

Cath Lab Digest

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A Product, News and Clinical Update for the Cardiac Catheterization Laboratory Specialist

Cath Lab Spotlight



Left to right: Edna Reeves, RN; Andrea Webb, RCIS; Melony Broyles, CVT; Rachel Hodges, RCIS (hidden); Cheryl McKesson, RN, BSN, CVBC; Andrea Stumpf, RCIS; Candice Carter, RCIS; Brenda Baines, RT(R); Richard Pearman RT(R) (back); Melissa Huskins, RCIS, Toni Grosso, RN, BSN; Lesley Boswell, RCIS (front); Bethany Hall, RN (back); Colleen Blackard, RN (front); Amy Cooke, RN (back); Bridget Verran, RCIS; Sherry Hunt, RN; Courtney Dykes, RCIS (middle); Bobby Morton, RCIS; Kathy Jordan, RN, BSN, clinical leader.

Johnson City Medical Center: Center for Cardiovascular Health

*Ed Stump, Director of Interventional Cardiology, AAS, BA, MBA, member HFMA, ACHE
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What is the size of your cath lab staff and facility?

Johnson City Medical Center's Center for Cardiovascular Health has a total of six cath labs, with one dedicated to electrophysiology (EP) procedures. There is a 32-bed holding room and the 34-member staff includes 25 registered nurses (RNs), with the remaining bulk of the staff being cath lab technologists. Each lab is staffed with one RN and two technologists. The RNs are specialty-trained for the cath lab and the technologists are certified as registered cardiac invasive specialists (RCISs).

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HEMODYNAMICS

The ABCs of A to V: Right Atrial/ Left Atrial (PCW) Pressures



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Many professionals working in the cardiac cath lab setting are able to recognize right heart pressures. However, many still do not understand what is happening physiologically and the information that can be acquired from the waveform. Many hemodynamic systems provide a value for the a-wave and the v-wave, but what does it tell us about our patient's condition? Let's take a closer look at what is actually occurring within the cardiac cycle to cause the various peaks and valleys, and what pathologic conditions can alter these waveforms.

Right Atrial Waveform

Let's begin with the waveform of the right atrium (Figure 1). The first positive deflection is the a-wave. This is generated when the atrium contracts, which causes the increased pressure within the atrium. This occurs during the P-wave on the ECG. The next increase in pressure is

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SPECIAL COMMUNICATIONS

Occupational Health Hazards in the Interventional Laboratory: Time for a safer environment

Lloyd W. Klein,^{1} MD, Donald L. Miller,² MD, Stephen Balter,³ PhD, Warren Laskey,⁴ MD, David Haines,⁵ MD, Alexander Norbash,⁶ MD, Matthew A. Mauro,⁷ MD, and James A. Goldstein,⁵ MD, on behalf of the members of the Joint Inter-Society Task Force on Occupational Hazards in the Interventional Laboratory*

This document is a consensus statement by the major American societies of physicians who work in the interventional laboratory environment. It reviews available data on the prevalence of occupational health risks and summarizes ongoing epidemiologic studies designed to further elucidate these risks. Its purpose is to affirm that the interventional laboratory poses workplace hazards that must be acknowledged, better understood, and mitigated to the greatest extent possible. Vigorous efforts are advocated to reduce these hazards. Interventional physicians and their professional societies, working together with industry, should strive toward minimizing operator radiation exposure, eliminating the need for personal protective apparel, and ending the orthopedic and ergonomic consequences of the interventional laboratory work environment.

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The ABCs of A to V: Right Atrial/Left Atrial (PCW) Pressures

caused during ventricular contraction. The sudden closure of the tricuspid valve and the rapid increase in ventricular pressures causes the valve to bulge into the right atrium. This wave is called the c-wave and can be found directly following the QRS complex on the ECG. Note: The c-wave is very slight and not seen all of the time. The first major negative deflection of the waveform is the x-descent. This sudden drop in pressure occurs as a result of depolarization of the right atrium and at this point the tricuspid ring is actually being pulled into the ventricle. This occurs between the QRS complex and the T-wave on the ECG. The v-wave represents the passive filling of the right atrium as the tricuspid valve is closed. This can be located during the T-wave on the ECG. The final negative deflection is the y-descent. This is a result of the rapid fall in right atrial pressure as the tricuspid valve opens and the right atrium empties into the right ventricle during ventricular diastole. This can be found after the T-wave on the ECG.

