Ask the Clinical Instructor

A Q&A column for those new to the cath lab

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"We have some physicians that do unusual things when trying to analyze valves. What is the correct way?" — RCIS Online student

Part II.

In the April issue (*Part I*), we presented some ideas about how to interrogate the aortic valve.

In this month's article, we will cover mitral valve analysis. Many of the same principles apply as with the aortic valve. Let's review some of the principles of mitral valve analysis:

1. To analyze a valve, you must know the pressure on each side of the valve.
2. Tricuspid and mitral valves are closed during systole and open during diastole.
3. Aortic and pulmonary valves are open during systole and closed during diastole.
4. Valves open and close due to pressure differences on either side.
5. Stenosis shows when valves are open.
6. Regurgitation shows when valves are closed.

As with the aortic valve, we must know the pressures on each side of the valve to establish the gradient, which is the challenge with mitral valve analysis. The options available to obtain the pressures on each side of the valve are limited.

Ventricle Pressure and Wedge Pressure

We already are comfortable with knowing that a pressure can be obtained from a ventricle by placing a catheter in it. But how do we get the pressure on the "other" side of the mitral valve, or from the left atrium (LA)? We'll discuss how to obtain a direct pressure reading from the LA in a moment, but it is not a common procedure. The best we can do is to obtain a distant reading that mimics the LA. If we go back to some basic hemodynamics, we should recall that we use a Swan-Ganz catheter to obtain pulmonary capillary wedge (PCW) pressures (Figure 1).

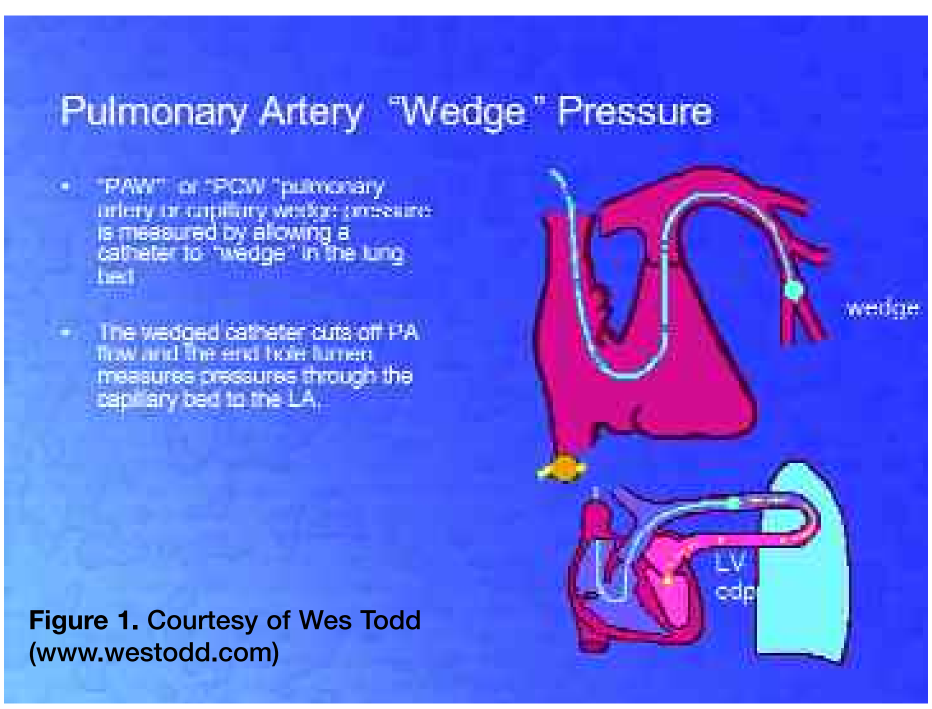

Figure 1. Courtesy of Wes Todd (www.westodd.com)

Figure 2. In this snapshot, we can see that the left ventricular end diastolic pressure (LVEDP) and the pulmonary capillary wedge (PCW) mean match fairly well. Remember, to eyeball the LVEDP, come straight down from the QRS complex and intersect it with the LV waveform. Any gradient in these waveforms is insignificant.

In the normal patient, we can also "see" all the way to the left ventricle, specifically, the left ventricular end diastolic pressure (LVEDP). Once the tip of the Swan-Ganz catheter is 'wedged,' it creates a continuous, fluid-filled pathway from the tip of the catheter to the ventricle.

