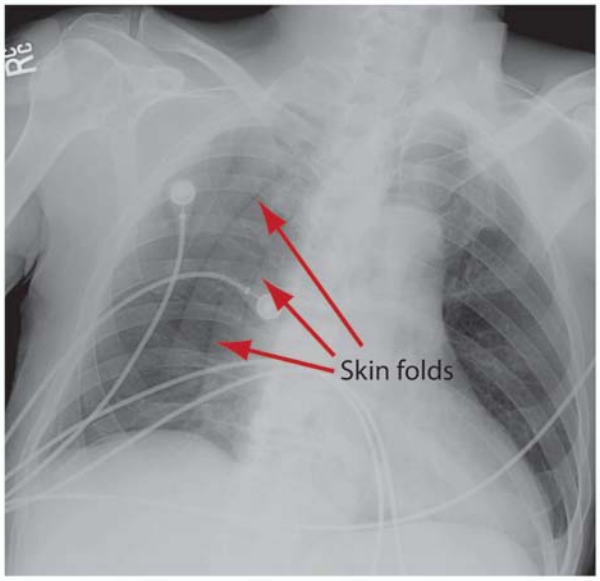




A skin fold is thicker than a pleural line. You can see lung markings peripheral to a skin fold, while with a pneumo, you should have featureless pleural air beyond the thin pleural line.

What else?



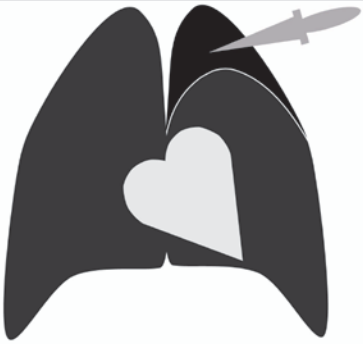


Since a skin fold is a non-anatomic feature, it will do things that a pneumo won't. Here are 3 skin folds crossing from the right to the left chest. A pleural line won't extend into the opposite hemithorax.

Pneumothoraces are tricky. What is the most common cause?

Anything that results in communication between the atmosphere or air in the subpleural lung and the pleural space can give you a pneumothorax. Can you think of some etiologies?

If you cross the pleural space and poke a hole in the lung while putting in a central line you can get a pneumo.



That's probably the most common cause. Other potential etiologies include penetrating trauma like a stab wound, rib fractures and barotrauma.

I can see how penetrating injuries and rib fractures could tear the lung and pleura, but how does barotrauma result in a pneumothorax?

Positive pressure ventilation may result in alveolar hyperinflation. If over inflated sub-pleural alveoli rupture into the pleural space, the patient ends up with a pneumothorax. Sometimes, there is a one way valve effect, with rapid accumulation of air in the pleural space resulting in a tension pneumothorax. A pneumothorax in an intubated patient can quickly become life threatening.

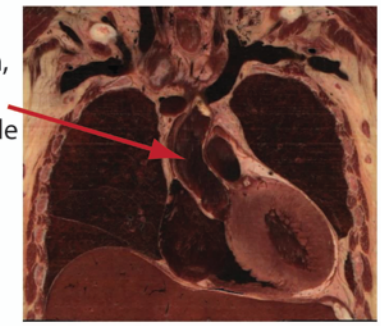
But not all pneumos occur in traumatized or intubated patients, right?

This is not really a bleb, but it gives you the idea. From Netter

True. There are cases of spontaneous pneumothorax, especially in tall skinny people, usually the result of rupture of something called a bleb. A bleb is a small air bubble in the visceral pleural that can rupture into the pleural space, causing a pneumothorax. I'll let you look up catamenial pneumothorax on your own.

Can we move on to pneumomediastinum?