Left Atrial Waveform

The left atrial waveform is very similar to the right atrial waveform; however, the a-wave and the v-wave are

larger because of the lower compliance found within the left atrium (Figure 2). Once again, the a-wave is produced from the increased pressure during the atrial contraction. This will coincide with the P-wave of the ECG. The c-wave in this case is a result of the left ventricular contraction and subsequent bulging of the mitral valve into the left atrium, found directly following the QRS complex. The x-descent represents atrial relaxation. This occurs between the QRS complex and the T-wave on the ECG. The v-wave represents the passive filling before the opening of the mitral valve. This will occur directly with T-wave. The y-descent represents the opening of the mitral valve and the rapid filling of the ventricle from the atrium.

Pulmonary Capillary Wedge Pressure (PCWP)

Pulmonary capillary wedge pressure (PCWP) acquired during a right heart procedure is used to represent left atrial pressure. This method eliminates the need for a transeptal puncture to acquire left atrial pressure. The PCWP and left atrial pressures are the same; however, the PCWP pressure shows slight damping and is shifted to the right in

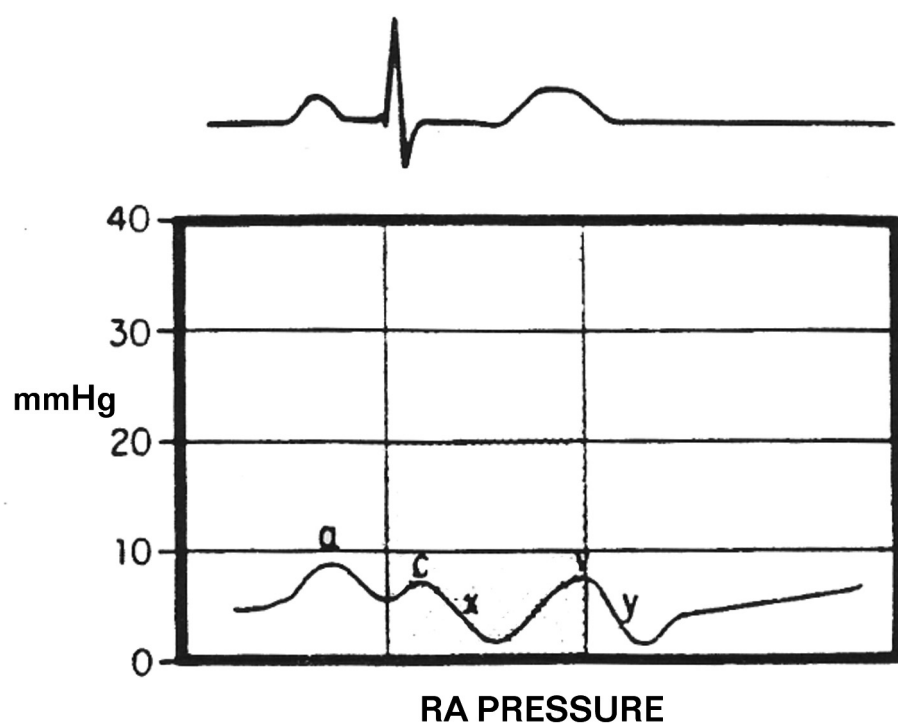


Figure 1. Typical right atrial pressures: a-wave = 2.5- 7.0 mmHg; v-wave = 2.0- 7.5 mmHg; Mean pressure = 2.0- 5.0 mmHg

