Cardiovascular Physiology Concepts

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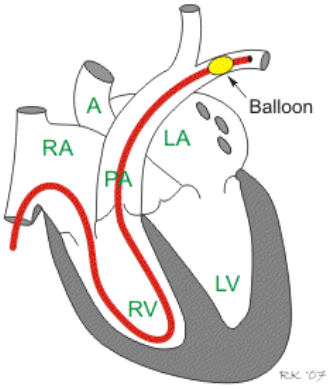
Pulmonary Capillary Wedge Pressure

What does it measure?

Pulmonary capillary wedge pressure (PCWP) provides an indirect estimate of left atrial pressure (LAP). Although left ventricular pressure can be directly measured by placing a catheter into the left ventricle by feeding it through a peripheral artery, into the aorta, and then into the ventricle, it is not feasible to advance this catheter back into the left atrium. LAP can be measured by placing a special catheter into the right atrium then punching through the interatrial septum; however, for obvious reasons, this is not usually performed because of damage to the septum and potential harm to the patient.

How is it measured?

PCWP is measured by inserting balloon-tipped, multi-lumen catheter (**Swan-Ganz catheter**) into a peripheral vein, then advancing the catheter into the right atrium, right ventricle, pulmonary artery, and then into a branch of the pulmonary artery. Just behind the tip of the catheter is a small balloon that can be inflated with air (~1 cc). The catheter has one opening (port) at the tip (distal to the balloon) and a second port several centimeters proximal to the balloon. These ports are connected to pressure transducers. When properly positioned in a branch of the pulmonary artery, the distal port measures pulmonary artery pressure (~ 25/10 mmHg) and the proximal port measures right atrial pressure (~ 0-3 mmHg). The balloon is then inflated, which occludes the branch of the pulmonary artery. When this occurs, the pressure in the distal port rapidly falls, and after several seconds, reaches a stable lower value that is very similar to left atrial pressure (normally about 8-10 mmHg). The balloon is then deflated. The same catheter can be used to measure cardiac output by the thermodilution technique.



Balloon-tipped, Swan-Ganz catheter for measuring pulmonary capillary wedge pressure (PCWP).

The pressure recorded during balloon inflation is similar to left atrial pressure because the occluded vessel, along with its distal branches that eventually form the pulmonary veins, acts as a long catheter that measures the blood pressures within the pulmonary veins and left atrium.

Why is it measured?

It is important to measure PCWP to diagnose the severity of left ventricular failure and to quantify the degree of mitral valve stenosis. Both of these conditions elevate LAP and therefore PCWP. These pressures are normally 8-10 mmHg. Aortic valve stenosis and regurgitation, and mitral regurgitation also elevate LAP. When these pressures are above 20 mmHg, pulmonary edema are likely to be present, which is a life-threatening condition. Note that LAP is the outflow or venous pressure for the pulmonary circulation and increases in LAP are transmitted almost fully back to the pulmonary capillaries thereby increasing their filtration. By measuring PCWP, the physician can titrate the dose of diuretic drugs and other drugs that are used to reduce pulmonary venous venous and capillary pressure, and thereby reduce the pulmonary edema. Therefore, measurement of PCWP can help guide therapeutic efficacy.

PCWP is also necessary to measure when evaluating pulmonary hypertension. Pulmonary hypertension is often caused by an increase in pulmonary vascular resistance. To calculate this,

pulmonary blood flow (usually measured by the thermodilution technique), pulmonary artery pressure and pulmonary venous pressure (PCWP) measurements are required. Pulmonary hypertension can also result from increases in pulmonary venous pressure and pulmonary blood volume secondary to left ventricular failure or mitral or aortic valve disease.

PCWP is also useful in evaluating blood volume status when fluids are administered during hypotensive shock. One practice is to administer fluids at a rate that maintains PCWP between 12-14 mmHg.

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