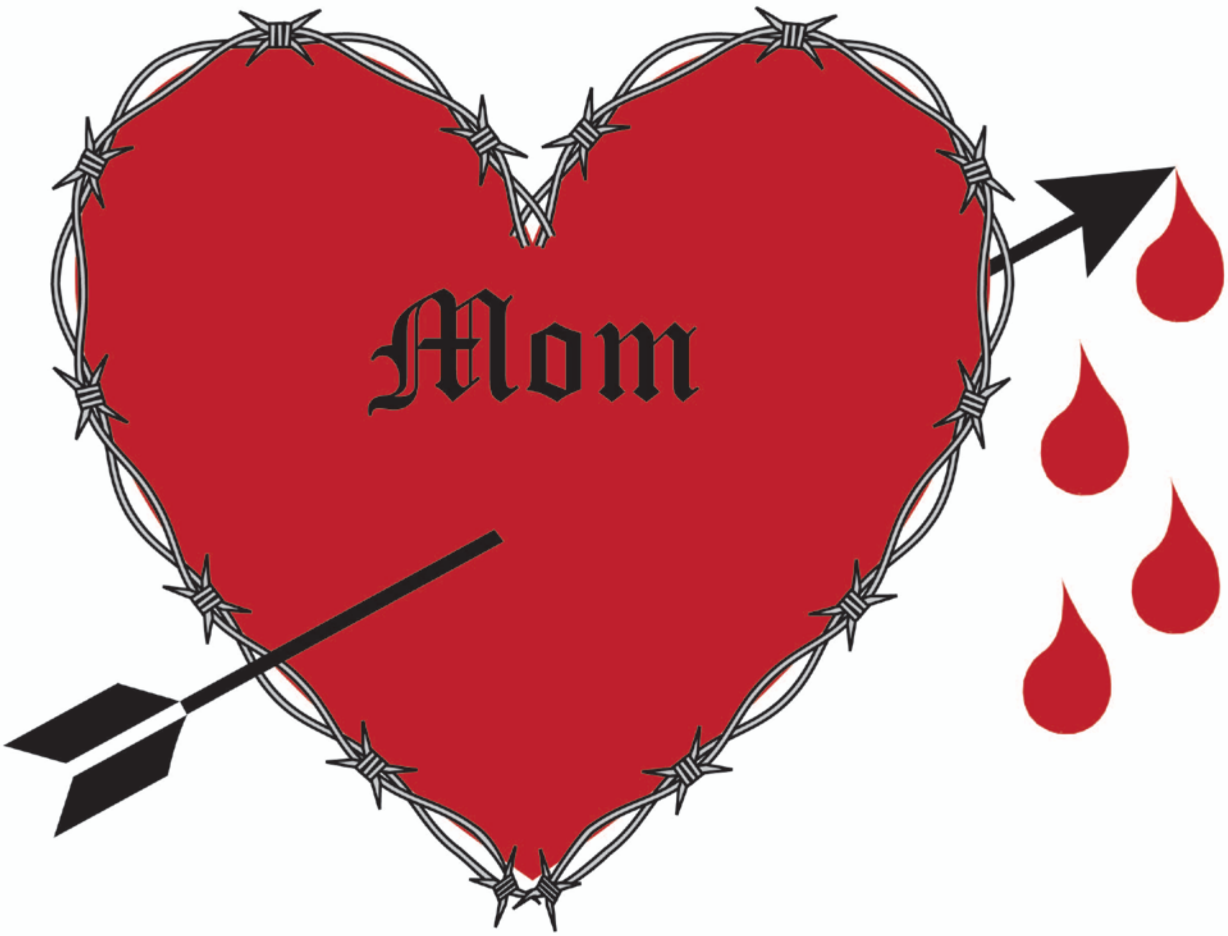
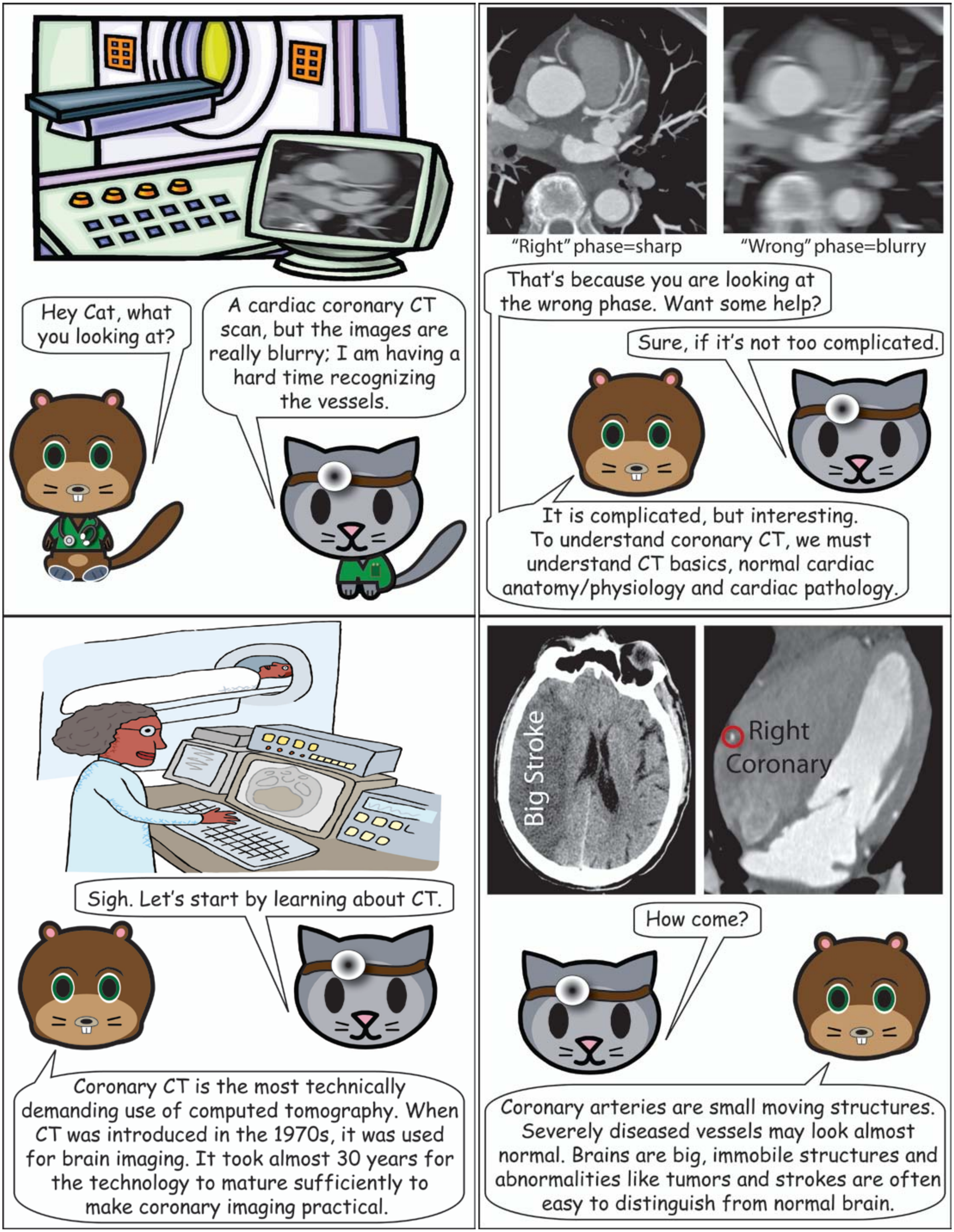
A "Doc Squirrel" and "Kid Cat" Adventure