Since the mitral valve is open during diastole (Principle #2), we "see" the ventricle during diastole, and the moment just before contraction is when we see the LVEDP (Figure 2). You might be wondering how we would know the LA pressure when looking at the ventricle. Refer to Principle #2. If the valve is open, and the ventricle is in diastole, then before it contracts, the pressures between the LA and the LV must be equal, since the valve is open. Refer to Principle #4. Once the pressure is high in the LV, it will close the mitral valve.

Therefore, it can easily be remembered that:

PCW = LA (mean) = LVEDP

This means that we CAN know what the pressure is in the LA by using the PCW pressure and obtaining the mean from the LA. However, this does not apply to patients who have pulmonary hypertension, or other pathologies that create disturbances in the pressures within the lung beds. If that is the case, you cannot reliably use this process.

Now that we have the necessary information, what do we do with it? First, you have to allow your monitoring system to help. With the aortic analysis, we looked at peak-to-peak gradients (systole). With mitral valve analysis, we are looking for diastolic filling, so we have to look at the area underneath the pressure gradient. This is more difficult and we rely on the computers to figure it out. One thing that must happen is that the tracings must be adjusted to correctly line up. When reading the PCW compared to the LV, there will be a delay in the PCW reading, because of the time it takes for the pressure wave to reach the tip of the Swan-Ganz catheter. You would need to move the tracing over to line it up, as shown in Figure 3a.

After you complete this task, obtain the information from your computer. Once you know the gradient of the valve, you can apply it to the Gorlin Formula to obtain your valve area (to be discussed in the next issue).

Direct LA Pressure Reading

More difficult, and done less often, is the transeptal procedure to obtain a direct pressure reading from the LA. We described this procedure in detail in a previous column (November 2006; available online at http://cathlabdigest.com/article/6459).

A catheter is again placed in the

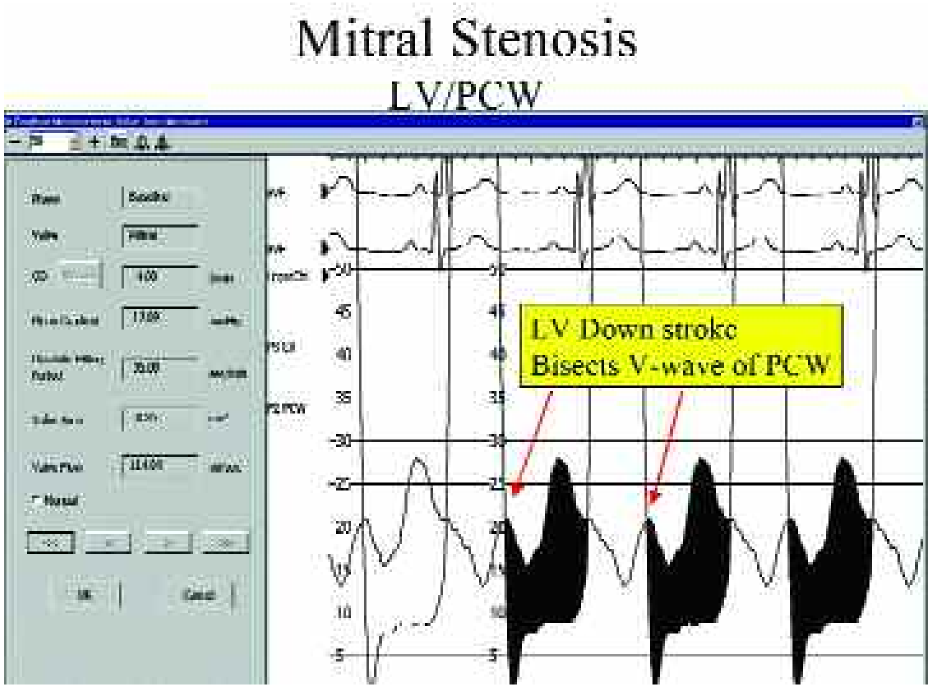

Figure 3a. In this figure, we see that the waveforms have been transitioned to match up, in order to take into account the delay in the pressure reading being read from the pulmonary capillary wedge (PCW). Once properly matched up, the computer can analyze the data.

Figure 3b. In many systems, the default analysis of the mitral valve gradient includes increasing the sweep speed and decreasing the scale so that a more accurate measurement can be taken. Before computers were available to analyze the gradients, physicians or staff would use a planimeter (a cartography tool) to measure the highlighted area. We can all thank technology that we don't have to do this!