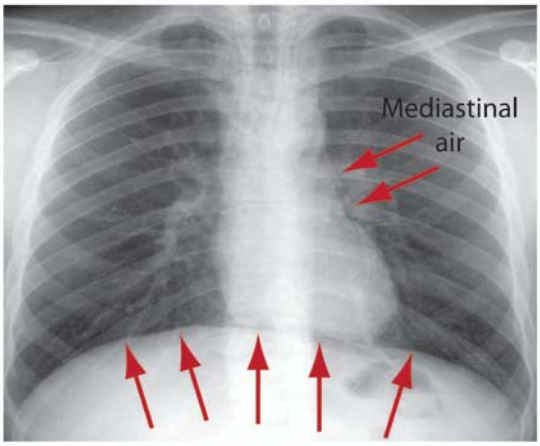
The mediastinum, that soft tissue lump in the middle of the chest



Of course. Let's start with the definition.

Easy. A pneumomediastinum is any abnormal air collection in the mediastinum.

Right. The findings may be tricky. Since there is no potential space for the air to accumulate, what you most commonly see are streaks of air in the mediastinum often extending into the neck. There may also be a continuous diaphragm sign.



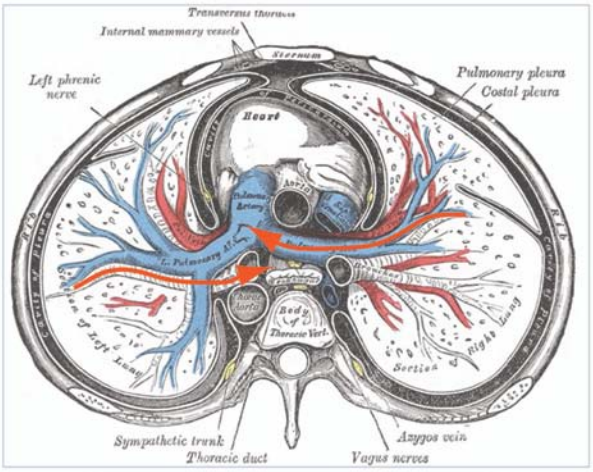
Continuous diaphragm

What's that?

The idea is similar to the silhouette sign. Normally, you cannot draw a line all the way across the diaphragm without bumping into the heart because the soft tissue heart sits on top of the soft tissue diaphragm. With a pneumomediastinum, air gets in between the heart and the diaphragm, allowing you to see the entire diaphragm.

Can you think of any etiologies for a pneumomediastinum?

Sure. The mediastinum contains the esophagus and the tracheobronchial tree. Rupture of any of these structures can result in leakage of air into the mediastinum.



True, but most cases of pneumomediastinum are not caused by esophageal or tracheobronchial rupture. Most of the time a pneumomediastinum is caused by rupture of overinflated alveoli. The air then dissects (orange arrows) back to the mediastinum along bronchi or vessels.

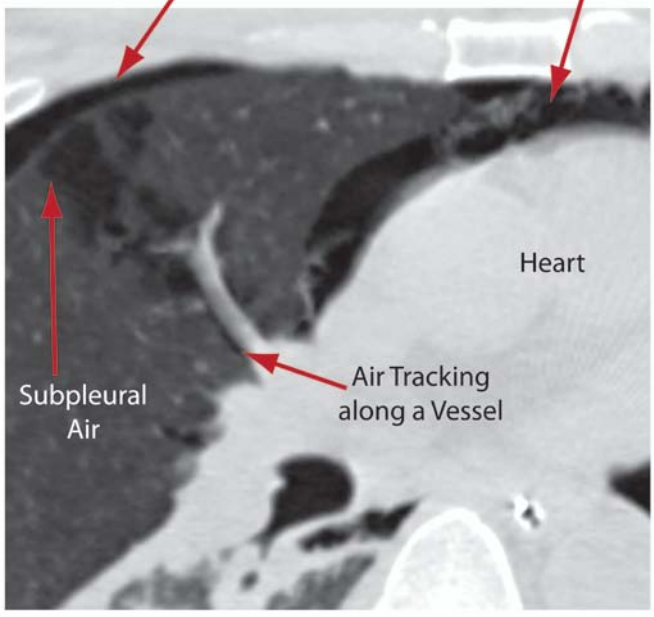
Wait a minute; doesn't alveolar rupture cause a pneumothorax?

It depends on the site of rupture. If subpleural alveoli are involved, you may have rupture into the pleural space with a resulting pneumothorax. If alveolar rupture occurs more centrally, a pneumomediastinum may result.