Coronary CT

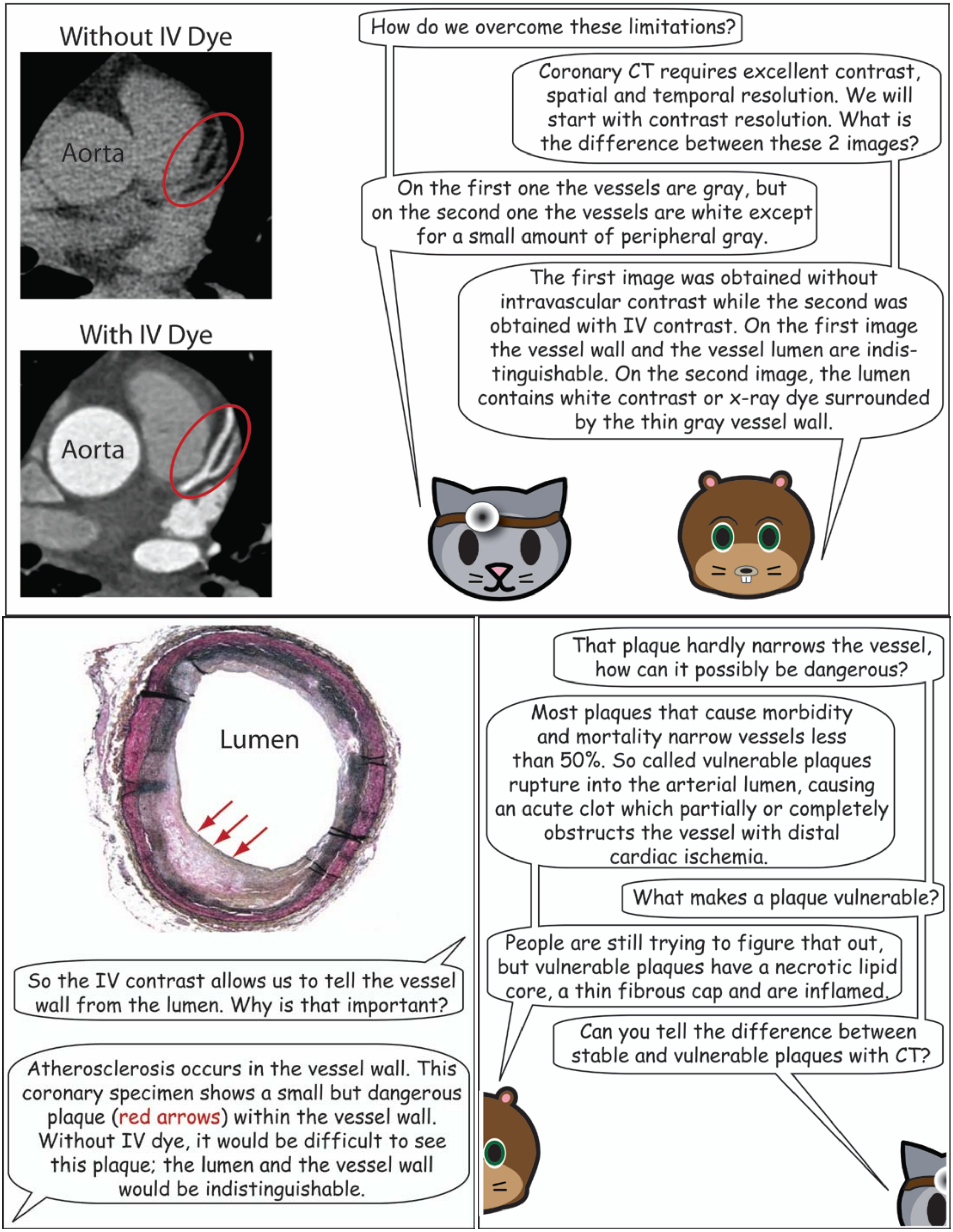


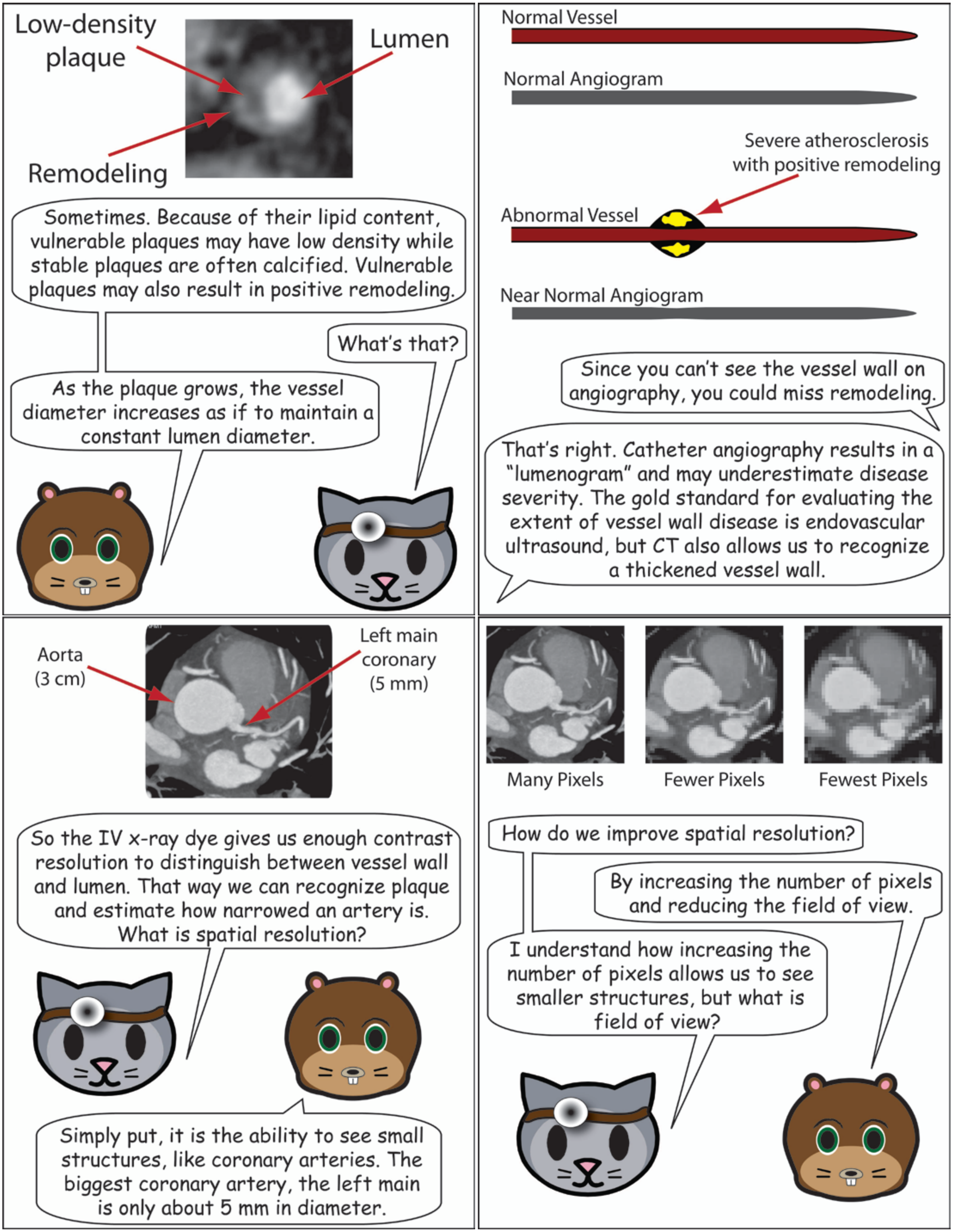
Stefan Tigges MD MSCR

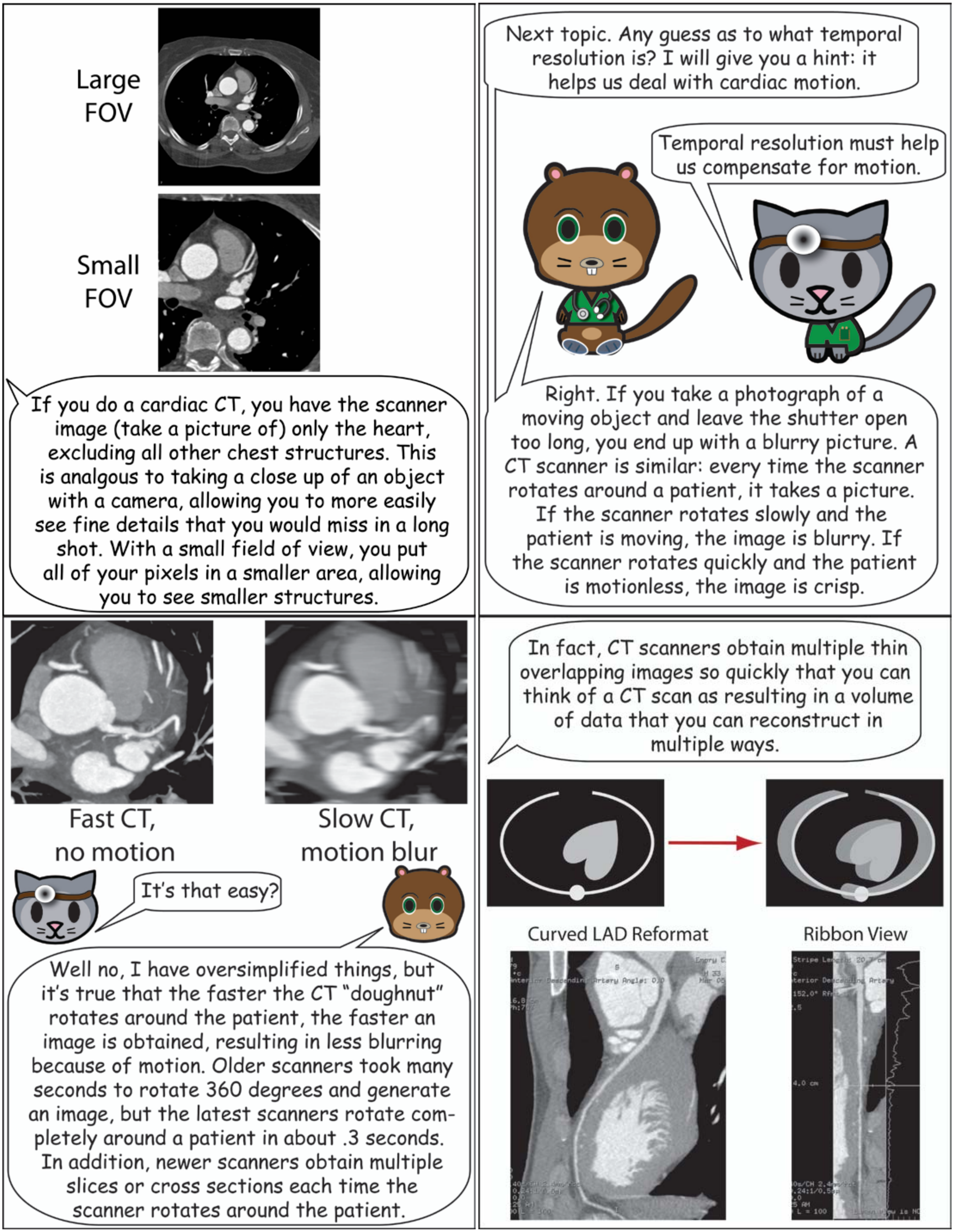


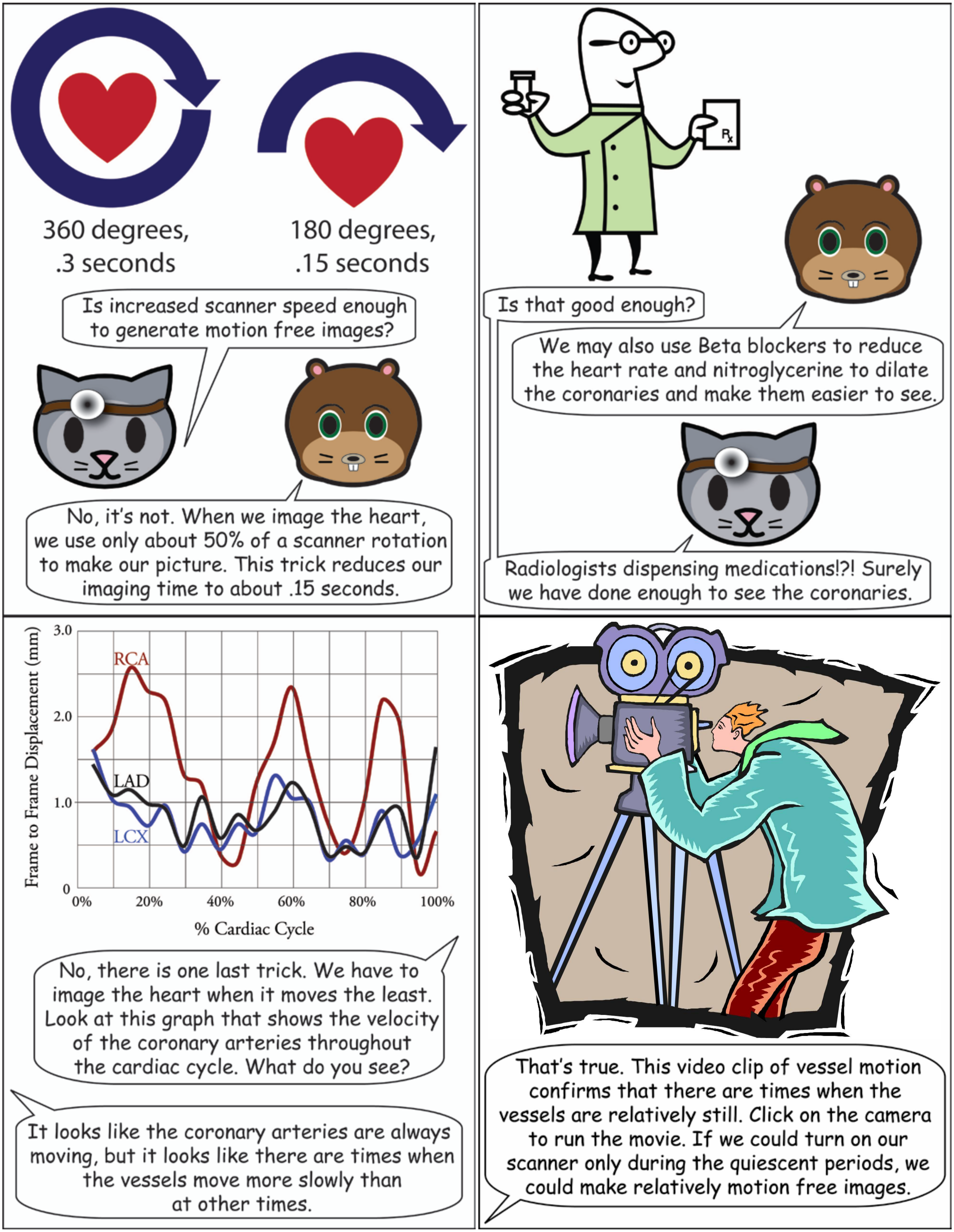
Hey Cat, what you looking at?
A cardiac coronary CT scan, but the images are really blurry; I am having a hard time recognizing the vessels.
"Right" phase=sharp
"Wrong" phase=blurry
That's because you are looking at the wrong phase. Want some help?
Sure, if it's not too complicated.
It is complicated, but interesting. To understand coronary CT, we must understand CT basics, normal cardiac anatomy/physiology and cardiac pathology.
Sigh. Let's start by learning about CT.
Coronary CT is the most technically demanding use of computed tomography. When CT was introduced in the 1970s, it was used for brain imaging. It took almost 30 years for the technology to mature sufficiently to make coronary imaging practical.
Big Stroke
Right Coronary
How come?
Coronary arteries are small moving structures. Severely diseased vessels may look almost normal. Brains are big, immobile structures and abnormalities like tumors and strokes are often easy to distinguish from normal brain.

1


Without IV Dye
Aorta
With IV Dye
Aorta
How do we overcome these limitations?
Coronary CT requires excellent contrast, spatial and temporal resolution. We will start with contrast resolution. What is the difference between these 2 images?
On the first one the vessels are gray, but on the second one the vessels are white except for a small amount of peripheral gray.
The first image was obtained without intravascular contrast while the second was obtained with IV contrast. On the first image the vessel wall and the vessel lumen are indistinguishable. On the second image, the lumen contains white contrast or x-ray dye surrounded by the thin gray vessel wall.
Lumen
So the IV contrast allows us to tell the vessel wall from the lumen. Why is that important?
Atherosclerosis occurs in the vessel wall. This coronary specimen shows a small but dangerous plaque (red arrows) within the vessel wall. Without IV dye, it would be difficult to see this plaque; the lumen and the vessel wall would be indistinguishable.
That plaque hardly narrows the vessel, how can it possibly be dangerous?
Most plaques that cause morbidity and mortality narrow vessels less than 50%. So called vulnerable plaques rupture into the arterial lumen, causing an acute clot which partially or completely obstructs the vessel with distal cardiac ischemia.
What makes a plaque vulnerable?
People are still trying to figure that out, but vulnerable plaques have a necrotic lipid core, a thin fibrous cap and are inflamed.
Can you tell the difference between stable and vulnerable plaques with CT?


Low-density plaque
Lumen
Remodeling
Sometimes. Because of their lipid content, vulnerable plaques may have low density while stable plaques are often calcified. Vulnerable plaques may also result in positive remodeling.
What's that?
As the plaque grows, the vessel diameter increases as if to maintain a constant lumen diameter.
Normal Vessel
Normal Angiogram
Severe atherosclerosis with positive remodeling
Abnormal Vessel
Near Normal Angiogram
Since you can't see the vessel wall on angiography, you could miss remodeling.
That's right. Catheter angiography results in a "lumenogram" and may underestimate disease severity. The gold standard for evaluating the extent of vessel wall disease is endovascular ultrasound, but CT also allows us to recognize a thickened vessel wall.
Aorta (3 cm)
Left main coronary (5 mm)
So the IV x-ray dye gives us enough contrast resolution to distinguish between vessel wall and lumen. That way we can recognize plaque and estimate how narrowed an artery is. What is spatial resolution?
Simply put, it is the ability to see small structures, like coronary arteries. The biggest coronary artery, the left main is only about 5 mm in diameter.
Many Pixels
Fewer Pixels
Fewest Pixels
How do we improve spatial resolution?
By increasing the number of pixels and reducing the field of view.
I understand how increasing the number of pixels allows us to see smaller structures, but what is field of view?


Large FOV
Small FOV
If you do a cardiac CT, you have the scanner image (take a picture of) only the heart, excluding all other chest structures. This is analgous to taking a close up of an object with a camera, allowing you to more easily see fine details that you would miss in a long shot. With a small field of view, you put all of your pixels in a smaller area, allowing you to see smaller structures.
Next topic. Any guess as to what temporal resolution is? I will give you a hint: it helps us deal with cardiac motion.
Temporal resolution must help us compensate for motion.
Right. If you take a photograph of a moving object and leave the shutter open too long, you end up with a blurry picture. A CT scanner is similar: every time the scanner rotates around a patient, it takes a picture. If the scanner rotates slowly and the patient is moving, the image is blurry. If the scanner rotates quickly and the patient is motionless, the image is crisp.
Fast CT, no motion
Slow CT, motion blur
It's that easy?
Well no, I have oversimplified things, but it's true that the faster the CT "doughnut" rotates around the patient, the faster an image is obtained, resulting in less blurring because of motion. Older scanners took many seconds to rotate 360 degrees and generate an image, but the latest scanners rotate completely around a patient in about .3 seconds. In addition, newer scanners obtain multiple slices or cross sections each time the scanner rotates around the patient.
In fact, CT scanners obtain multiple thin overlapping images so quickly that you can think of a CT scan as resulting in a volume of data that you can reconstruct in multiple ways.
Curved LAD Reformat
Ribbon View



360 degrees,
.3 seconds
180 degrees,
.15 seconds
Is increased scanner speed enough to generate motion free images?
No, it's not. When we image the heart, we use only about 50% of a scanner rotation to make our picture. This trick reduces our imaging time to about .15 seconds.
Is that good enough?
We may also use Beta blockers to reduce the heart rate and nitroglycerine to dilate the coronaries and make them easier to see.
Radiologists dispensing medications!?! Surely we have done enough to see the coronaries.
Frame to Frame Displacement (mm)
3.0
2.0
1.0
0
RCA
LAD
LCX
0%
20%
40%
60%
80%
100%
% Cardiac Cycle
No, there is one last trick. We have to image the heart when it moves the least. Look at this graph that shows the velocity of the coronary arteries throughout the cardiac cycle. What do you see?
It looks like the coronary arteries are always moving, but it looks like there are times when the vessels move more slowly than at other times.
That's true. This video clip of vessel motion confirms that there are times when the vessels are relatively still. Click on the camera to run the movie. If we could turn on our scanner only during the quiescent periods, we could make relatively motion free images.

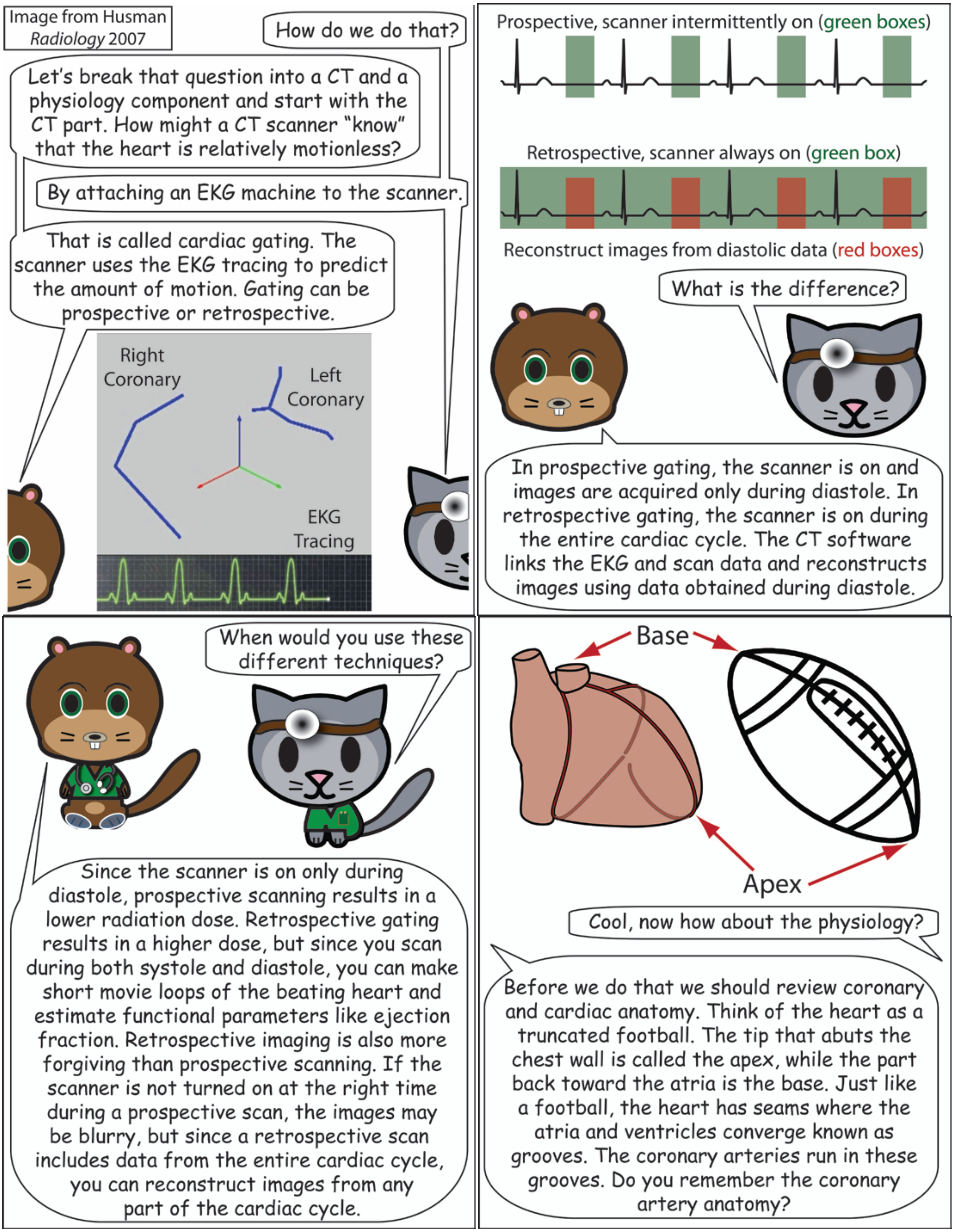
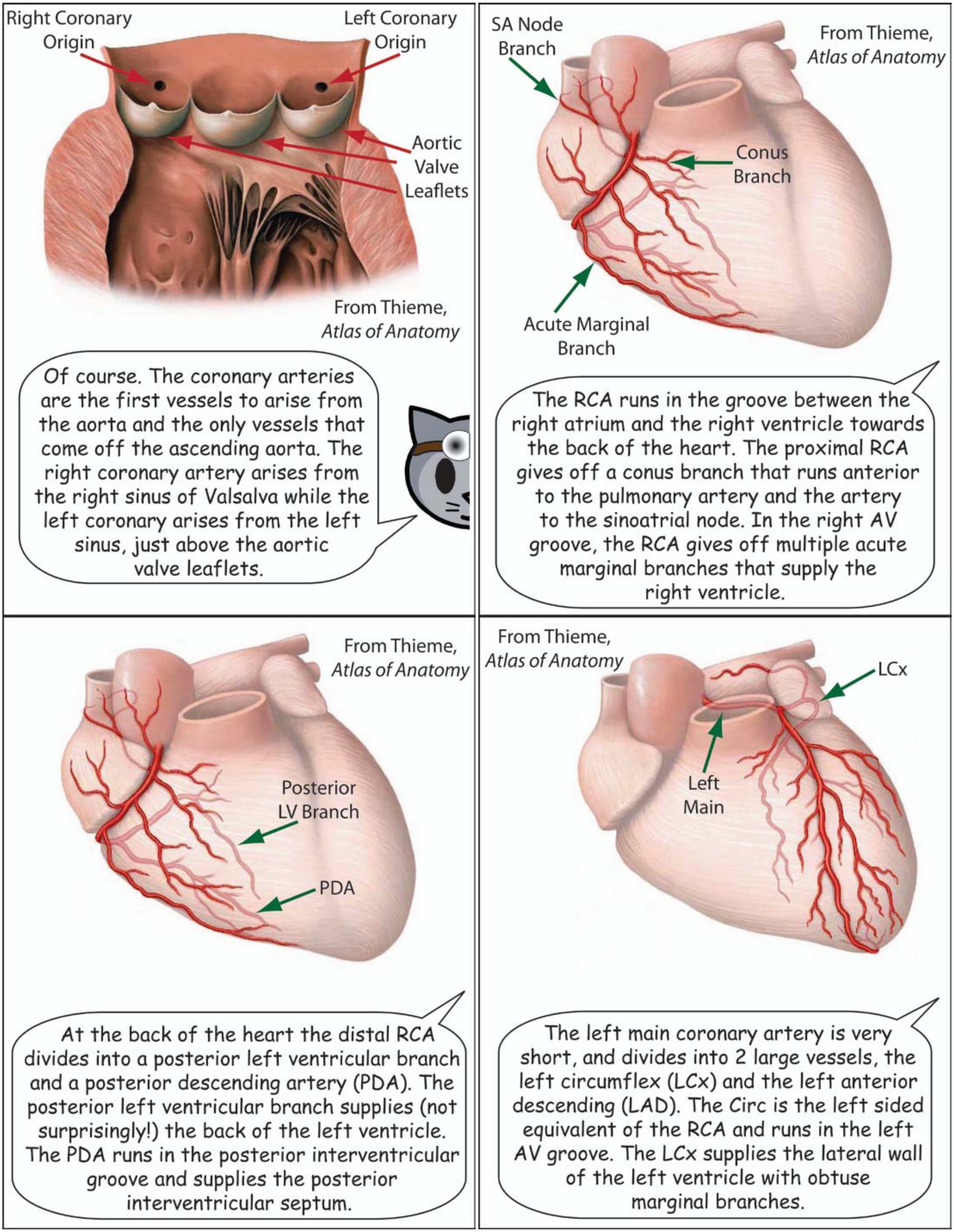
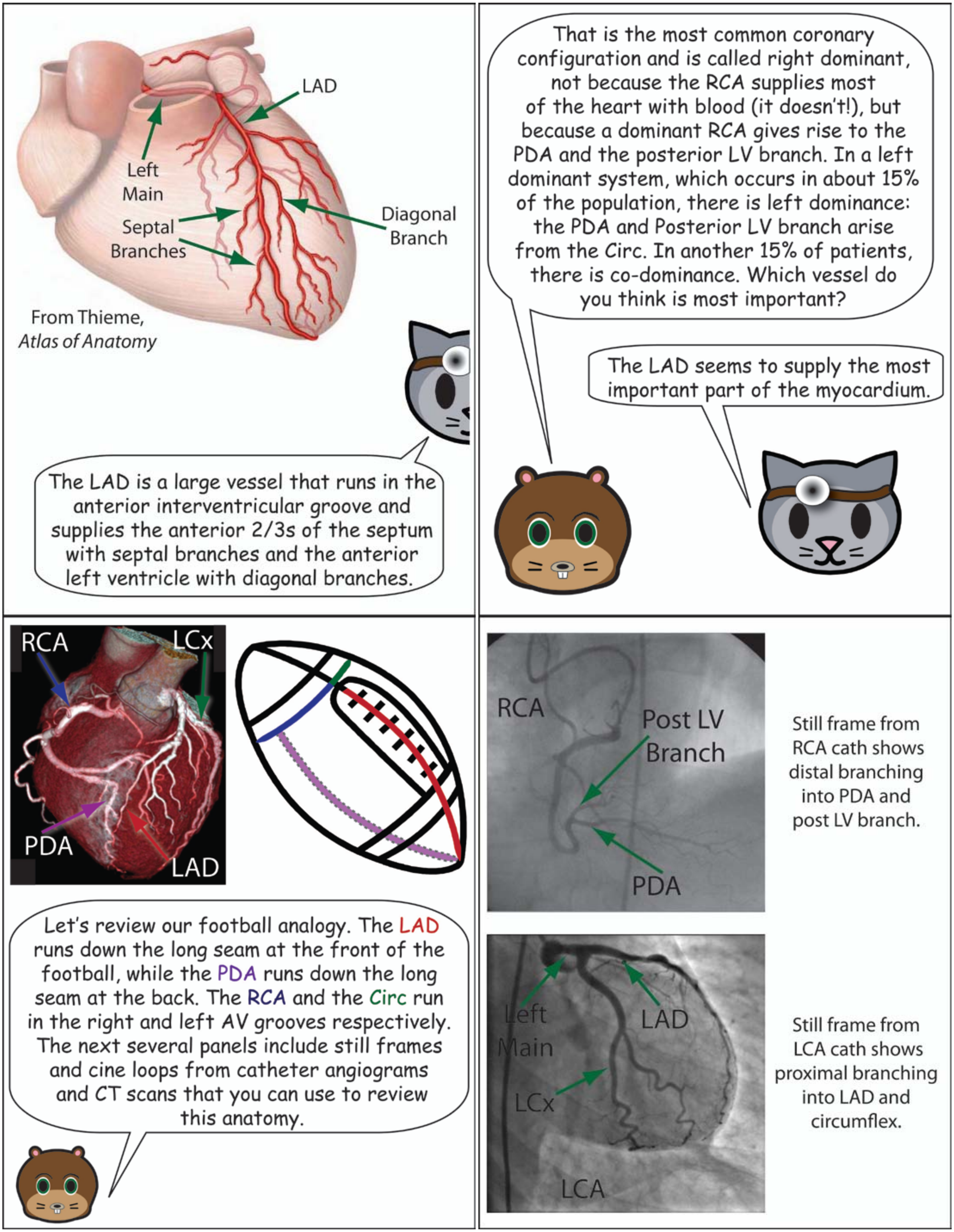
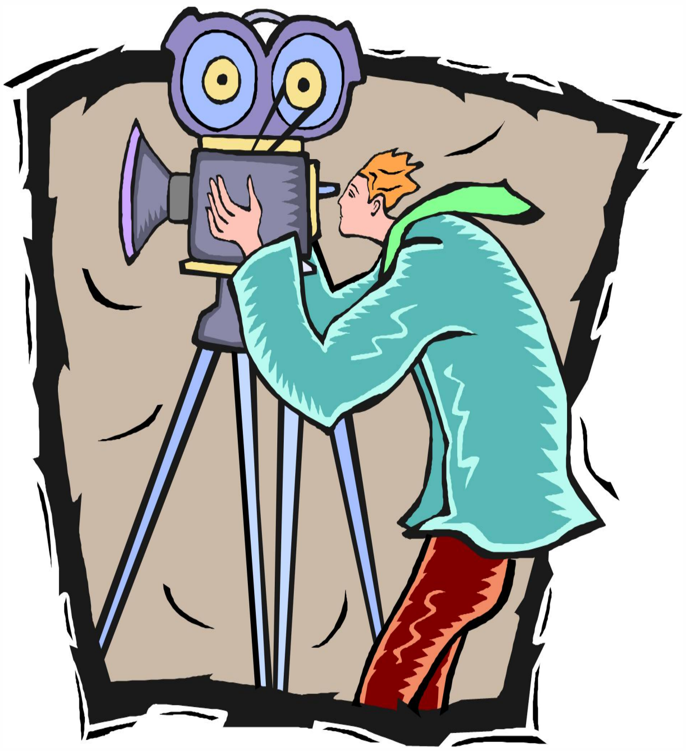