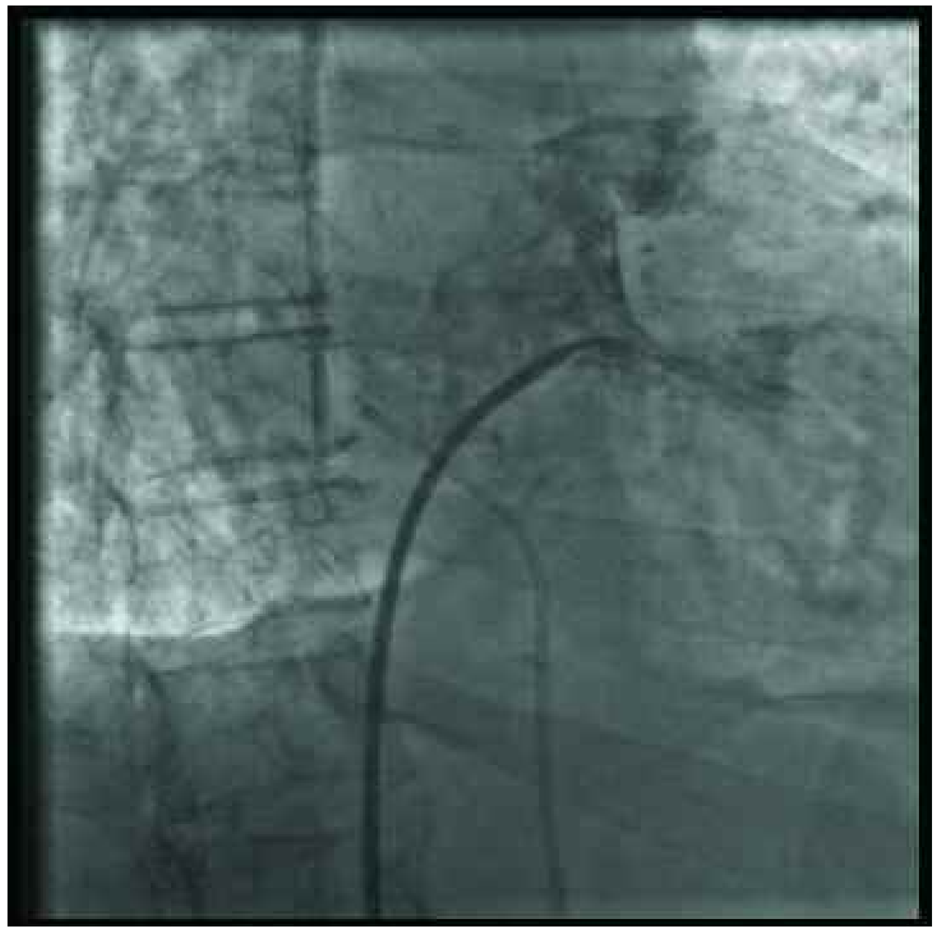

Figure 4. In this figure, a transseptal catheter has been places in the right atrium (RA) and the septum between the RA and the left atrium (LA) has been punctured. Contrast is being delivered via the catheter to assure placement in the LA. You can also see a multi-purpose catheter that will soon be placed into the LV to obtain the pressure readings from both sides of the valve.

If nothing else, remember that Pulmonary Capillary Wedge Pressure = Left Atrial (mean) = Left Ventricular End-Diastolic Pressure, or PCW=LAm=LVEDP.

ventricle and another one in the LA. This is possible with an understanding of the anatomy of the heart. A special catheter set is inserted through the femoral vein and eventually into the right atrium (RA) (Figure 4). Under fluoroscopy, and possibly with the aid of trans-esophageal echo (TEE), the foramen ovale is identified and punctured, with the catheter being inserted over the device until it is in the LA.

At this point, Principle #1 is met, and direct readings of the LA and LV are obtained and processed to provide the gradient reading.

If your facility performs mitral valvuloplasty, then likely you complete this assessment numerous times during the overall procedure to evaluate the valve initially, as well as after each balloon inflation. (We will cover this in greater detail next month.)

The transeptal procedure is not without risks, and should be reserved only for situations where the PCW pressure will not be reliable. It should also be performed by only the most skilled of physicians. It is a common procedure performed by electrophysiologists to complete certain ablation procedures.

Both of these methods can provide information concerning the status of the mitral valve. ■

Next month, we'll talk about the interventions that may be undertaken in the cath lab when we find these gradients in the aortic and mitral valves.

"The only foolish question is one left unasked."

New Staff: Your suggested topics and questions are needed!

(You are welcome to remain anonymous.)

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