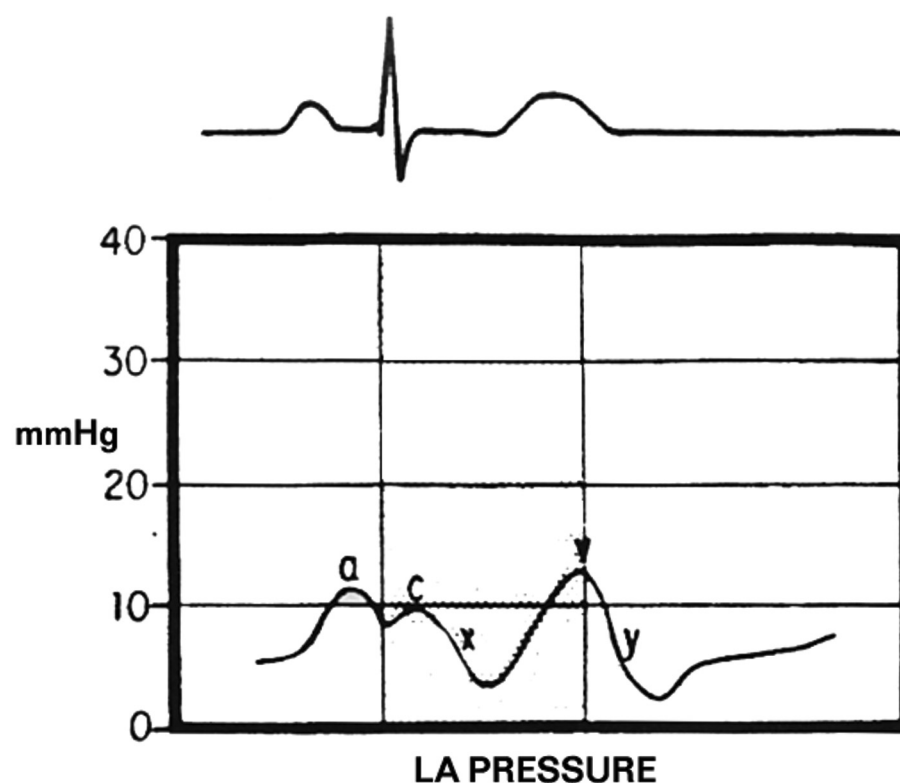


Figure 2. Typical left atrial pressures: a-wave = 4.0- 16 mmHg; v-wave = 6.0-21 mmHg; Mean pressure = 2.0-12 mmHg