Image from Husman *Radiology* 2007
How do we do that?
Let's break that question into a CT and a physiology component and start with the CT part. How might a CT scanner "know" that the heart is relatively motionless?
By attaching an EKG machine to the scanner.
That is called cardiac gating. The scanner uses the EKG tracing to predict the amount of motion. Gating can be prospective or retrospective.
Right Coronary
Left Coronary
EKG Tracing
Prospective, scanner intermittently on (green boxes)
Retrospective, scanner always on (green box)
Reconstruct images from diastolic data (red boxes)
What is the difference?
In prospective gating, the scanner is on and images are acquired only during diastole. In retrospective gating, the scanner is on during the entire cardiac cycle. The CT software links the EKG and scan data and reconstructs images using data obtained during diastole.
When would you use these different techniques?
Since the scanner is on only during diastole, prospective scanning results in a lower radiation dose. Retrospective gating results in a higher dose, but since you scan during both systole and diastole, you can make short movie loops of the beating heart and estimate functional parameters like ejection fraction. Retrospective imaging is also more forgiving than prospective scanning. If the scanner is not turned on at the right time during a prospective scan, the images may be blurry, but since a retrospective scan includes data from the entire cardiac cycle, you can reconstruct images from any part of the cardiac cycle.
Base
Apex
Cool, now how about the physiology?
Before we do that we should review coronary and cardiac anatomy. Think of the heart as a truncated football. The tip that abuts the chest wall is called the apex, while the part back toward the atria is the base. Just like a football, the heart has seams where the atria and ventricles converge known as grooves. The coronary arteries run in these grooves. Do you remember the coronary artery anatomy?

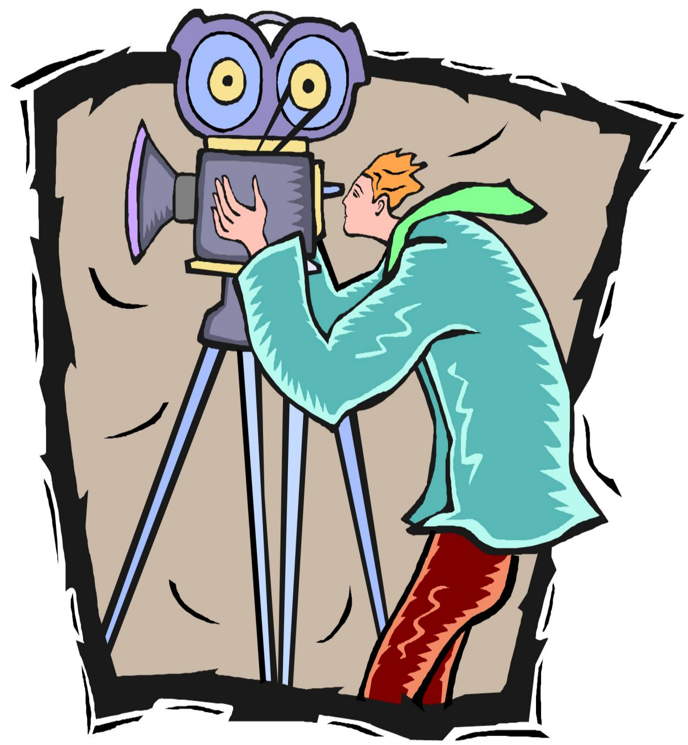

Right Coronary Origin
Left Coronary Origin
Aortic Valve Leaflets
From Thieme, *Atlas of Anatomy*
Of course. The coronary arteries are the first vessels to arise from the aorta and the only vessels that come off the ascending aorta. The right coronary artery arises from the right sinus of Valsalva while the left coronary arises from the left sinus, just above the aortic valve leaflets.
SA Node Branch
From Thieme, *Atlas of Anatomy*
Conus Branch
Acute Marginal Branch
The RCA runs in the groove between the right atrium and the right ventricle towards the back of the heart. The proximal RCA gives off a conus branch that runs anterior to the pulmonary artery and the artery to the sinoatrial node. In the right AV groove, the RCA gives off multiple acute marginal branches that supply the right ventricle.
From Thieme, *Atlas of Anatomy*
Posterior LV Branch
PDA
At the back of the heart the distal RCA divides into a posterior left ventricular branch and a posterior descending artery (PDA). The posterior left ventricular branch supplies (not surprisingly!) the back of the left ventricle. The PDA runs in the posterior interventricular groove and supplies the posterior interventricular septum.
From Thieme, *Atlas of Anatomy*
LCx
Left Main
The left main coronary artery is very short, and divides into 2 large vessels, the left circumflex (LCx) and the left anterior descending (LAD). The Circ is the left sided equivalent of the RCA and runs in the left AV groove. The LCx supplies the lateral wall of the left ventricle with obtuse marginal branches.


LAD
Left Main
Septal Branches
Diagonal Branch
From Thieme, *Atlas of Anatomy*
The LAD is a large vessel that runs in the anterior interventricular groove and supplies the anterior 2/3s of the septum with septal branches and the anterior left ventricle with diagonal branches.
That is the most common coronary configuration and is called right dominant, not because the RCA supplies most of the heart with blood (it doesn't!), but because a dominant RCA gives rise to the PDA and the posterior LV branch. In a left dominant system, which occurs in about 15% of the population, there is left dominance: the PDA and Posterior LV branch arise from the Circ. In another 15% of patients, there is co-dominance. Which vessel do you think is most important?
The LAD seems to supply the most important part of the myocardium.
RCA
LCx
PDA
LAD
Let's review our football analogy. The LAD runs down the long seam at the front of the football, while the PDA runs down the long seam at the back. The RCA and the Circ run in the right and left AV grooves respectively. The next several panels include still frames and cine loops from catheter angiograms and CT scans that you can use to review this anatomy.
RCA
Post LV Branch
PDA
Still frame from RCA cath shows distal branching into PDA and post LV branch.
Left Main
LAD
LCx
LCA
Still frame from LCA cath shows proximal branching into LAD and circumflex.

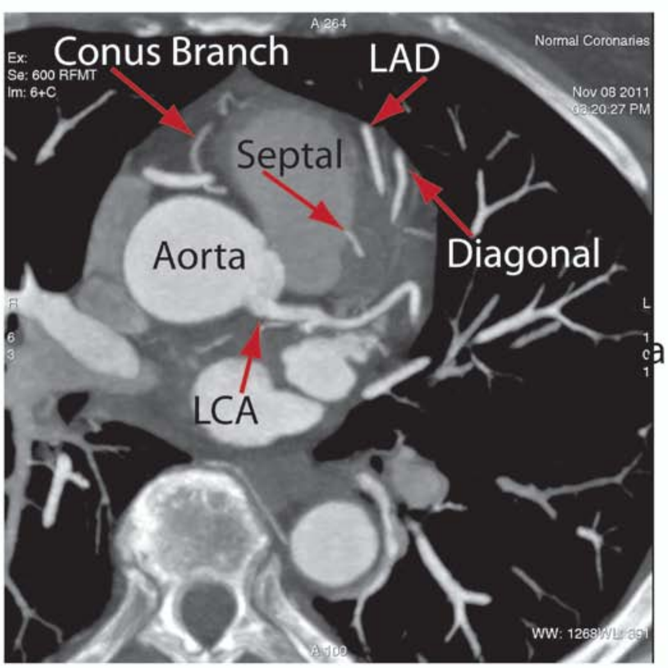
RCA Cath Cine, click on the camera to start.

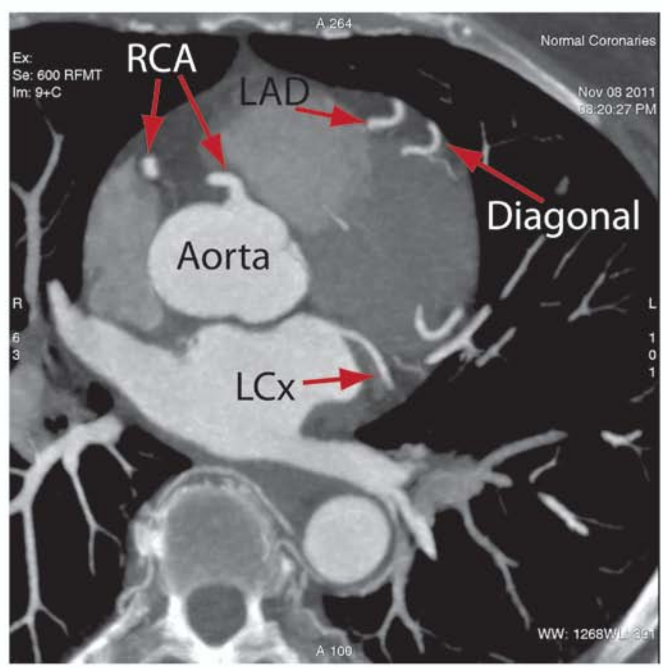


LCA Cath Cine, click on the camera to start.