In what types of clinical settings might you see a pneumomediastinum?

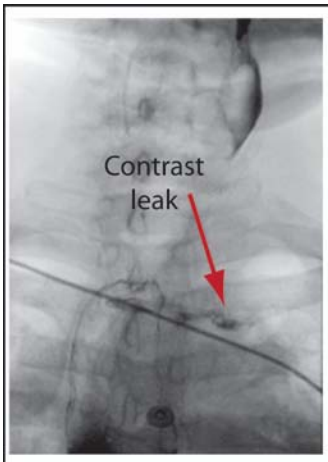
Patients with esophageal or tracheobronchial injury typically have a history of severe blunt or penetrating trauma. Endoscopy can sometimes result in perforation of these structures. Prolonged vomiting or swallowing a sharp object such as a chicken bone can tear the esophagus.

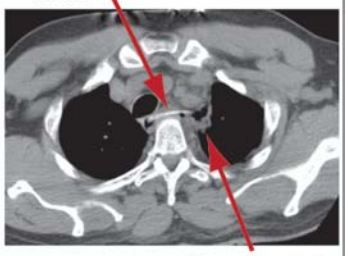
This ICU patient on PEEP developed both a pneumothorax and a pneumomediastinum. Air is present subjacent to the pleura and along a vessel tracking back to the mediastinum.



What should I consider in an outpatient with pneumomediastinum?

The most common cause of pneumomediastinum in the outpatient setting is transient increased intrathoracic pressure with alveolar rupture. Asthmatics frequently have this finding because of airway obstruction, but a vigorous Valsalva maneuver and vomiting can also cause alveolar rupture.

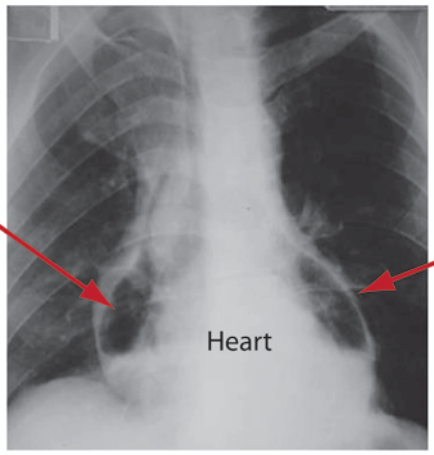




I can see how a pneumomediastinum in the setting of prolonged vomiting could be problematic.

You may need to do a contrast swallow and a CT scan to rule out an esophageal rupture.

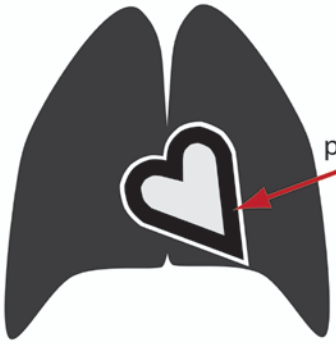
What types of inpatients are at risk for pneumomediastinum?



Courtesy Gautham Reddy MD

Intubated patients on positive pressure ventilation. In fact, these patients often have both a pneumothorax and a pneumomediastinum. The one doesn't cause the other, but they may share a common etiology.What abnormal air collection do you see on this x-ray?

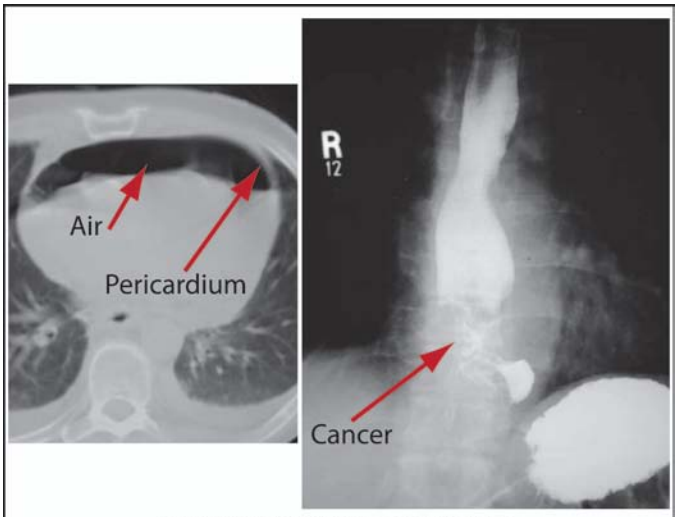
There is air surrounding the heart.