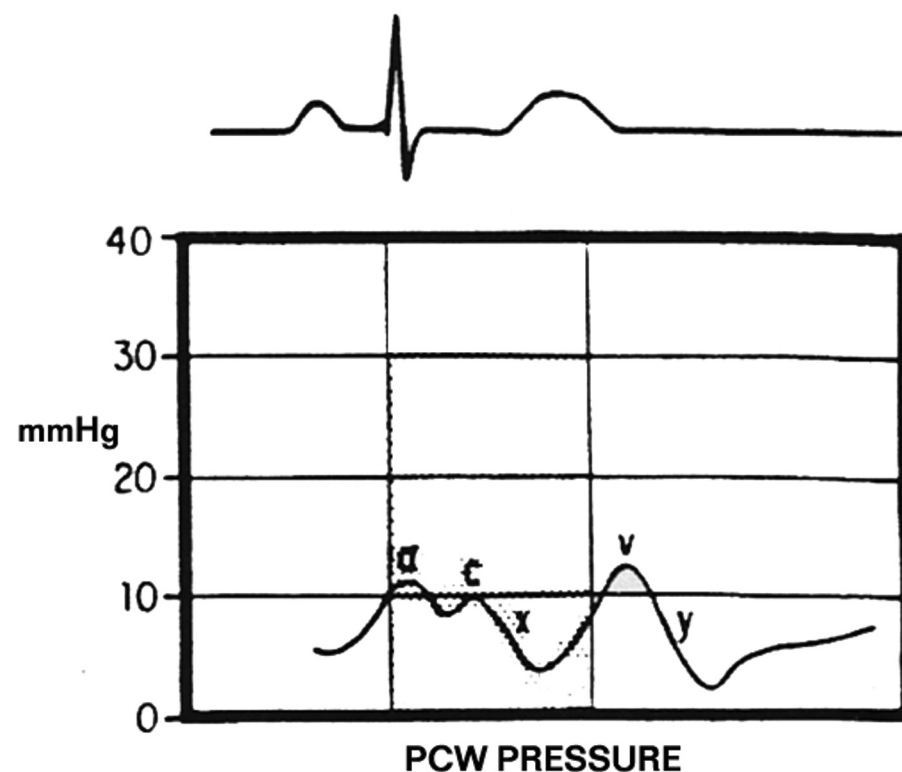


Figure 3. Typical PCW pressures: a-wave = 3.0- 15 mmHg; v-wave = 3.0- 12 mmHg; Mean PCW= 4.5- 13 mmHg

relation to the ECG (Figure 3). The time delay is the result of the left arterial pressure waveform having to travel through the pulmonary veins, pulmonary capillaries and pulmonary arteries before arriving at the monitoring catheter, located in a pulmonary artery. The a-wave and the v-wave are the most important aspects of the right heart pressures. Changes in the size of either the a-wave or v-wave can give valuable clues for determining a correct diagnosis.

As previously stated, the a-wave is the pressure obtained during atrial contraction. Increases in the a-wave are caused by pathological conditions

that would directly generate higher pressures within the atrium. Mitral or tricuspid stenosis are good examples of direct increases in pressure when the atrium contracts (Figure 4). Other examples would include any disease states that decrease compliance of the atrial wall. Decreases in atrial wall compliance can be found with pericardial diseases, such as constrictive pericarditis or cardiac tamponade. Regarding any increases in atrial pressures, we must also keep in mind any increases in the volume of blood being returned to the atrium. This increased volume of blood return will increase the pressure within the atrium,

ultimately increasing the a-wave. The best example of an increased volume would be in cases of mitral or tricuspid insufficiencies. Inversely, in cases of atrial fibrillation there would be no atrial contraction and therefore, no a-wave present. The absence or decreased a-wave can also be seen in cases of severe hypovolemia.

The significance of the v-wave is related to any pathological condition that would affect atrial filling during systole against closed atrial-ventricular valves. The size of the v-wave is determined partially by the amount of blood entering the atrium. The most common cause of large v-waves is mitral regurgitation (MR)¹ (Figure 5). Giant v-waves can be seen in cases of acute MR (e.g., ruptured chordae tendineae). V-waves greater than twice the mean pulmonary capillary wedge pressures are suggestive of severe MR.² Other examples that would show an increased v-wave are hypervolemia, atrial septal defects, and atrial fibrillation (all of which are related to increased volume returning to the atrium).

Over the last several years, hemodynamic computer systems have improved tremendously. However, they are not infallible. The systems can mislabel a, x, y and v waves. As professionals we need to review the information given to us by the computer and using our hemodynamic knowledge, make adjustments as necessary or confirm the system findings. During your next right heart catheterization, get back to the basics, test your knowledge and apply it to the patient's condition. You will soon find these routine cases more interesting, and more importantly, you will find that you can be a much more valuable member to your cath lab team. ■

About the author: Bryan Foucha is a 1996 graduate of Louisiana State University Medical Center with a bachelor of science degree from the Department of Cardiopulmonary Science, School of Allied Health Professions. He obtained registry as a respiratory therapist in 1996. Bryan began working in the cardiac catheterization lab right after graduation. With knowledge gained from his allied health degree and acquired cath lab experience, he obtained his registry for invasive cardiology in 1998. Bryan is currently an active member in both the American Association for Respiratory Care (AARC) and the Society of Invasive Cardiovascular Professionals (SICP). He is helping the Advocacy Committee for the SICP with the education and recognition with regards to the advancement of the registered cardiovascular invasive specialist (RCIS) credential.