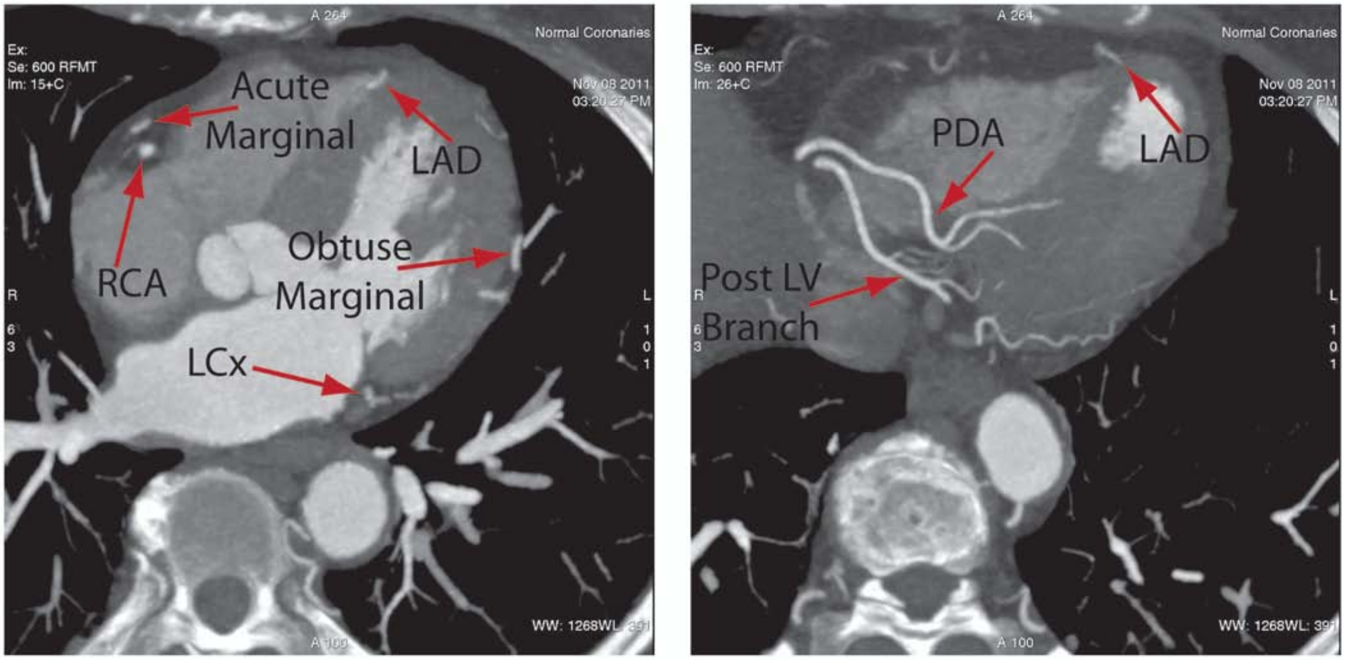


Coronary CT Anatomy

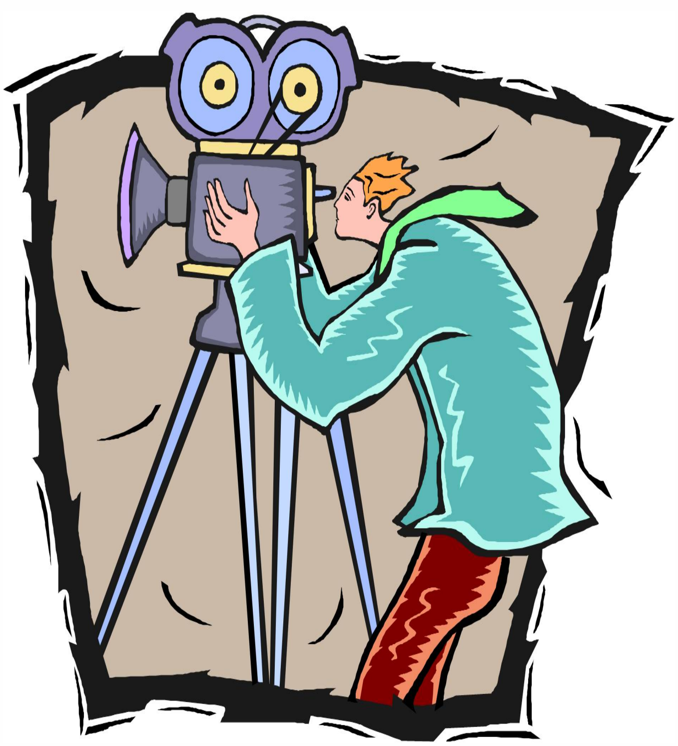


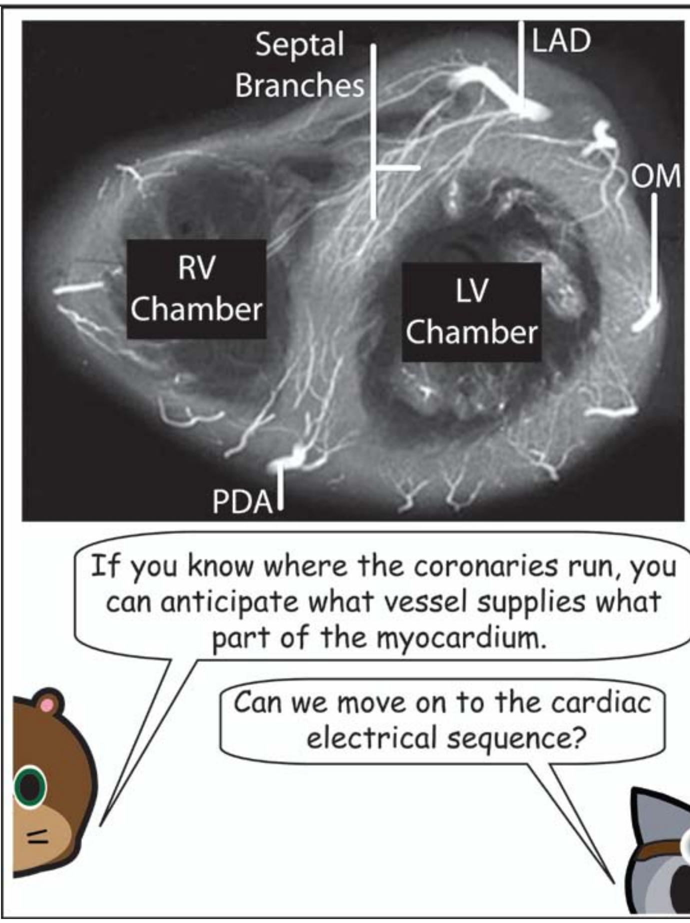


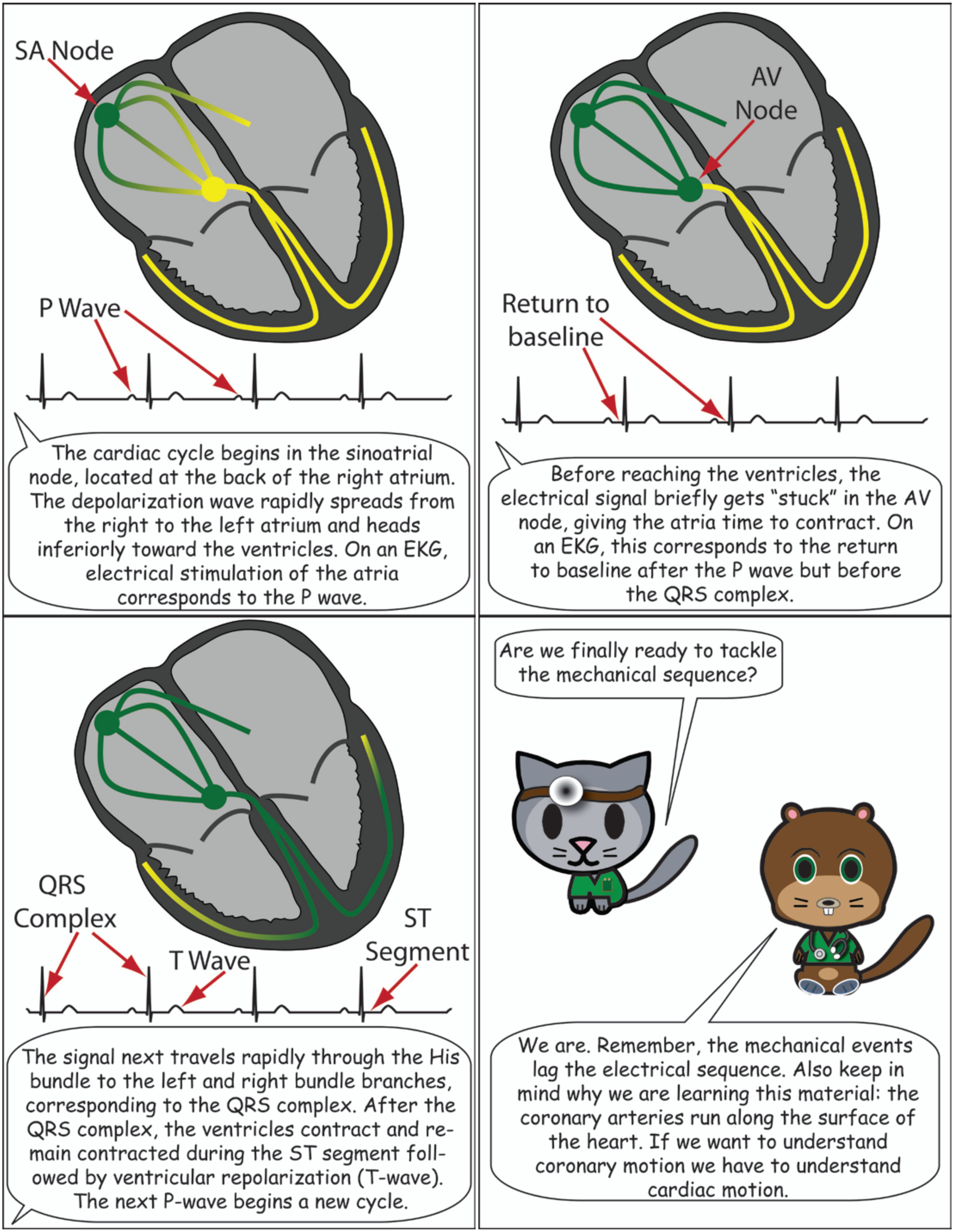
Coronary CT Anatomy

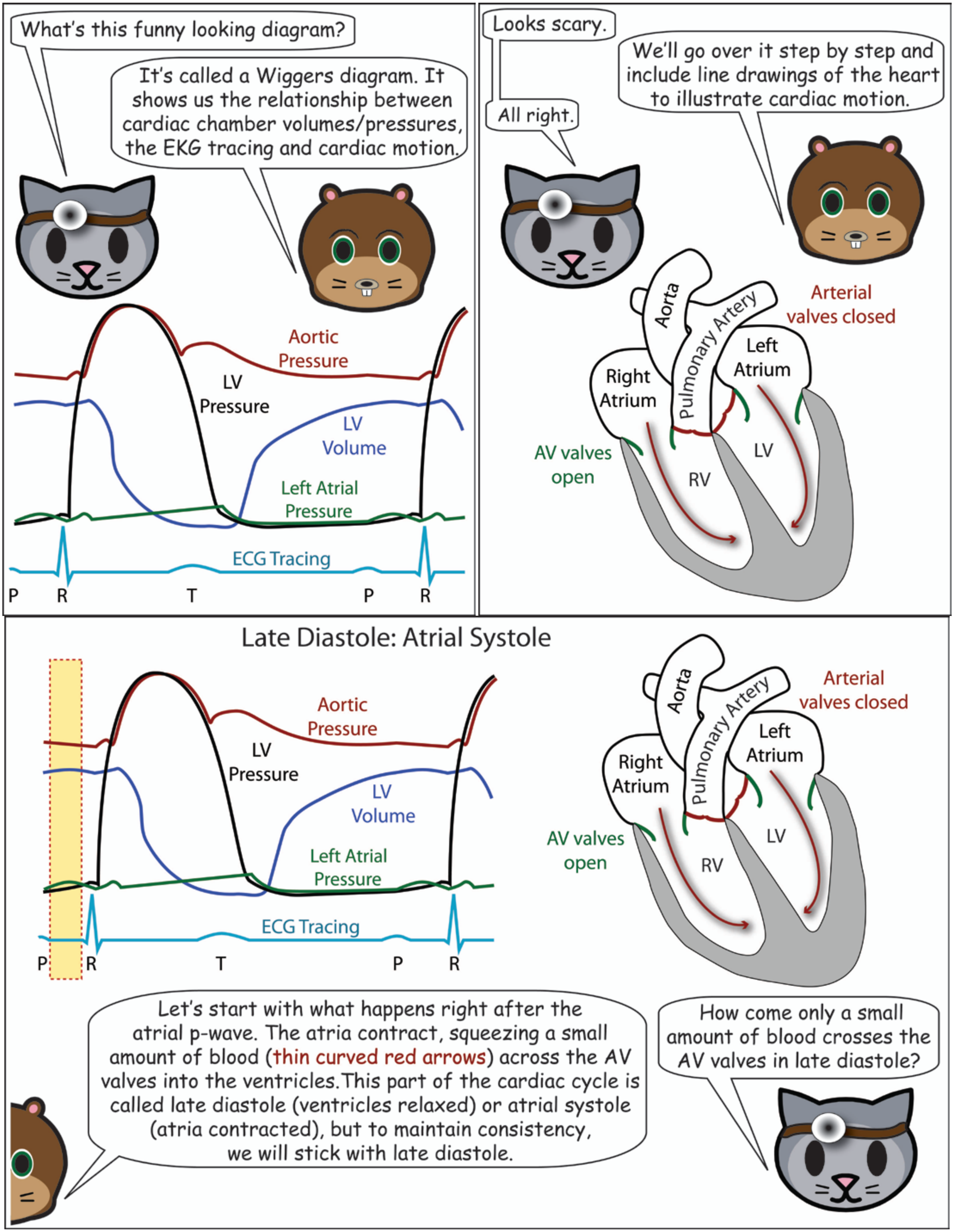


Coronary CT cine, click on camera to start

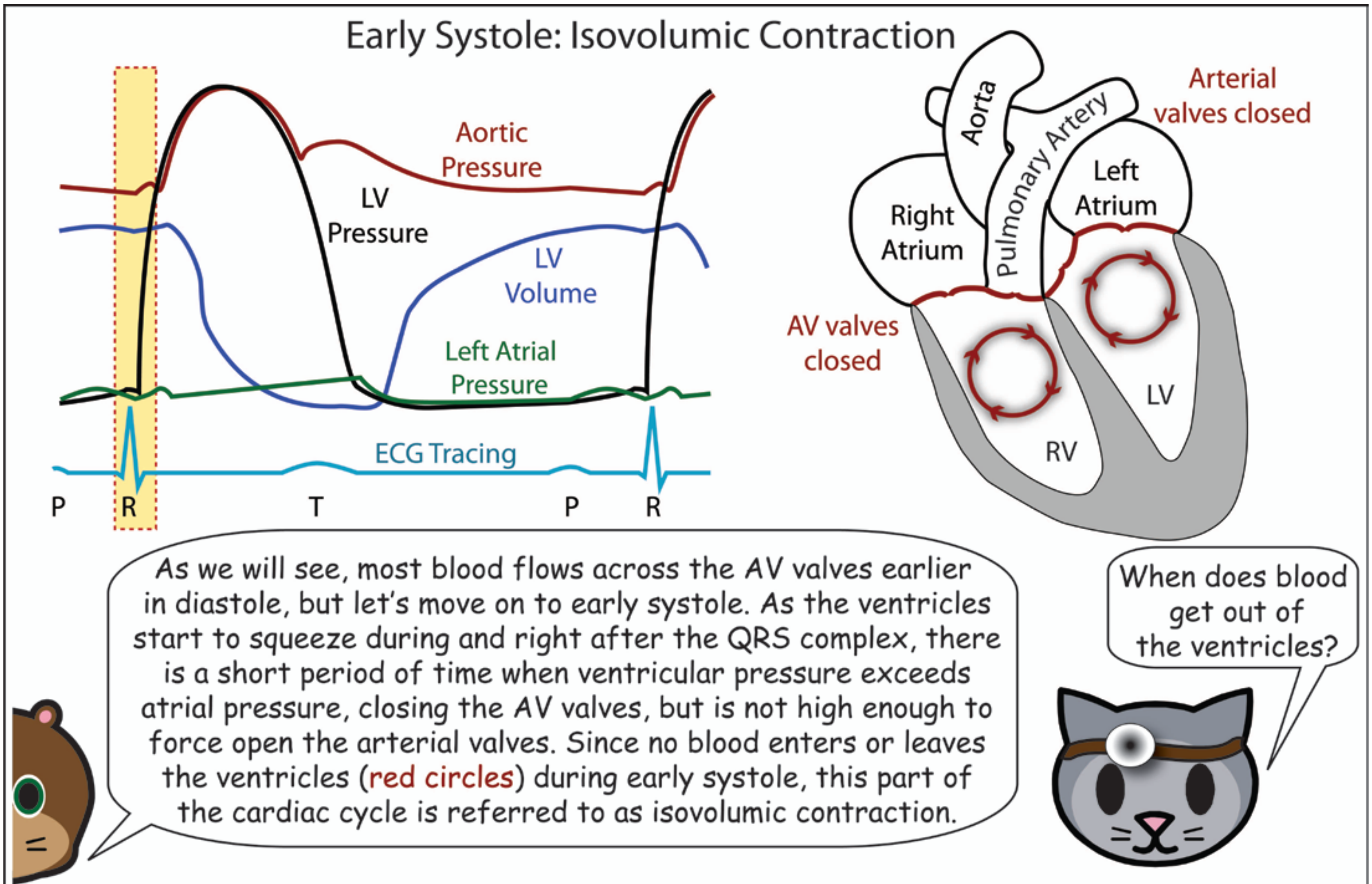


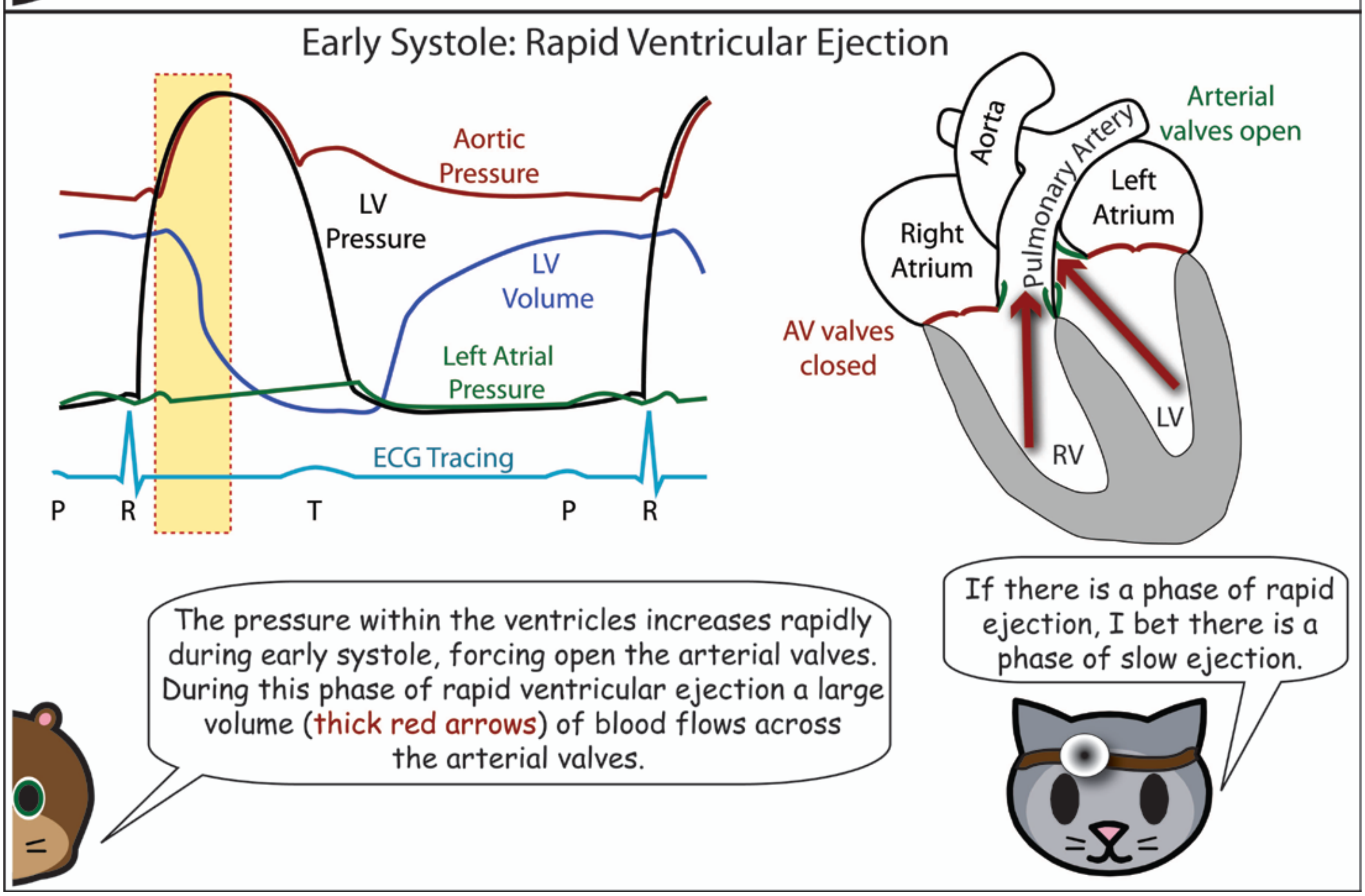


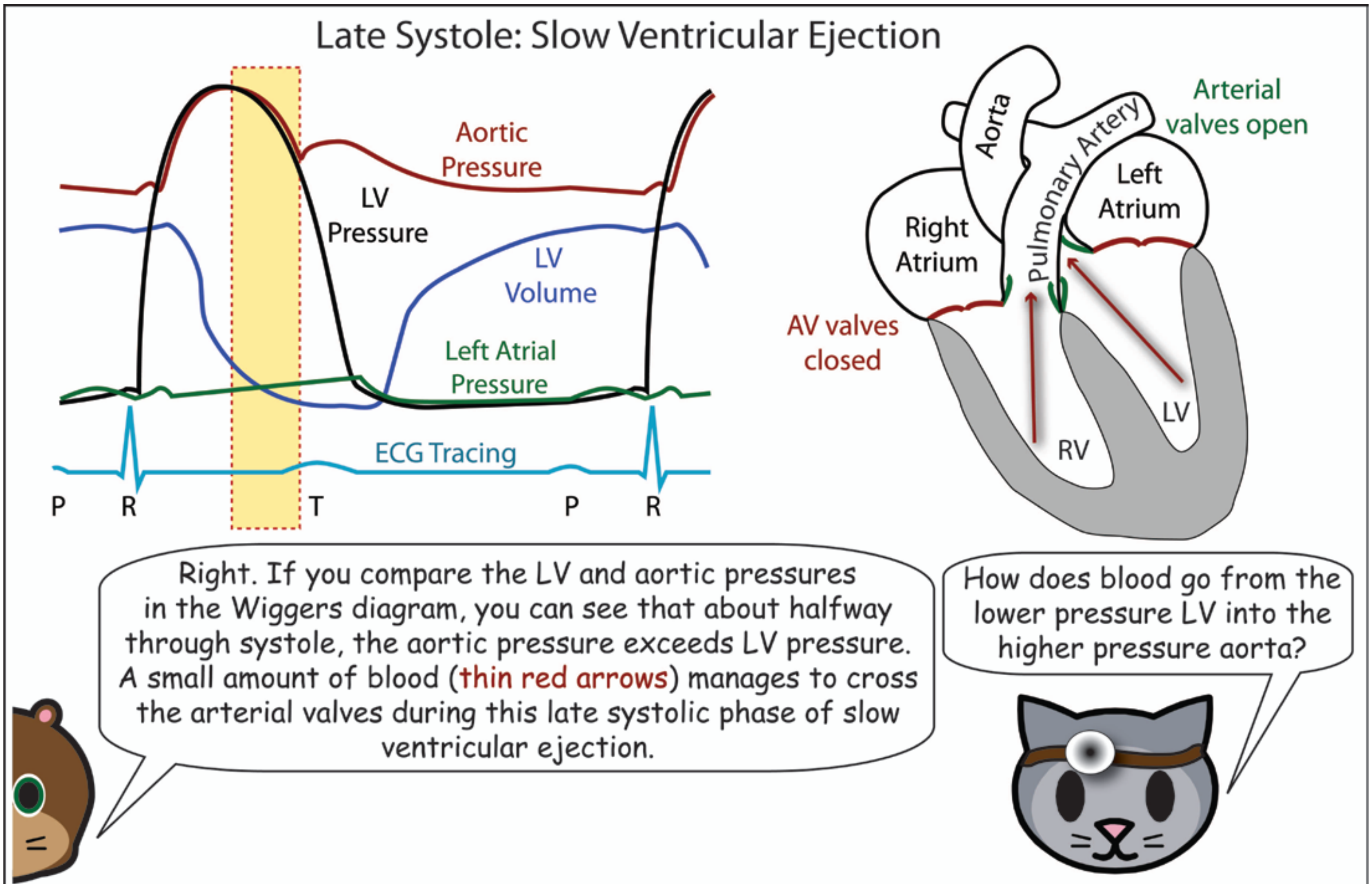

SA Node
P Wave
The cardiac cycle begins in the sinoatrial node, located at the back of the right atrium. The depolarization wave rapidly spreads from the right to the left atrium and heads inferiorly toward the ventricles. On an EKG, electrical stimulation of the atria corresponds to the P wave.
AV Node
Return to baseline
Before reaching the ventricles, the electrical signal briefly gets "stuck" in the AV node, giving the atria time to contract. On an EKG, this corresponds to the return to baseline after the P wave but before the QRS complex.
QRS Complex
T Wave
ST Segment
The signal next travels rapidly through the His bundle to the left and right bundle branches, corresponding to the QRS complex. After the QRS complex, the ventricles contract and remain contracted during the ST segment followed by ventricular repolarization (T-wave). The next P-wave begins a new cycle.
Are we finally ready to tackle the mechanical sequence?
We are. Remember, the mechanical events lag the electrical sequence. Also keep in mind why we are learning this material: the coronary arteries run along the surface of the heart. If we want to understand coronary motion we have to understand cardiac motion.