Correct. Air in the pericardium is called pneumopericardium. Causes include trauma, surgery, infection with gas forming organisms and positive pressure ventilation.

How does positive pressure cause pneumopericardium?

I don't know. But you can see it occasionally in intubated patients along with pneumothorax and pneumomediastinum.The finding is easily recognized because both sides of the heart are outlined with air.

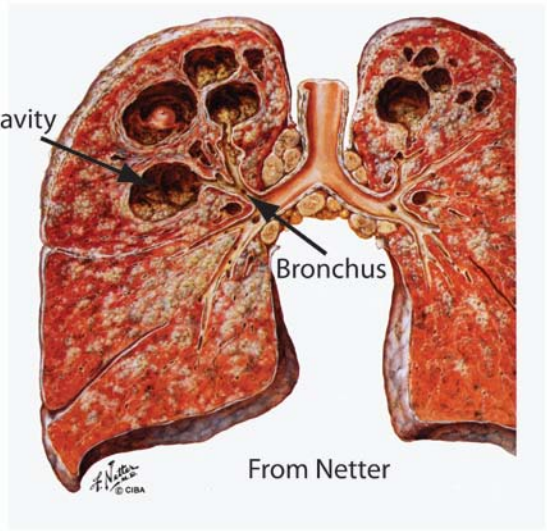


Courtesy Gautham Reddy MD

This patient developed an esophagopericardial fistula because of an esophageal cancer that eroded into the pericardium.

That's awful!

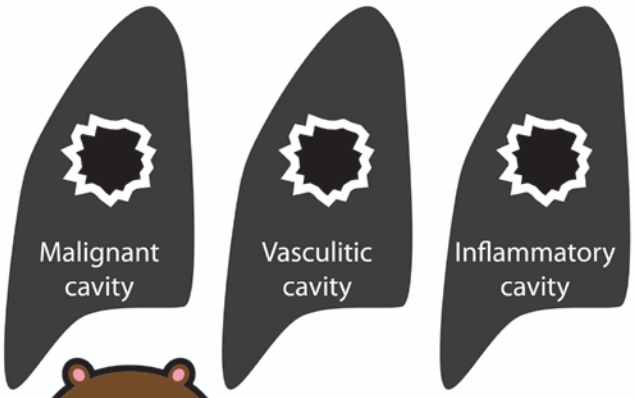
Last topic: pulmonary cavities, also pretty awful.



A pulmonary cavity occurs whenever a portion of lung is destroyed and replaced by air.

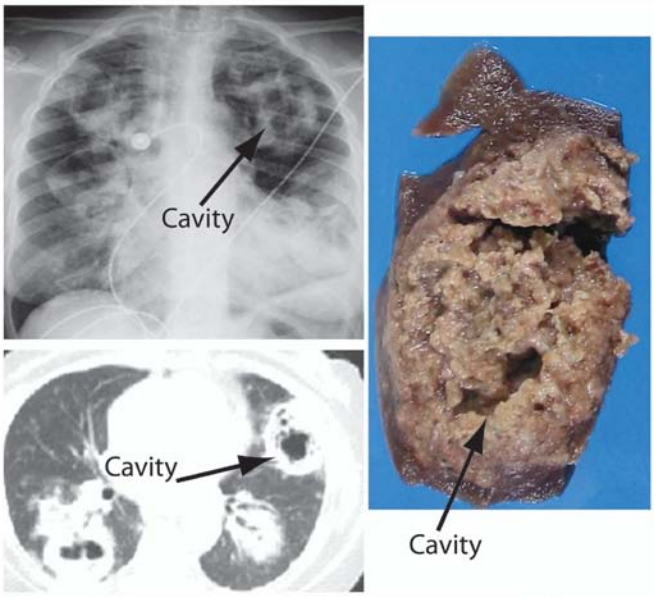
How does air replace necrotic lung?

