

# What does a Real Heart Look Like?

## Dissecting a Porcine (Pig) Heart (Continued)



### The Coronary Arteries (36k (left) & 60k (right) JPEG)

Before we get into the left side of the heart, we'll have a look at the coronary arteries. Since the heart pumps so much blood (generally 4-6 liters per minute in an adult) it requires nutrients at a high rate. The heart muscle requires energy in the form of sugars and oxygen, both of which are present in blood returning from the lungs. This means that the heart is one of its own best customers - a considerable amount of blood that the heart pumps out the aorta returns to the heart muscle (called myocardium) through the coronary arteries. The human heart has two coronary arteries

which are both attached to the aorta at a coronary sinus in the aortic valve. The left coronary attaches to the left coronary sinus, and I'll bet you can guess which sinus the right coronary artery attaches to! Like any artery, the coronary arteries divide into smaller branches called arterioles, and then down to capillaries where metabolite and nutrient exchange takes place with the myocardium. In atherosclerosis (commonly known as coronary artery disease or hardening of the arteries) one or more of the coronary arteries become partially or completely clogged. This reduces or may even prevent blood from reaching parts of the myocardium, causing the tissue to weaken and perhaps even die.



### Top View of Heart (21k JPEG)

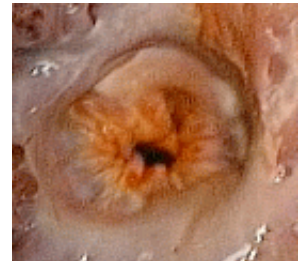
This view, taken looking down on the top of the heart, shows the aorta flanked by the *Right Atrium* on the right and *Left Atrium* on the left of the aorta. The atria are the red sacks that sit on top of the heart beside the arteries. The *Pulmonary Artery* is serpentine in shape, curling around the aorta. Presumably because it sees lower stresses than the aorta, the pulmonary artery has a thinner wall and is less stiff.



### The Pulmonary Veins & Left Atrium (50k JPEG's)

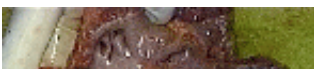
On the left is an image of the left atrium (on the left) and the two pulmonary veins at the position where they return to the atrium from the left and right lungs. My fingers are in the pulmonary veins. The atrium serves as a temporary storage depot where blood can pool as it returns to the heart from the lungs.

In the image to the right, the left atrium has been dissected to show the inside of the atrium and the atrial aspect of the mitral valve. Blood passes from the pulmonary veins into the left atrium, then it goes through the mitral valve into the left atrium during diastole.

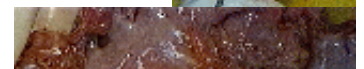


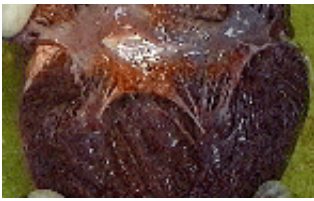
### Dissecting Into the Left Ventricle (38k JPEG)

This longitudinal incision extends from the apex of the heart (at the bottom) to the top of the left ventricle, then continues up into the atrium to allow us to view the entire left heart.



### The Mitral Valve (38k JPEG)

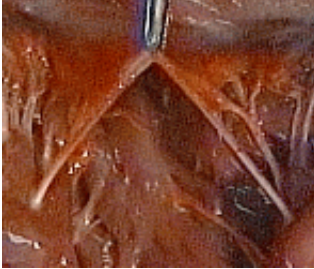




The mitral valve prevents blood from flowing back into the left atrium during contraction of the myocardium (systole). If the mitral valve is not operating properly, it may either prevent blood from flowing into the ventricle (called stenosis) or it may allow blood to flow backwards into the atrium (regurgitation or insufficiency). The mitral valve (image at left) is positioned



between the atrium (at top) and ventricle (at bottom). It consists of two leaflets (image at right), called the anterior (left side) and posterior (right side). Each leaflet has a number of strings called chordae tendinae that act like guy wires, helping the leaflets to maintain their proper shape so that the valve will close during systole.



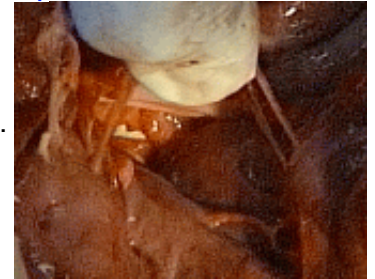
### The Left Ventricular Outflow (68k JPEG)

So, blood flows into the ventricles by passing through the mitral valve, but can you see where it flows out? This is a bit of a trick question because the outflow tract is hidden behind the anterior mitral leaflet.



### The Left Ventricular Outflow (20k (at left), 18k (at right) JPEG's)

Blood flows out of the left ventricle by passing between one of the mitral leaflets and the septum (the part of the myocardium that separates the left and right ventricles). If you look closely under the mitral leaflet, you can see the three aortic valve cusps. In the image at right, my finger is visible in the middle of the aortic valve.



**The Aortic Valve (5k JPEG)** This is the aortic valve viewed from the outflow side, i.e. from the aorta. Blood flows up through the valve from the left ventricle, pushing the cusps out of the way. Two of the three cusps are clearly visible in this view.



**The Aortic Valve (38k JPEG)** The aortic valve is the focus of a significant amount of research in this laboratory. In this image the large artery that directs blood out of the left side of the heart to the body, the aorta, is cut longitudinally so that the three cusps are visible. The cusps are identified by the aortic sinus that they are attached to. The sinuses are concave depressions in the wall of the aorta. There are three, each positioned at approximately 120 degrees from the other two. The coronary ostia, the locations where the coronary arteries merge with the aorta, appear as small holes in the aortic sinuses. In the middle are the left coronary sinus, containing the left coronary ostia and left coronary cusp. To the left are the posterior or non-coronary cusp and sinus. I bet you can guess which cusp I have stuck my finger in (hint, it's on the **right**).



**The Aortic Valve Cusps (15k JPEG)** So, what's all the fuss about? This is a shot of an *aortic cusp* from the fibrosal (aortic) side (at left). While it has a seemingly simple structure and acts in a passive manner, the failure of this small flap of tissue can mean death. At present, we don't



have an adequate replacement for the aortic valve when it becomes diseased. This cusp has been cut along the bottom where it would be attached to the base of an aortic sinus in the aortic root. The top is termed the *free edge*, and it's the part that 'flaps in the breeze'. Attachment points at the ends of the free edge are called *commissures*. The more transparent region at the top of the cusp is the *coaptation region* and is believed to be a redundancy mechanism to reduce regurgitation through the valve during *diastole* when the ventricles relax.

The surface that is visible here is called the *fibrosa* and is characterized by the large bundles of *collagen* that run across the cusp. Collagen is a connective tissue protein with a high tensile strength, and as such is believed to be the primary structural component of the cusp.

Shown above and to the right is the other side of the same cusp. The 'bottom' of the cusp is closest to the ventricle and as such is called the *ventricularis*. It contains collagen and *elastin*, both connective tissue proteins, in a different ratio than the fibrosa. Because of its less organized structure, the ventricularis is more extensible than the stiffer, stronger fibrosa.



**A tissue valve opening and closing (27k JPEG)** The valve shown here is mounted in a *pulse duplicator* which is a device used to test artificial heart valves. It is not a natural human or porcine heart valve, but demonstrates what a heart valve looks like when it's open (left) and closed (right).



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[Continue on to sections cut through the heart.](#)

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