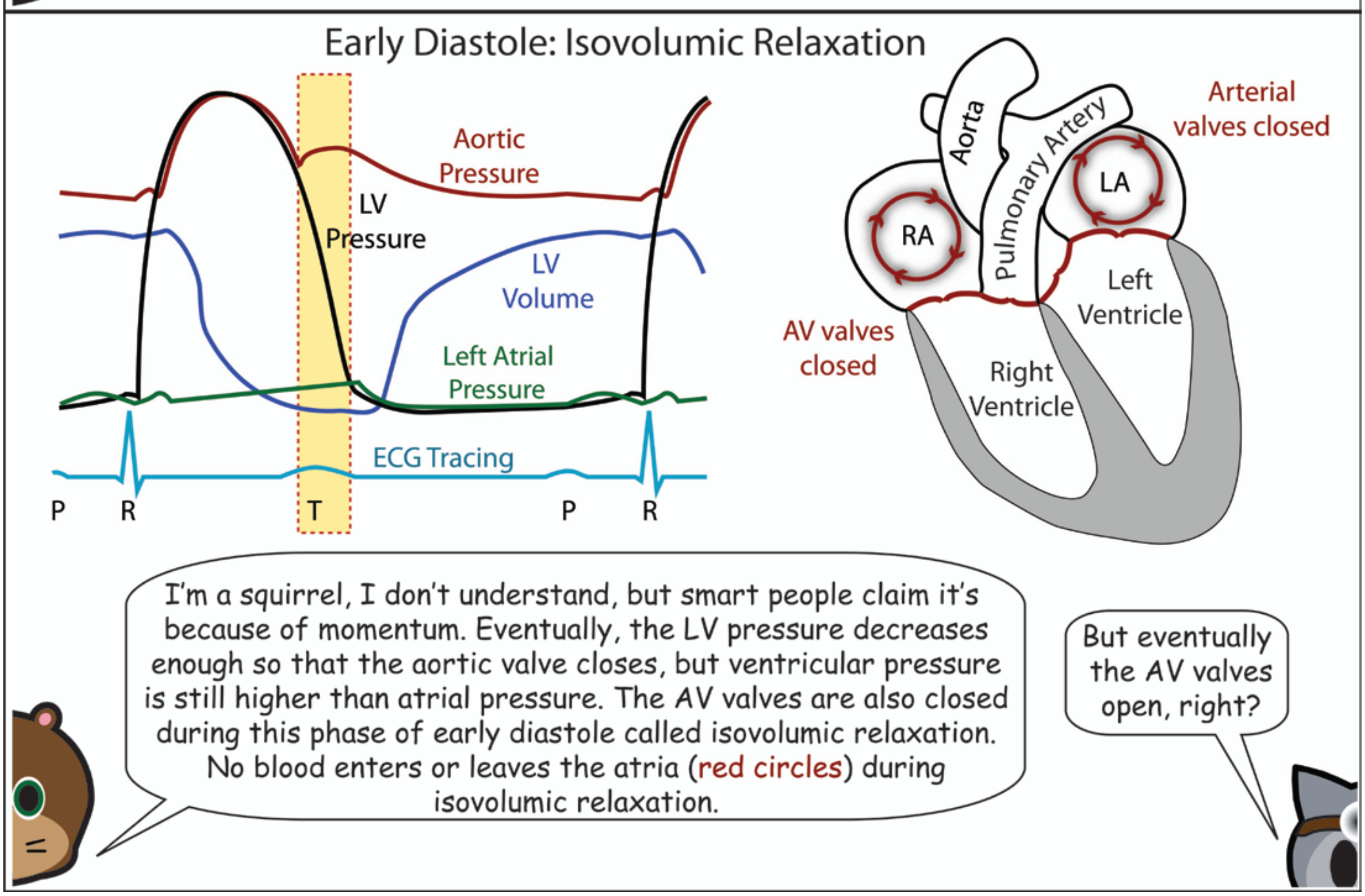


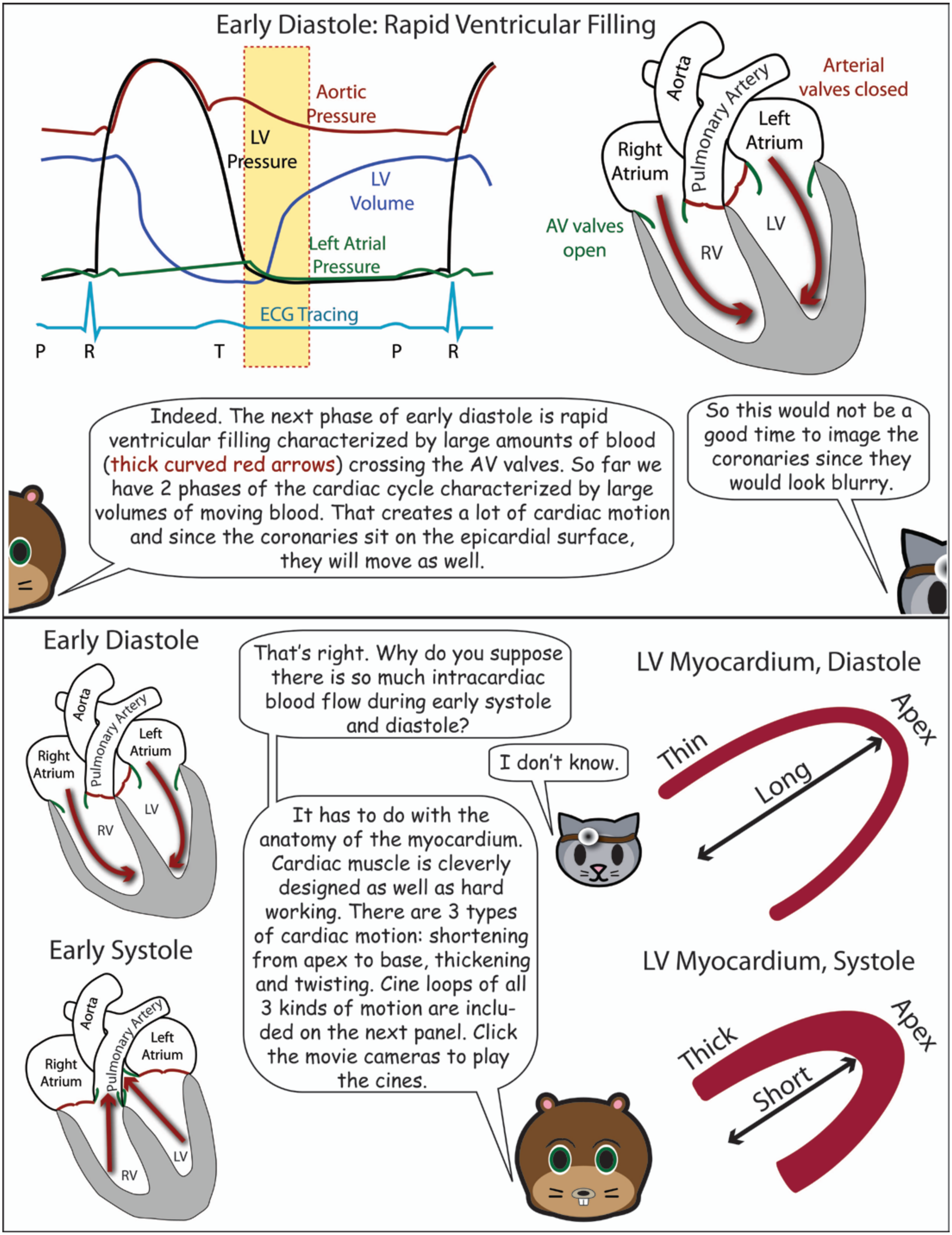
What's this funny looking diagram?
It's called a Wiggers diagram. It shows us the relationship between cardiac chamber volumes/pressures, the EKG tracing and cardiac motion.
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Looks scary.
All right.
We'll go over it step by step and include line drawings of the heart to illustrate cardiac motion.
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Late Diastole: Atrial Systole
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Let's start with what happens right after the atrial p-wave. The atria contract, squeezing a small amount of blood (thin curved red arrows) across the AV valves into the ventricles. This part of the cardiac cycle is called late diastole (ventricles relaxed) or atrial systole (atria contracted), but to maintain consistency, we will stick with late diastole.
How come only a small amount of blood crosses the AV valves in late diastole?

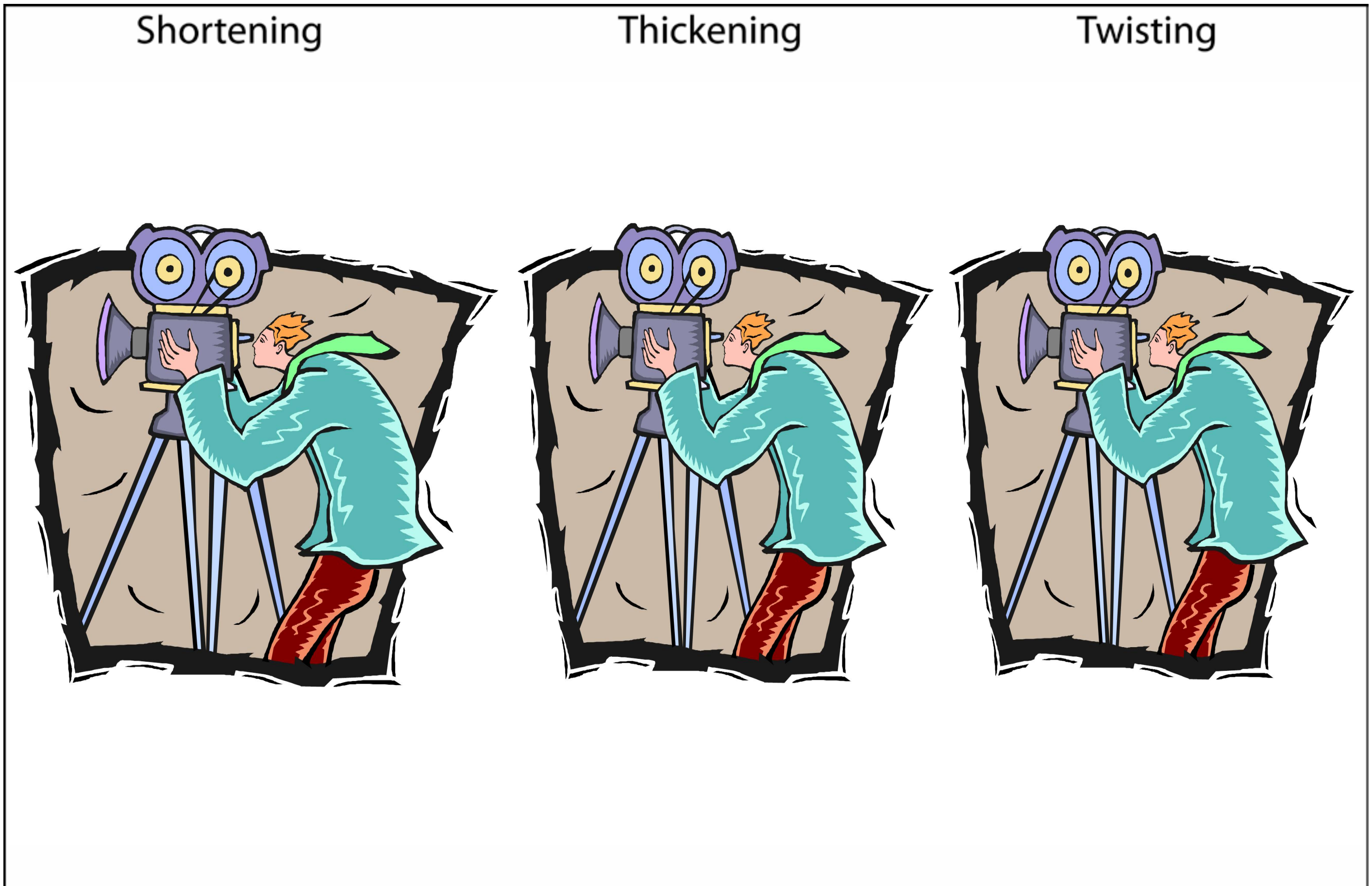

Early Systole: Isovolumic Contraction
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves closed
RV
LV
As we will see, most blood flows across the AV valves earlier in diastole, but let's move on to early systole. As the ventricles start to squeeze during and right after the QRS complex, there is a short period of time when ventricular pressure exceeds atrial pressure, closing the AV valves, but is not high enough to force open the arterial valves. Since no blood enters or leaves the ventricles (red circles) during early systole, this part of the cardiac cycle is referred to as isovolumic contraction.
When does blood get out of the ventricles?

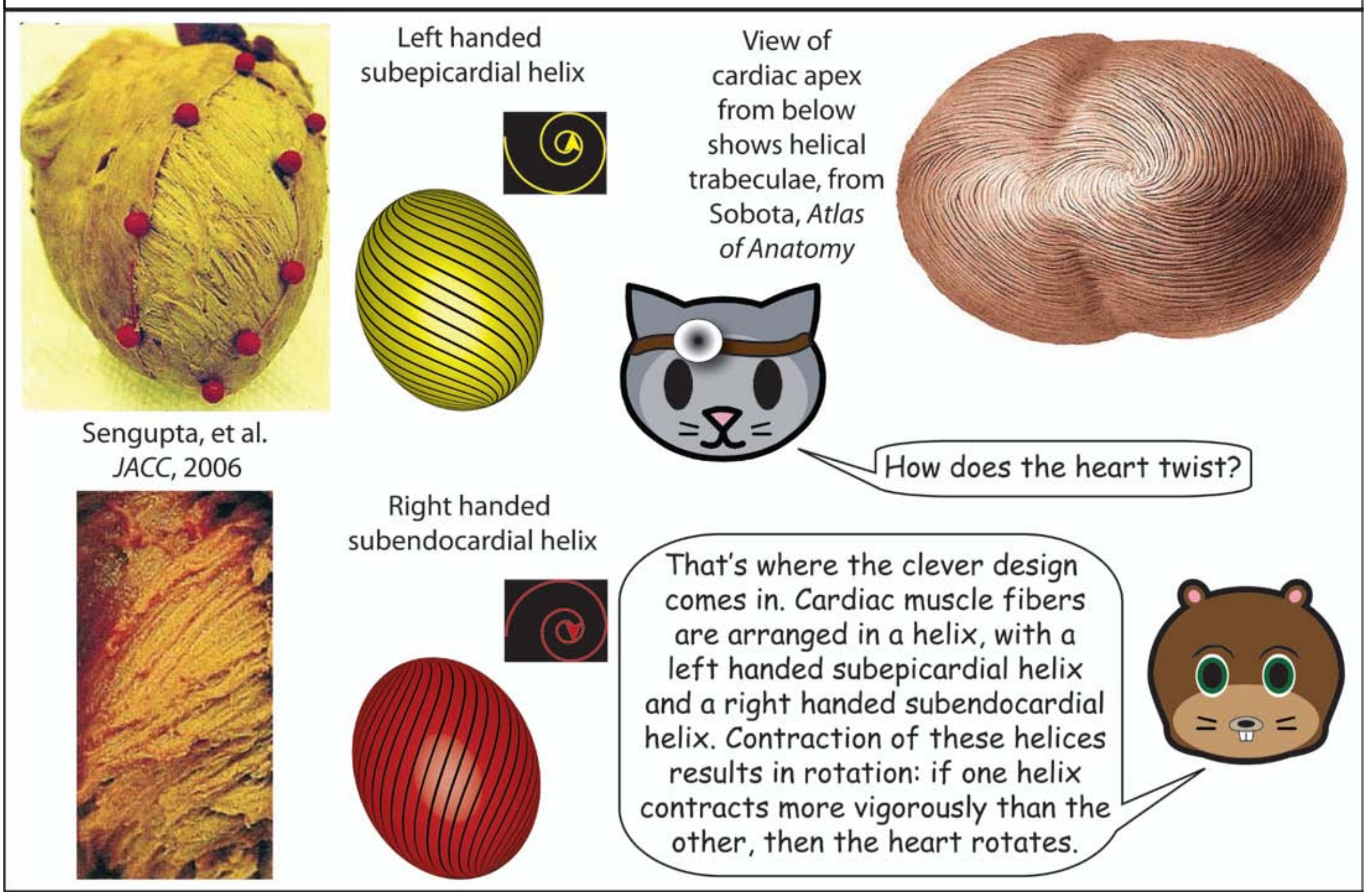

Early Systole: Rapid Ventricular Ejection
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves open
Right Atrium
Left Atrium
AV valves closed
RV
LV
The pressure within the ventricles increases rapidly during early systole, forcing open the arterial valves. During this phase of rapid ventricular ejection a large volume (thick red arrows) of blood flows across the arterial valves.
If there is a phase of rapid ejection, I bet there is a phase of slow ejection.