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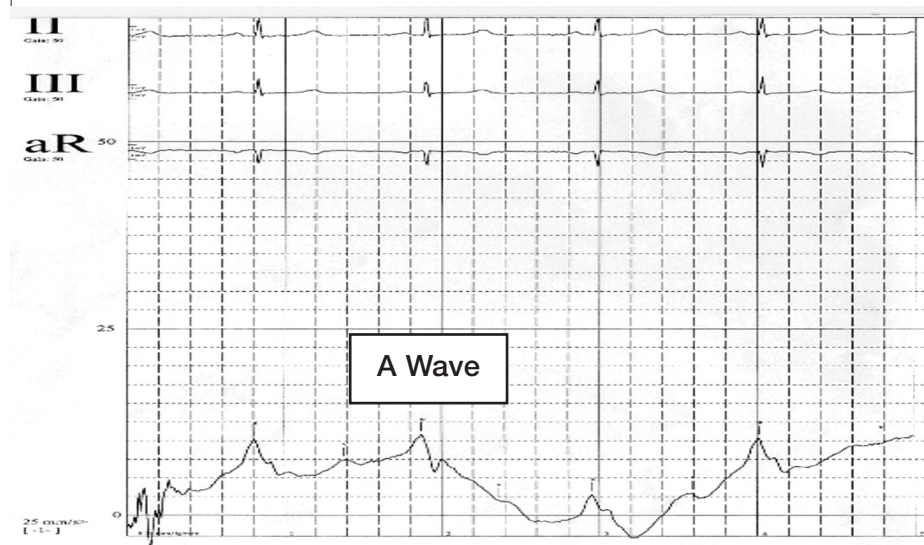


Figure 4. Left atrial (LA) pressure waveform recorded from a patient with mitral stenosis. Large a-waves can be seen directly under the p-wave on the ECG.

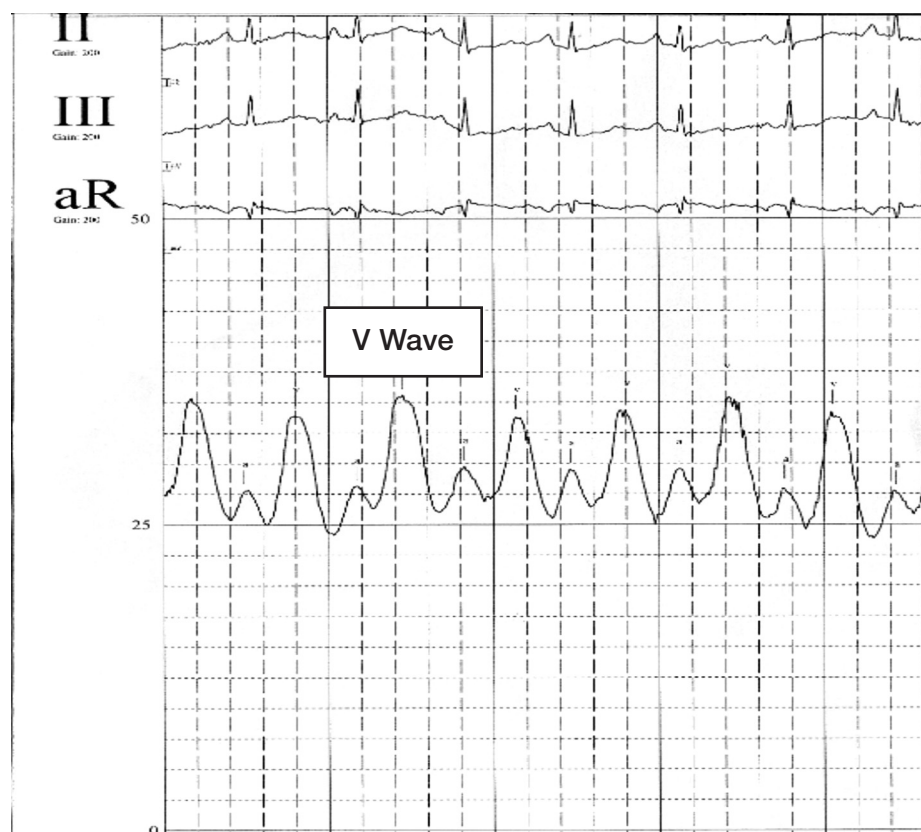


Figure 5. LA pressure recorded from a patient with mitral regurgitation. Note: The a-waves and the v-waves are both significantly increased; however, the v-waves are predominant.