The Pulmonary Artery Catheter: To Use or Not to Use?

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Ever wonder why a pulmonary artery catheter is also called a Swan?

In the late 1960s, Dr. Jeremy Swan was inspired by the movement of sailboats to develop the balloon tip we use today. Dr. William Ganz’s thermodilution method of measuring cardiac output was incorporated into the instrument—hence its other nickname, the Swan-Ganz catheter. But pulmonary artery catheterization had been accomplished in research labs for more than a century before this invention.

In fact, several Nobel Prizes have been awarded for methods of right- and left-heart catheterization. Before winning the Nobel Prize in 1956, an enterprising German surgical resident was fired for inserting a urologic catheter through a cut-down in his own forearm to his right atrium using a mirror and fluoroscopy.

The pulmonary artery (PA) catheter is introduced through a large vein into the right atrium and passes through the right ventricle; the tip resides in the pulmonary artery. Saline-filled pressurized ports in the catheter open into the right atrium and the pulmonary artery; an extra port is usually available and its function depends on the type of catheter. Each anatomic site generates its own waveform (Figure 1). Interpretation of these waveforms leads to hypotheses about the patient’s hemodynamic status, and fluid and pharmacologic therapies may be initiated based on these hypotheses (Table 1).

The use of pulmonary artery catheters is controversial. Some evidence suggests that their use increases costs without improving mortality in ICU patients (including those with acute coronary syndromes) or high-risk surgical patients. The benefit of PA catheters in septic shock is also unclear. There are many possible explanations for these findings, including incorrect interpretation of hemodynamic information. Using a questionnaire of hemodynamic data derived from PA catheters, one study found poor interpretation skills among physicians of all levels of training and experience (JAMA. 1990;264(22):2928-32).

The only unique measurement obtained from the PA catheter is the pulmonary capillary wedge pressure. The wedge is used to determine intravascular volume status and cardiac function. However, using the wedge pressure as a surrogate measurement of left ventricular end-diastolic volume entails assumptions that can potentially lead to errors (Table 2). The wedge tracing is assumed to reflect the pressure waveforms and filling pressure of the left ventricle at end-diastole. The left ventricular end-diastolic pressure (LVEDP) represents the LV end-diastolic volume, which represents preload, or the amount of stretch placed on the heart muscle prior to contraction. Anything that disrupts the compliance or function of any anatomic structure between the distal PA catheter port and the left ventricle can create artificial measurements or abnormal waveforms, leading to inaccurate interpretation and treatment (Figure 2).

Other measurements provided by the PA catheter can be obtained through less invasive means. Electrical bioimpedance...