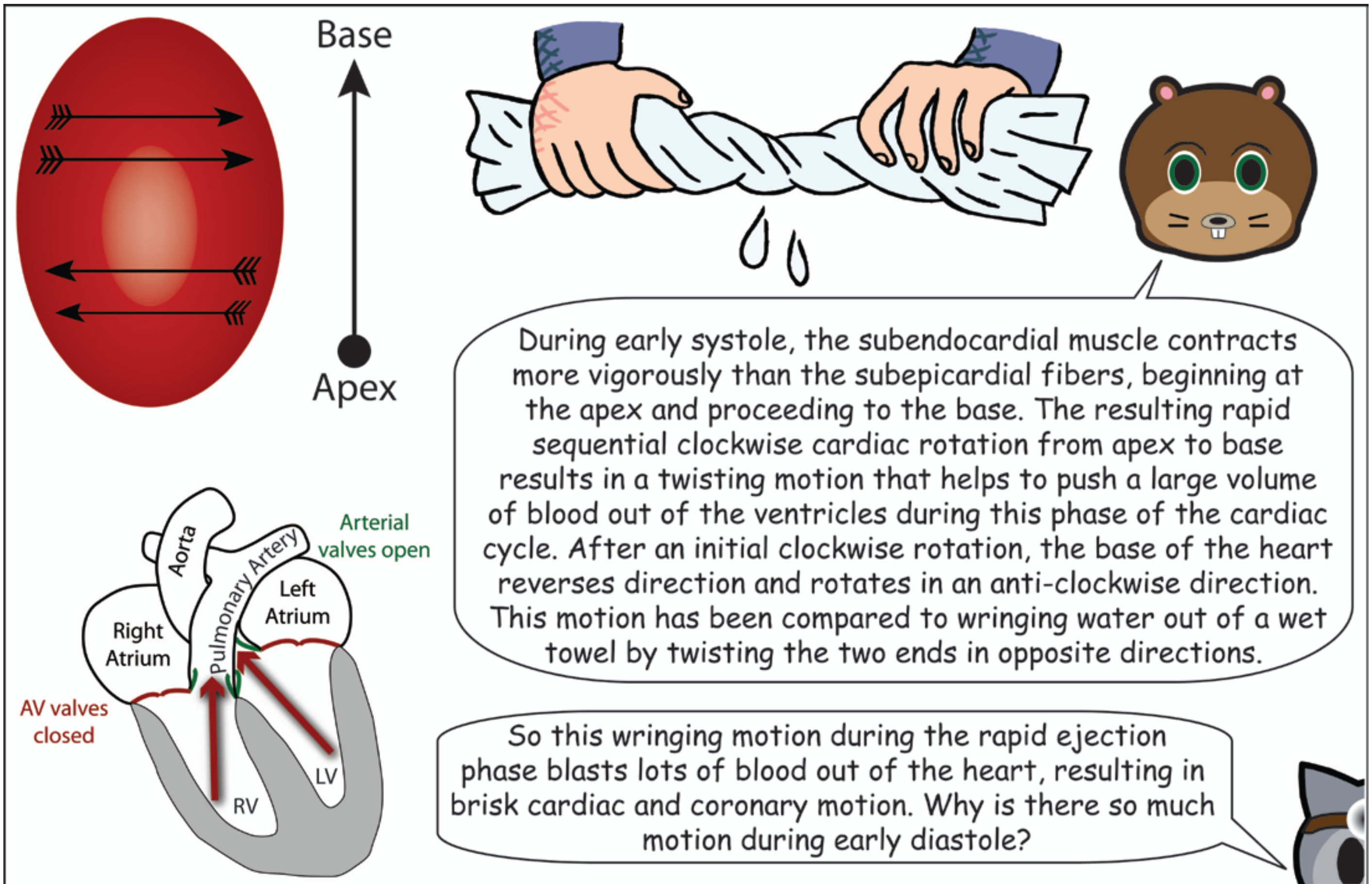

Late Systole: Slow Ventricular Ejection
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves open
Right Atrium
Left Atrium
AV valves closed
RV
LV
Right. If you compare the LV and aortic pressures in the Wiggers diagram, you can see that about halfway through systole, the aortic pressure exceeds LV pressure. A small amount of blood (thin red arrows) manages to cross the arterial valves during this late systolic phase of slow ventricular ejection.
How does blood go from the lower pressure LV into the higher pressure aorta?

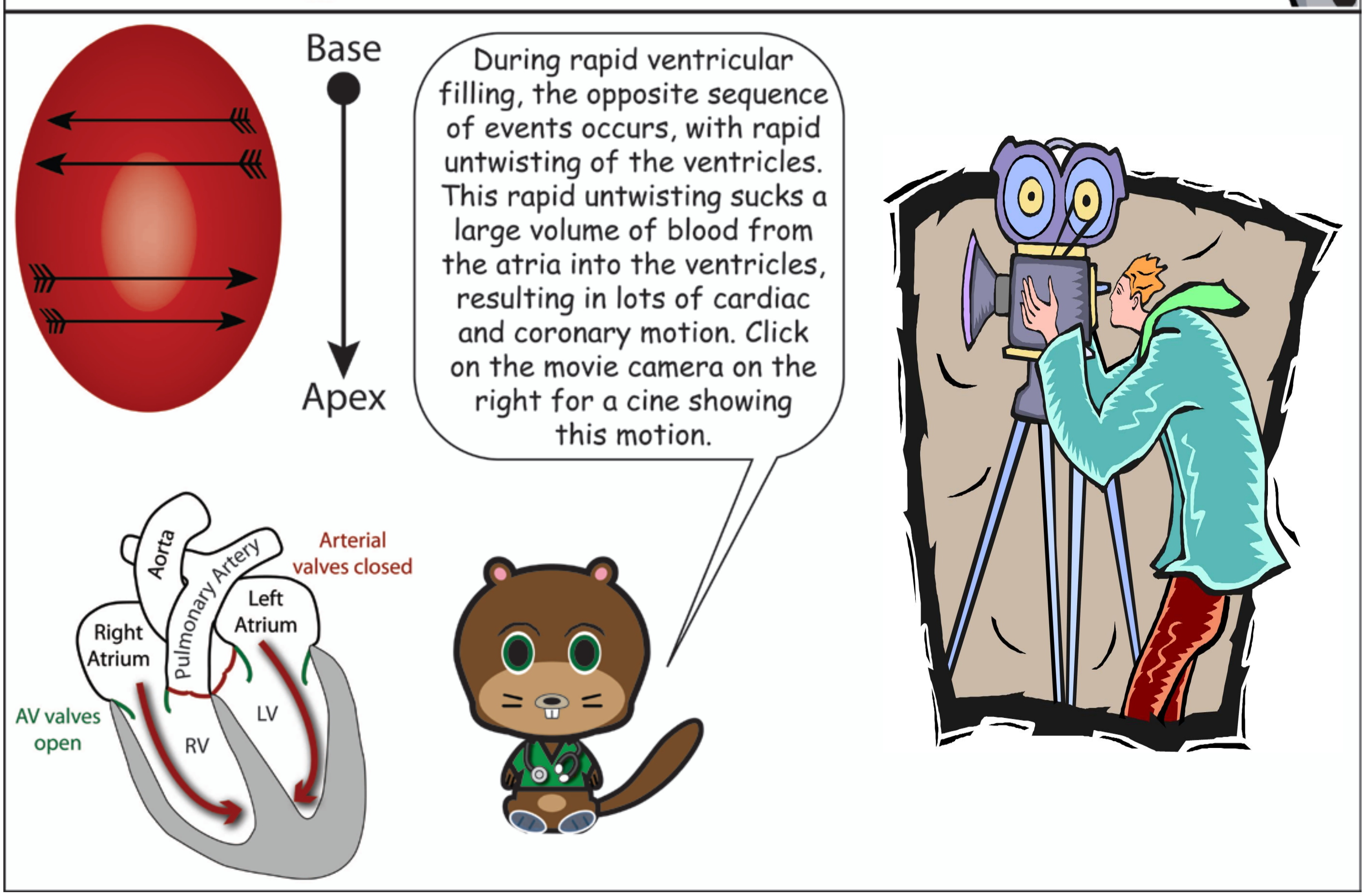

Early Diastole: Isovolumic Relaxation
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves closed
RA
LA
AV valves closed
Left Ventricle
Right Ventricle
I'm a squirrel, I don't understand, but smart people claim it's because of momentum. Eventually, the LV pressure decreases enough so that the aortic valve closes, but ventricular pressure is still higher than atrial pressure. The AV valves are also closed during this phase of early diastole called isovolumic relaxation. No blood enters or leaves the atria (red circles) during isovolumic relaxation.
But eventually the AV valves open, right?

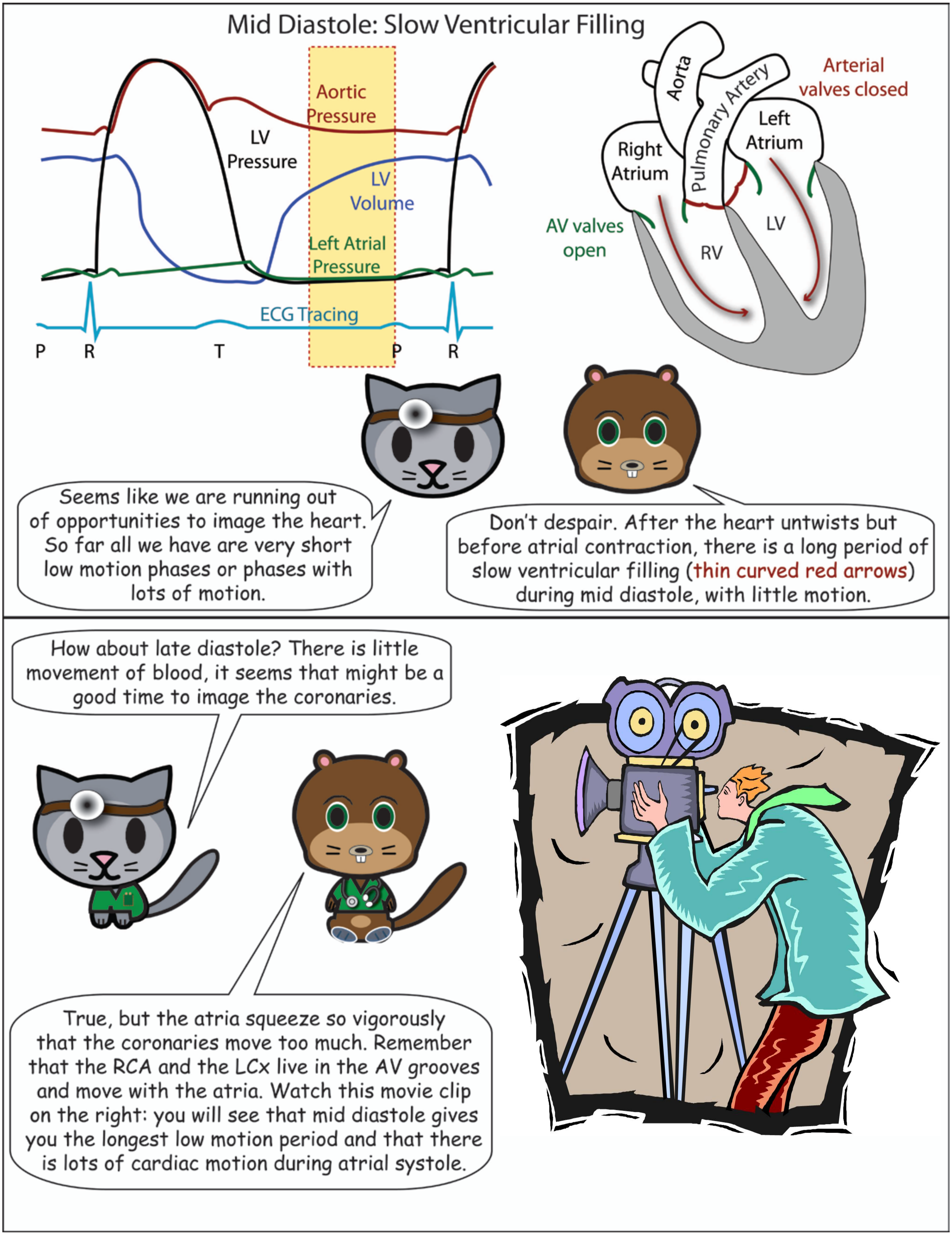

Early Diastole: Rapid Ventricular Filling
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Indeed. The next phase of early diastole is rapid ventricular filling characterized by large amounts of blood (thick curved red arrows) crossing the AV valves. So far we have 2 phases of the cardiac cycle characterized by large volumes of moving blood. That creates a lot of cardiac motion and since the coronaries sit on the epicardial surface, they will move as well.
So this would not be a good time to image the coronaries since they would look blurry.
Early Diastole
Aorta
Pulmonary Artery
Right Atrium
Left Atrium
RV
LV
Early Systole
Aorta
Pulmonary Artery
Right Atrium
Left Atrium
RV
LV
That's right. Why do you suppose there is so much intracardiac blood flow during early systole and diastole?
I don't know.
It has to do with the anatomy of the myocardium. Cardiac muscle is cleverly designed as well as hard working. There are 3 types of cardiac motion: shortening from apex to base, thickening and twisting. Cine loops of all 3 kinds of motion are included on the next panel. Click the movie cameras to play the cines.
LV Myocardium, Diastole
Thin
Long
Apex
LV Myocardium, Systole
Thick
Short
Apex

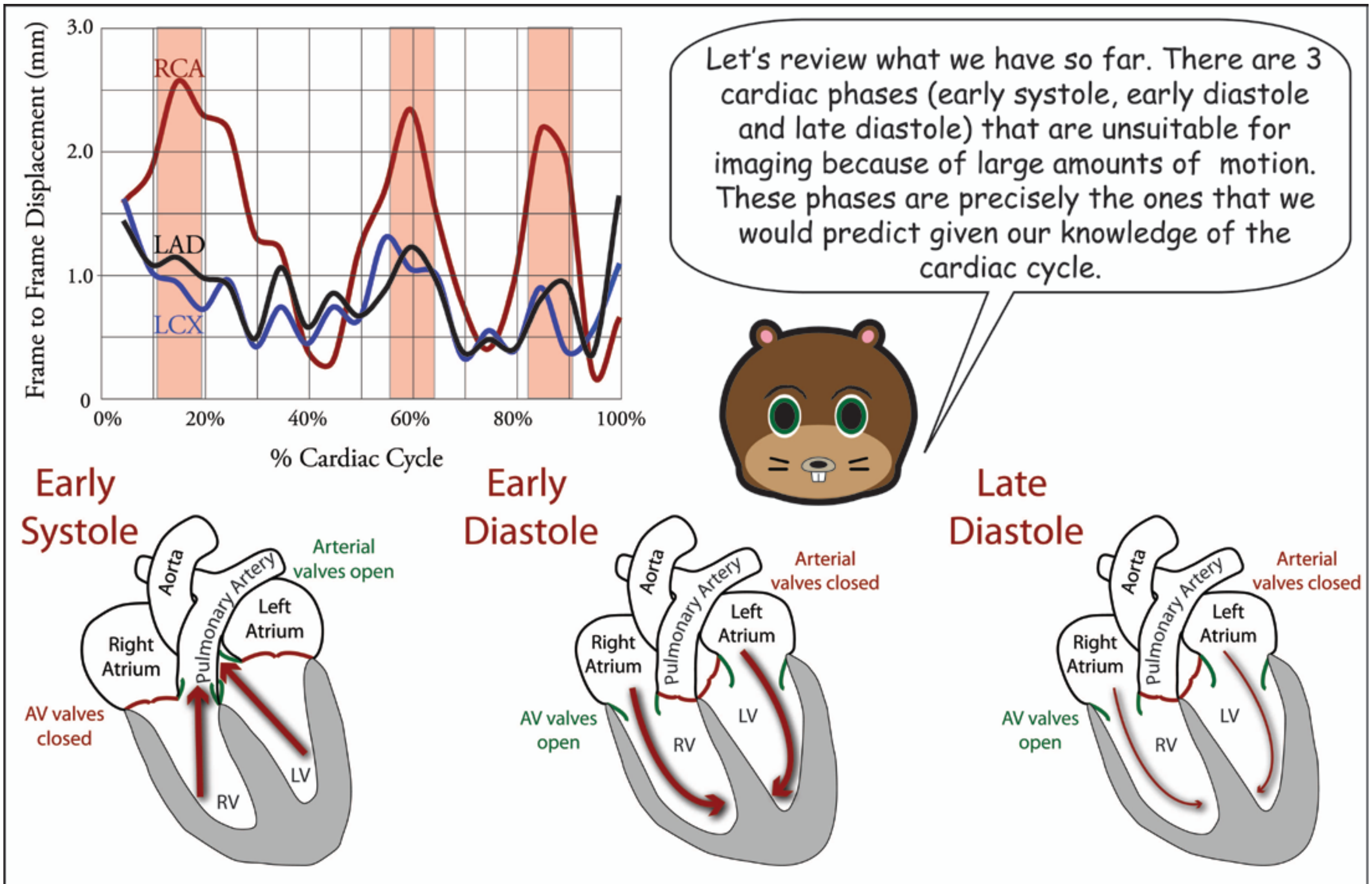

Shortening
Thickening
Twisting

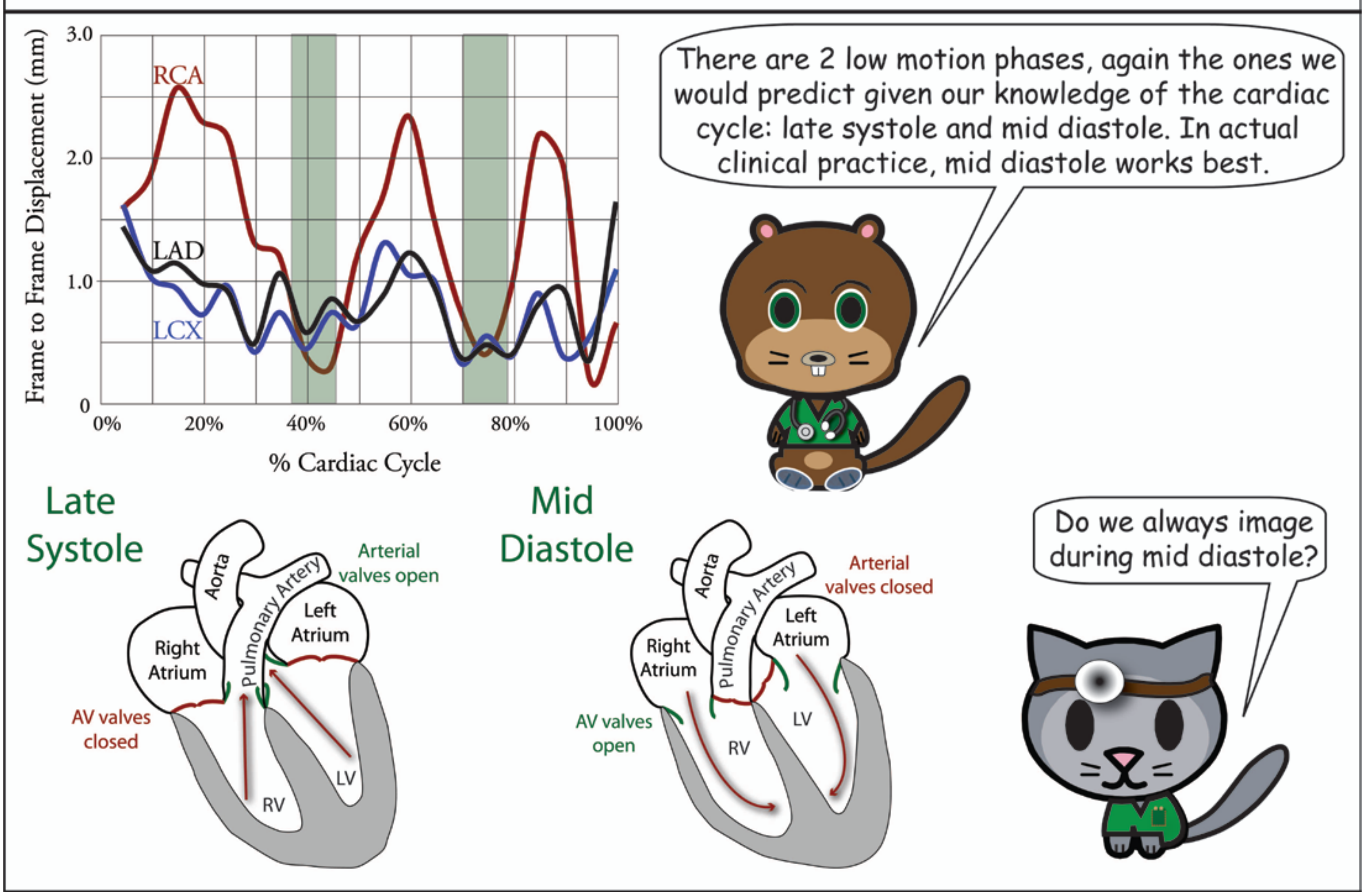

Left handed subepicardial helix
View of cardiac apex from below shows helical trabeculae, from Sobota, *Atlas of Anatomy*
Sengupta, et al. *JACC*, 2006
How does the heart twist?
Right handed subendocardial helix
That's where the clever design comes in. Cardiac muscle fibers are arranged in a helix, with a left handed subepicardial helix and a right handed subendocardial helix. Contraction of these helices results in rotation: if one helix contracts more vigorously than the other, then the heart rotates.