When the necrosis erodes into a bronchus, the necrotic tissue can be evacuated by coughing and replaced by air.

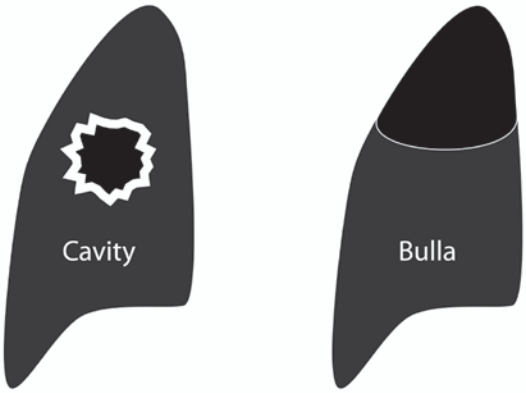


What causes a cavity?

Basically anything that destroys lung, including cancer, both primary and metastatic, infections and vasculitis. Unfortunately these processes may look identical. Again the history is key: if a patient smokes and is relatively asymptomatic, consider lung cancer, but a rapidly progressive course, fever and a productive cough suggest infection.

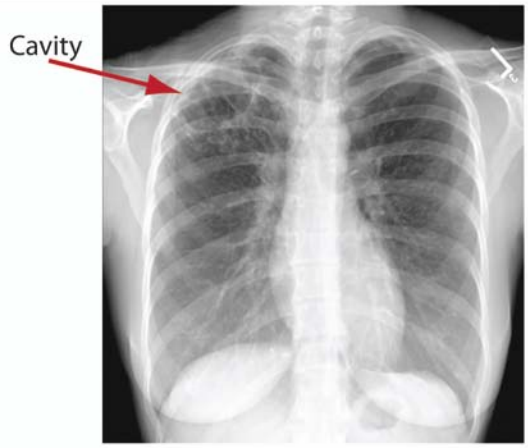


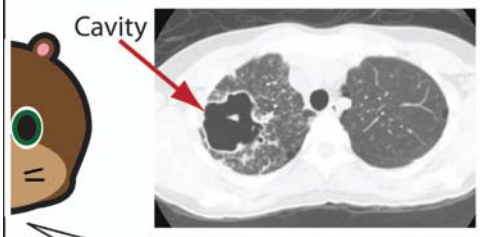
For example, this poor lady was immuno-compromised and had a rapid downhill course and died. An autopsy showed that the cavities were due to an aggressive pneumonia that resulted in multiple abscesses.



Hey, wait a minute! What's the difference between a bulla and a cavity?

Both occur when lung is destroyed & replaced by air, but a bulla is usually smooth and thin walled, while cavities have thick and irregular walls. Bullae are commonly seen in patients with emphysema and represent a long standing indolent process, while cavities represent active disease.

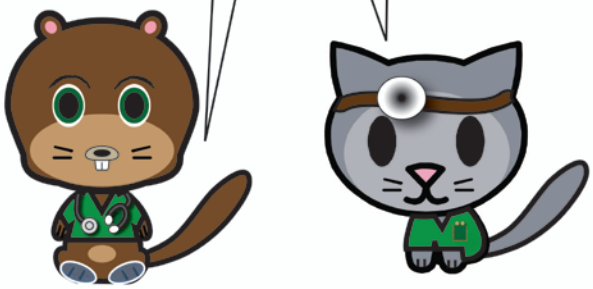




From: *Felson's Principles of Chest Roentgenology*

Post primaryTB has a fairly typical pattern of cavitation. You should think of reactivation TB if there is upper lobe cavitation involving the apical and/or posterior segments.

Finished at last!!!



References, Acknowledgements etc.

Many of the illustrations are modified clipart from Microsoft (Redmond, Washington) Office except "Doc" Squirrel is an original creation. Obviously I borrowed from Netter and other sources and (ususally) gave credit. All artwork was created or modified using Adobe Illustrator CS4 and/or Photoshop CS4 (San Jose, California). Look for more sequels, coming soon!