Base
Apex
Aorta
Pulmonary Artery
Arterial valves open
Left Atrium
Right Atrium
AV valves closed
RV
LV
During early systole, the subendocardial muscle contracts more vigorously than the subepicardial fibers, beginning at the apex and proceeding to the base. The resulting rapid sequential clockwise cardiac rotation from apex to base results in a twisting motion that helps to push a large volume of blood out of the ventricles during this phase of the cardiac cycle. After an initial clockwise rotation, the base of the heart reverses direction and rotates in an anti-clockwise direction. This motion has been compared to wringing water out of a wet towel by twisting the two ends in opposite directions.
So this wringing motion during the rapid ejection phase blasts lots of blood out of the heart, resulting in brisk cardiac and coronary motion. Why is there so much motion during early diastole?

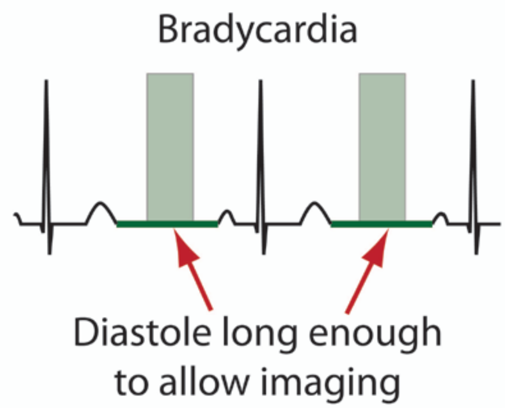

Base
Apex
During rapid ventricular filling, the opposite sequence of events occurs, with rapid untwisting of the ventricles. This rapid untwisting sucks a large volume of blood from the atria into the ventricles, resulting in lots of cardiac and coronary motion. Click on the movie camera on the right for a cine showing this motion.
Aorta
Pulmonary Artery
Arterial valves closed
Left Atrium
Right Atrium
AV valves open
RV
LV

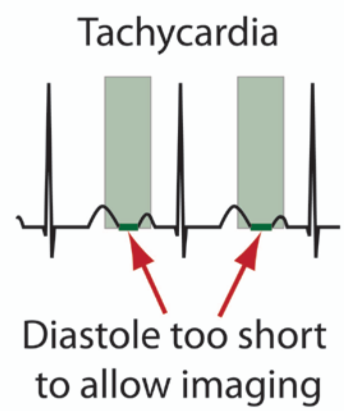

Mid Diastole: Slow Ventricular Filling
Aortic Pressure
LV Pressure
LV Volume
Left Atrial Pressure
ECG Tracing
P R T P R
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Seems like we are running out of opportunities to image the heart. So far all we have are very short low motion phases or phases with lots of motion.
Don't despair. After the heart untwists but before atrial contraction, there is a long period of slow ventricular filling (thin curved red arrows) during mid diastole, with little motion.
How about late diastole? There is little movement of blood, it seems that might be a good time to image the coronaries.
True, but the atria squeeze so vigorously that the coronaries move too much. Remember that the RCA and the LCx live in the AV grooves and move with the atria. Watch this movie clip on the right: you will see that mid diastole gives you the longest low motion period and that there is lots of cardiac motion during atrial systole.

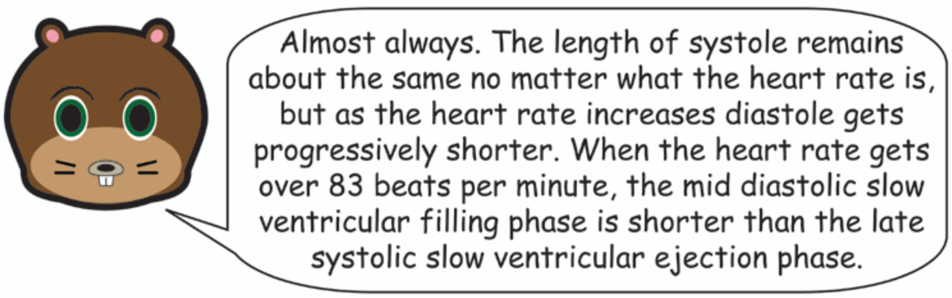

Frame to Frame Displacement (mm)
3.0
2.0
1.0
0
RCA
LAD
LCX
0%
20%
40%
60%
80%
100%
% Cardiac Cycle
Let's review what we have so far. There are 3 cardiac phases (early systole, early diastole and late diastole) that are unsuitable for imaging because of large amounts of motion. These phases are precisely the ones that we would predict given our knowledge of the cardiac cycle.
Early Systole
Aorta
Pulmonary Artery
Arterial valves open
Right Atrium
Left Atrium
AV valves closed
RV
LV
Early Diastole
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Late Diastole
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV

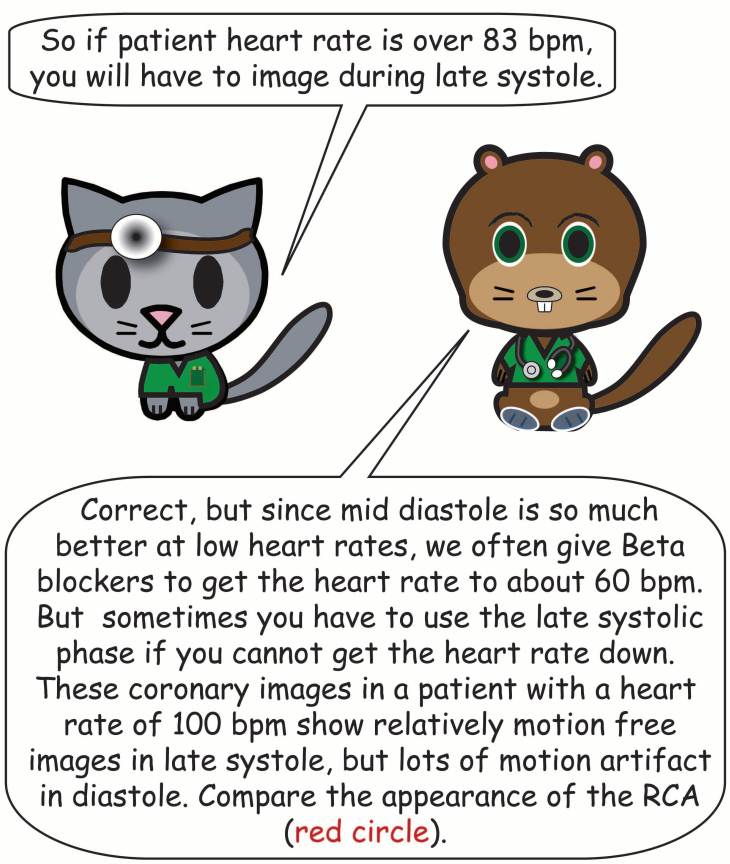

Frame to Frame Displacement (mm)
3.0
2.0
1.0
0
RCA
LAD
LCX
0%
20%
40%
60%
80%
100%
% Cardiac Cycle
There are 2 low motion phases, again the ones we would predict given our knowledge of the cardiac cycle: late systole and mid diastole. In actual clinical practice, mid diastole works best.
Late Systole
Aorta
Pulmonary Artery
Arterial valves open
Right Atrium
Left Atrium
AV valves closed
RV
LV
Mid Diastole
Aorta
Pulmonary Artery
Arterial valves closed
Right Atrium
Left Atrium
AV valves open
RV
LV
Do we always image during mid diastole?

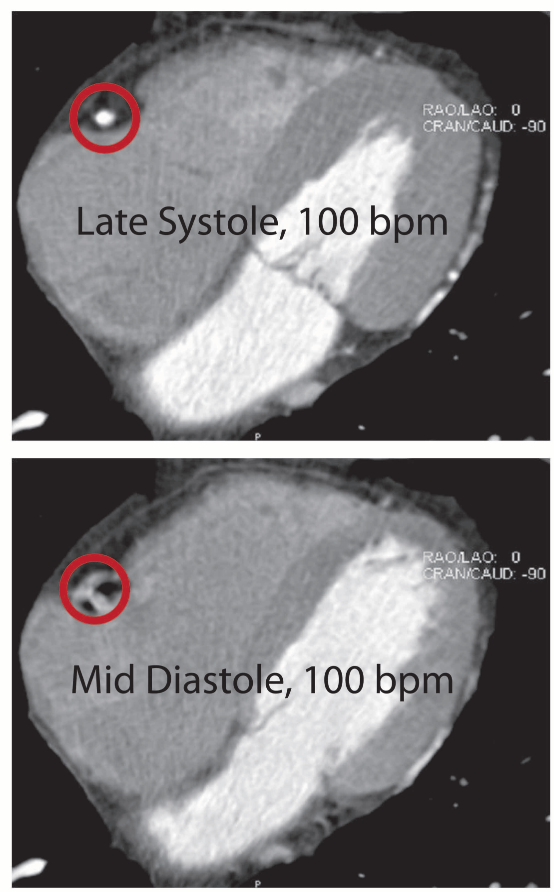
	45 beats per minute	100 beats per minute
Length cardiac cycle	1.33 seconds	0.60 seconds
Length of systole	0.40 seconds (30% of cycle)	0.36 seconds (60% of cycle)
Length of diastole	0.93 seconds (70% of cycle)	0.24 seconds (40% of cycle)

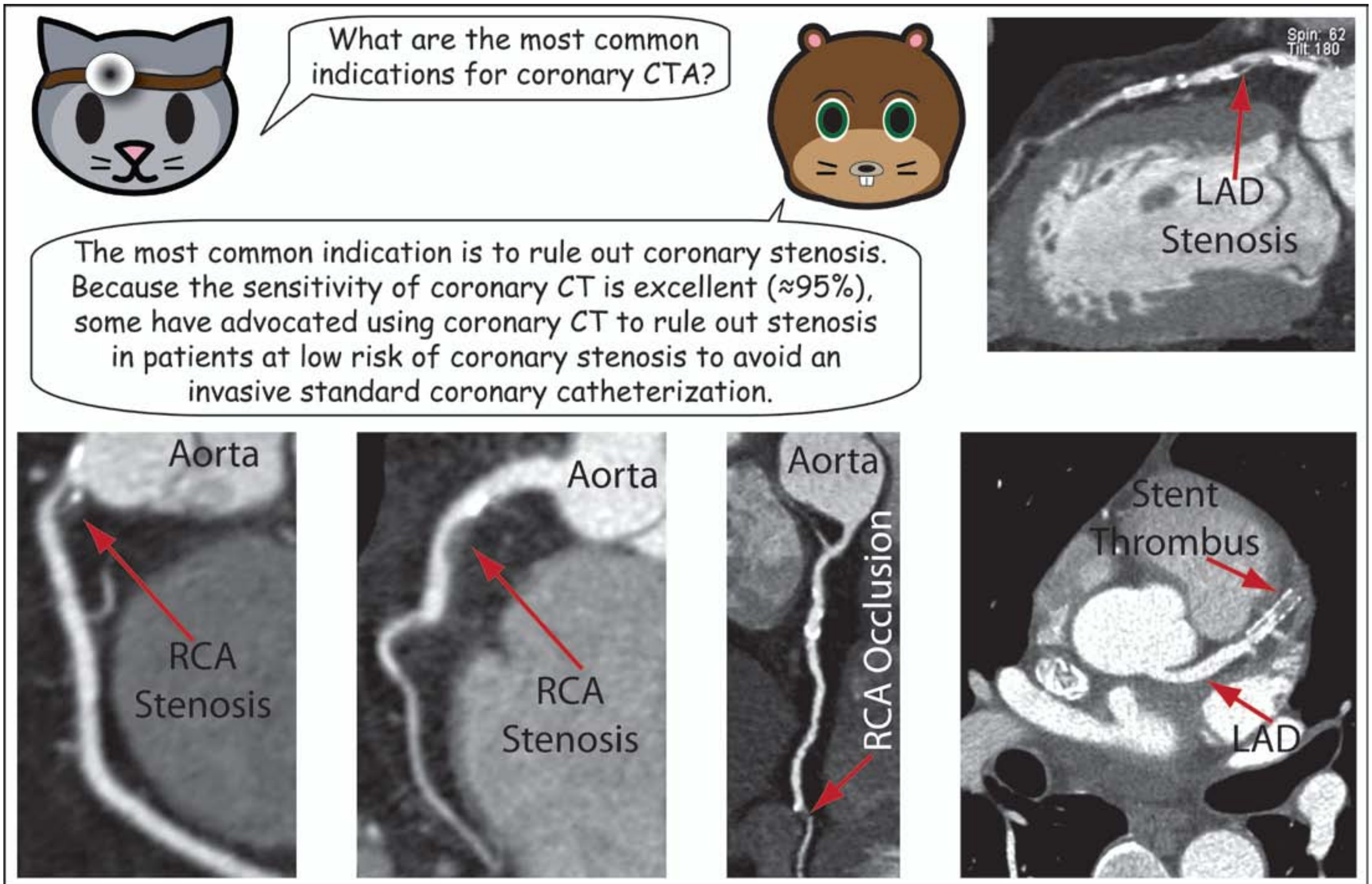


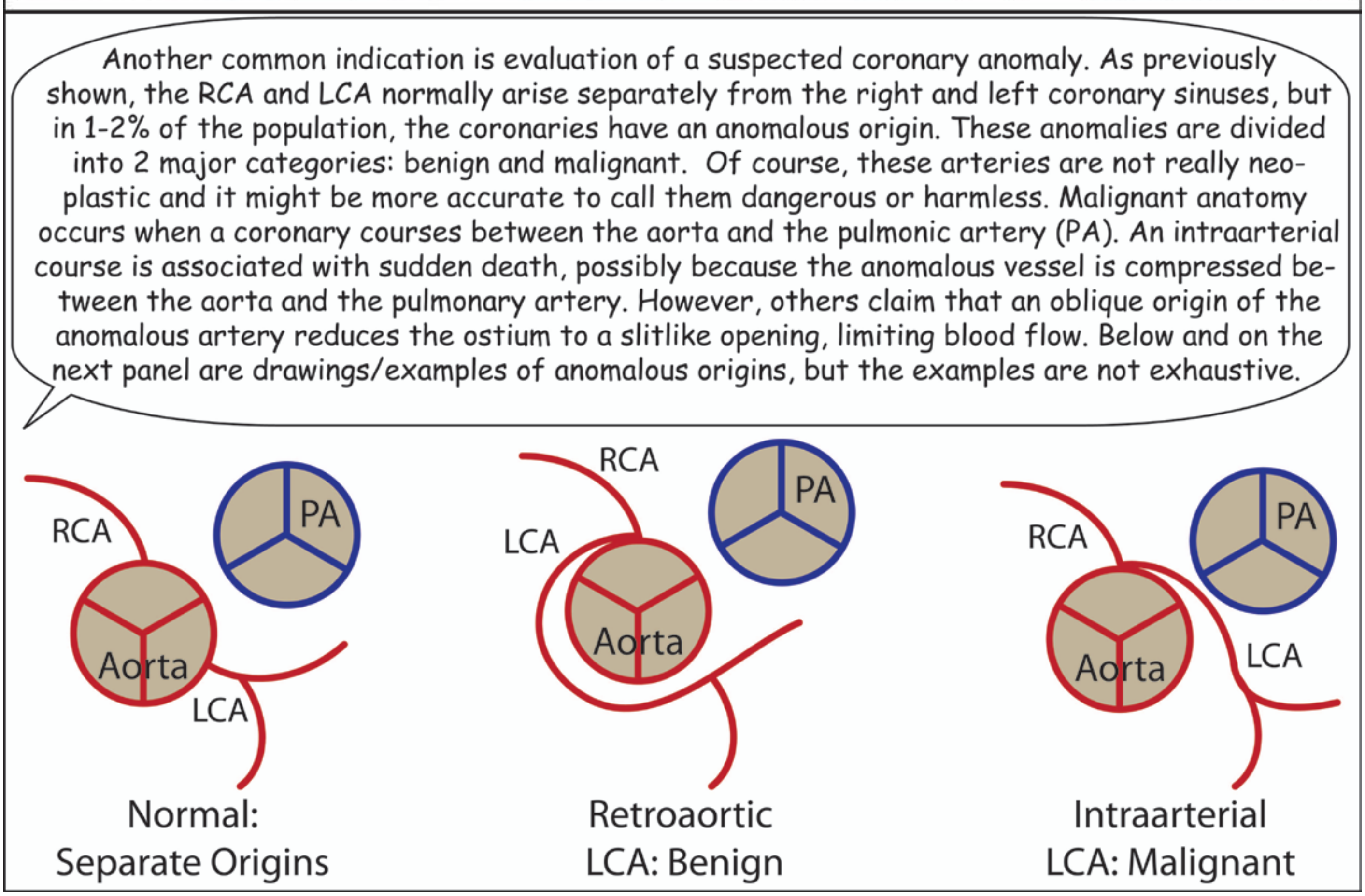


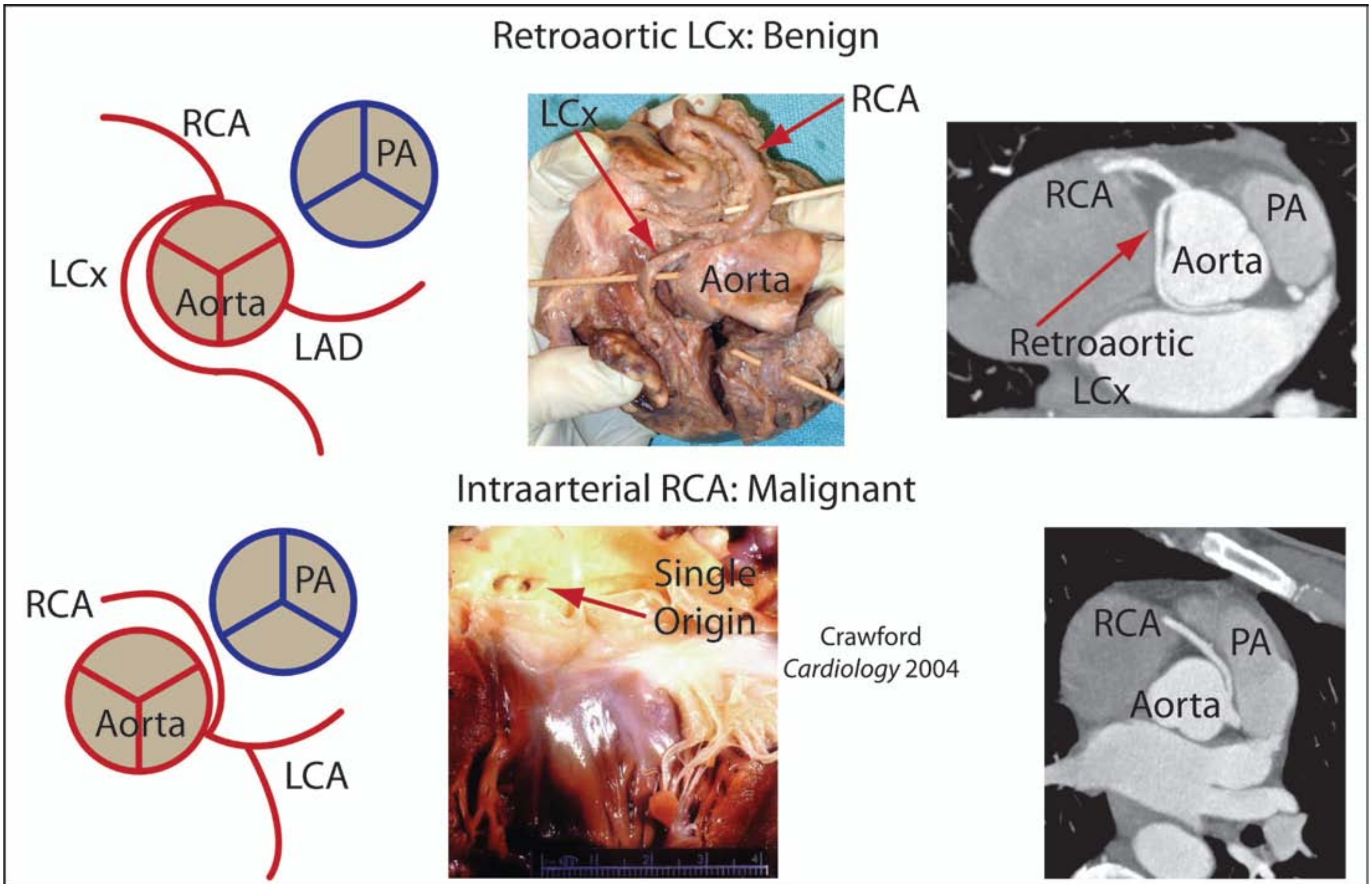




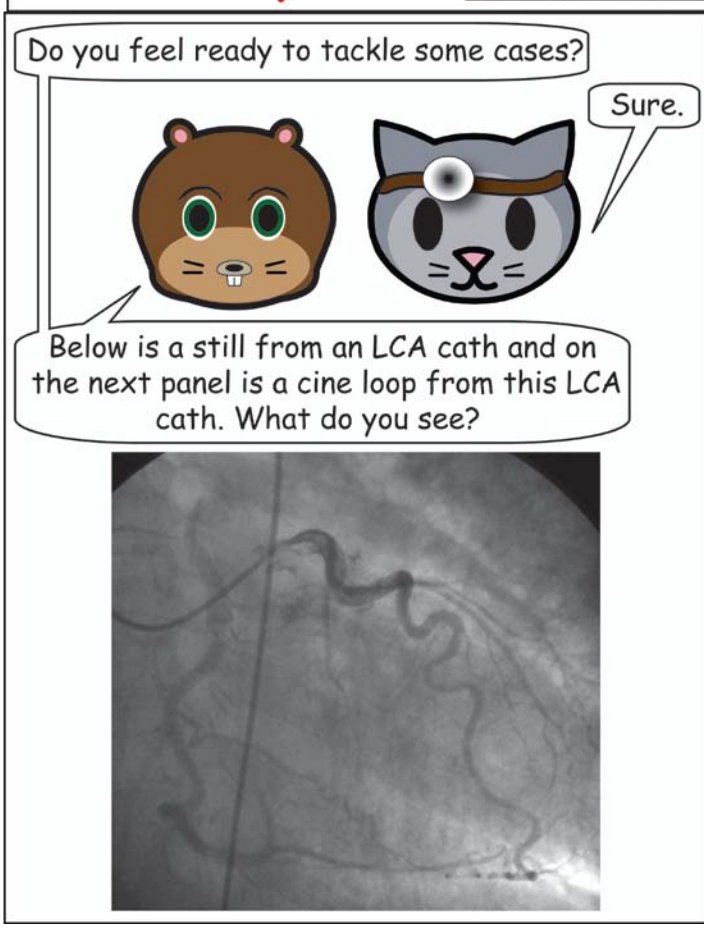


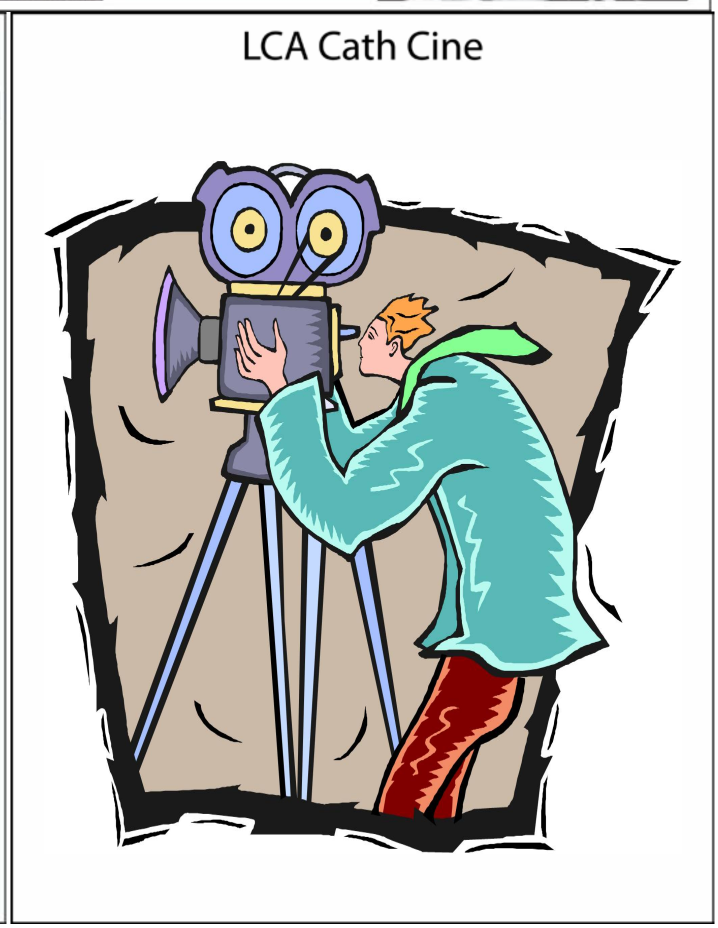

What are the most common indications for coronary CTA?
The most common indication is to rule out coronary stenosis. Because the sensitivity of coronary CT is excellent (≈95%), some have advocated using coronary CT to rule out stenosis in patients at low risk of coronary stenosis to avoid an invasive standard coronary catheterization.
Spin: 62
Tilt: 180
LAD Stenosis
Aorta
RCA Stenosis
Aorta
RCA Stenosis
Aorta
RCA Occlusion
Stent Thrombus
LAD

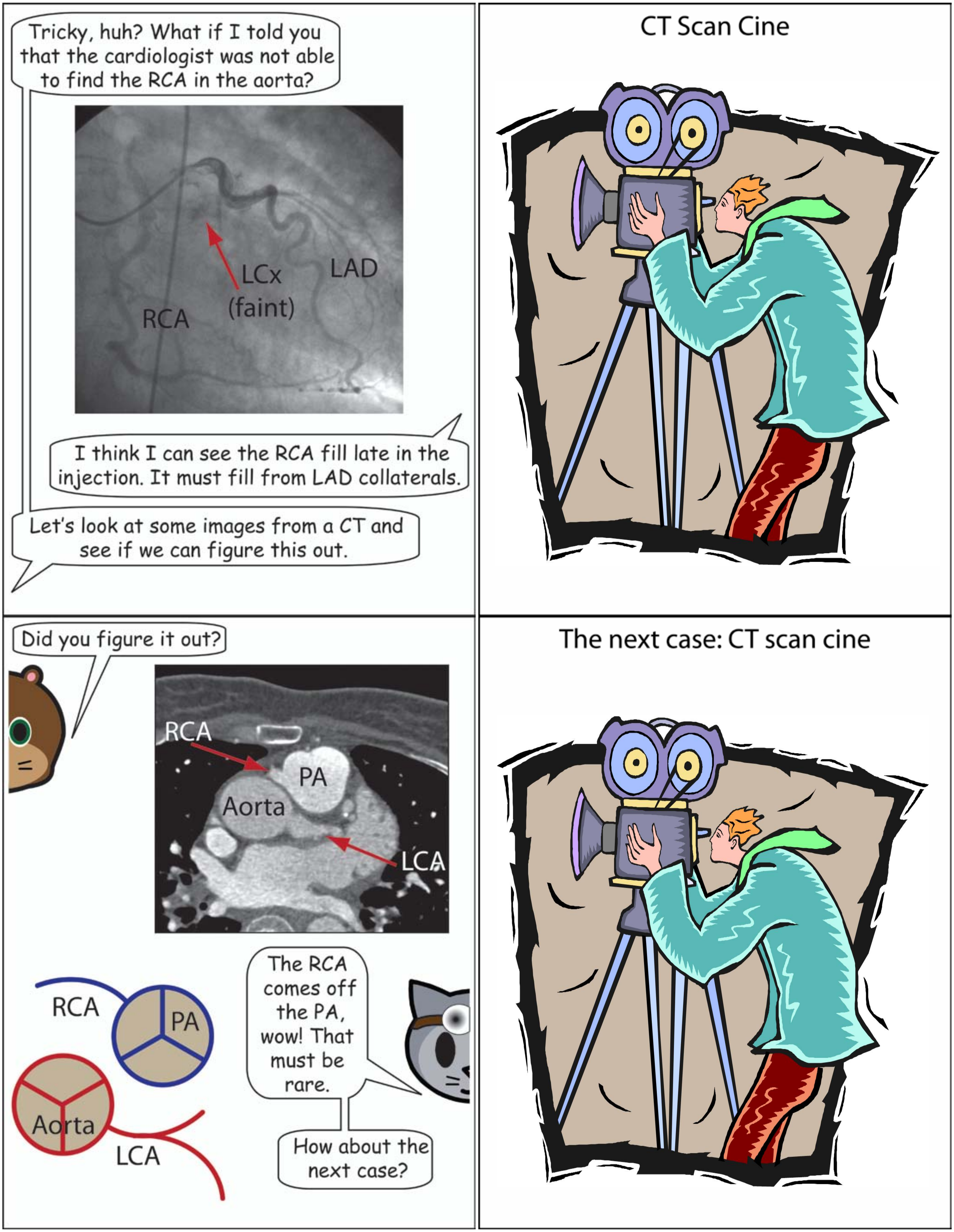

Another common indication is evaluation of a suspected coronary anomaly. As previously shown, the RCA and LCA normally arise separately from the right and left coronary sinuses, but in 1-2% of the population, the coronaries have an anomalous origin. These anomalies are divided into 2 major categories: benign and malignant. Of course, these arteries are not really neoplastic and it might be more accurate to call them dangerous or harmless. Malignant anatomy occurs when a coronary courses between the aorta and the pulmonic artery (PA). An intraarterial course is associated with sudden death, possibly because the anomalous vessel is compressed between the aorta and the pulmonary artery. However, others claim that an oblique origin of the anomalous artery reduces the ostium to a slitlike opening, limiting blood flow. Below and on the next panel are drawings/examples of anomalous origins, but the examples are not exhaustive.
RCA
PA
Aorta
LCA
Normal: Separate Origins
RCA
LCA
PA
Aorta
Retroaortic LCA: Benign
RCA
PA
Aorta
LCA
Intraarterial LCA: Malignant

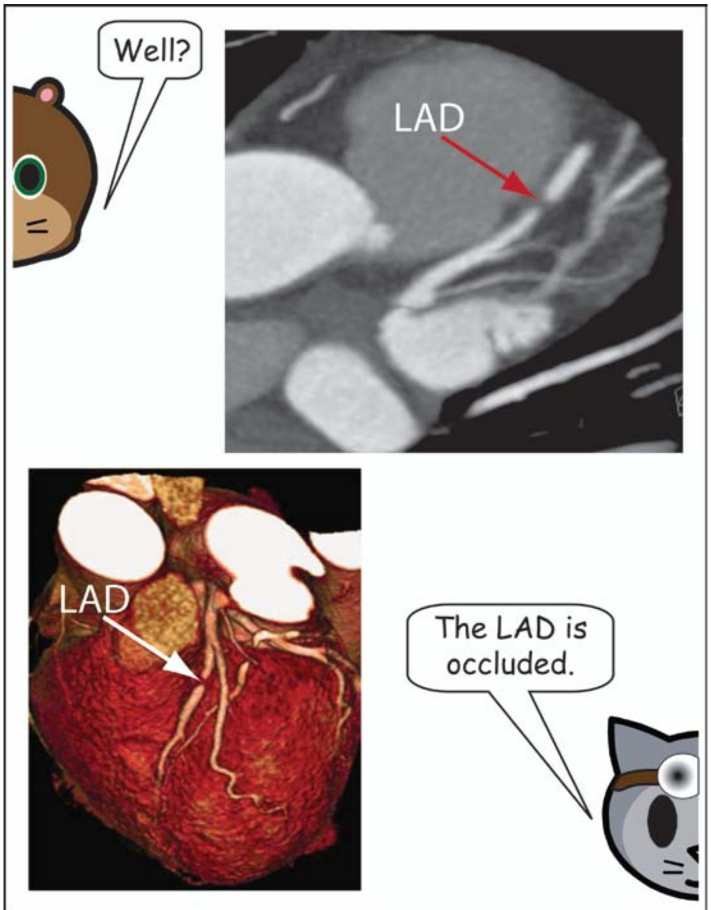

Retroaortic LCx: Benign
RCA
PA
LCx
Aorta
LAD
LCx
RCA
Aorta
RCA
PA
Aorta
Retroaortic
LCx
Intraarterial RCA: Malignant
PA
RCA
Aorta
LCA
Single
Origin
Crawford
Cardiology 2004
RCA
PA
Aorta

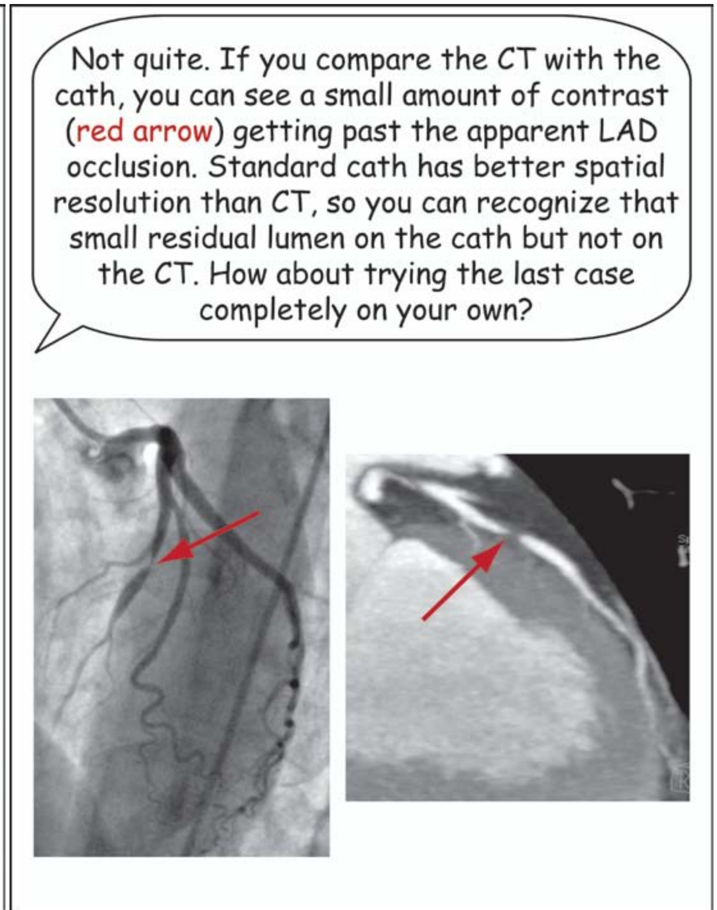
22


Do you feel ready to tackle some cases?
Sure.
Below is a still from an LCA cath and on the next panel is a cine loop from this LCA cath. What do you see?

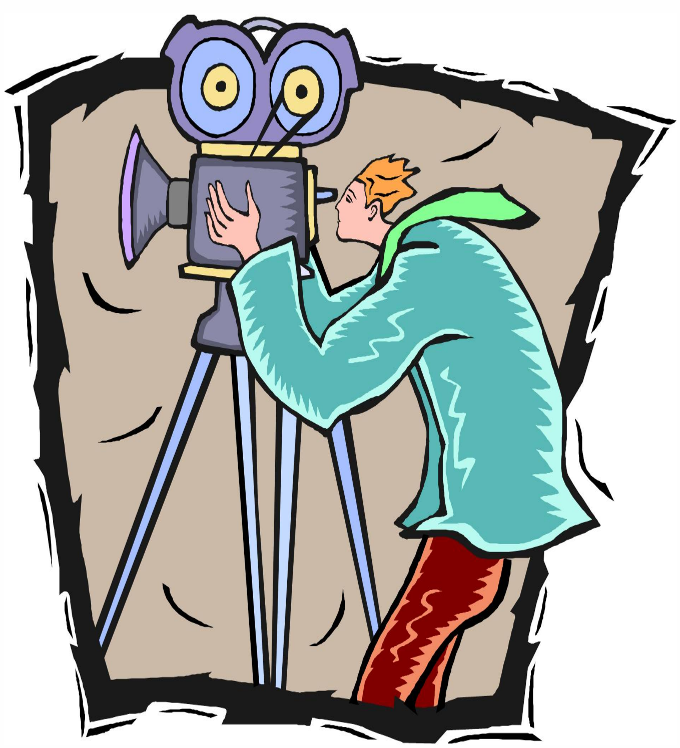

LCA Cath Cine


Tricky, huh? What if I told you that the cardiologist was not able to find the RCA in the aorta?
LCx (faint)
LAD
RCA
I think I can see the RCA fill late in the injection. It must fill from LAD collaterals.
Let's look at some images from a CT and see if we can figure this out.
CT Scan Cine
Did you figure it out?
RCA
PA
Aorta
LCA
RCA
PA
Aorta
LCA
The RCA comes off the PA, wow! That must be rare.
How about the next case?
The next case: CT scan cine





February/March 2012 Case of the Month



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 multiple sources and (usually) 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!