

## Commentary

# Pulmonary artery catheters in acute heart failure: end of an era?

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See related research by Ritter *et al.*, <http://ccforum.com/content/13/4/R133>

## Abstract

Whereas the pulmonary artery catheter (PAC) is still widely used in guiding assessment and treatment of heart failure, controversy surrounding its safety and efficacy has prompted development of newer, less invasive techniques. For these purposes, the transpulmonary thermodilution technique allows assessment of preload, cardiac output, filling volumes, and metrics of contractility without the need to pass a catheter through the right heart. In a previous issue of *Critical Care*, Ritter and colleagues compare metrics of transpulmonary thermodilution with the PAC in patients with acute heart failure and severe sepsis. The results add to a growing body of evidence that the PAC adds little to information attainable by less invasive methods in many conditions, including acute heart failure. Whether newer devices improve outcome needs to be tested in well-controlled prospective trials.

In a previous issue of *Critical Care* a comparison was made between metrics of transpulmonary thermodilution (TPT) and the pulmonary artery catheter (PAC) in patients with acute heart failure (AHF) and sepsis [1]. The results showed acceptable correlation between metrics derived from the two techniques and showed that TPT allowed identification of heart dysfunction in both heart failure and sepsis. This study, while small and retrospective, adds to mounting evidence that routine use of the PAC is probably no longer warranted in AHF and many other conditions. It appears that a grand chapter in the intensive care medicine story may be coming to an end.

The PAC first came into widespread use after its introduction by Swan and Ganz in 1970 [2]. Their balloon-tipped, flow-directed catheter allowed clinicians for the first time to assess advanced parameters of hemodynamics and gas exchange at the bedside – and it was an overnight success. In fact, the catheter was so enthusiastically adopted that it helped define the modern intensive care unit for the coming decades. But

the device was introduced without clinical trials establishing benefit, and in the ensuing years much debate as regards its safety and efficacy has occurred. Opponents of the device state that it has never been shown to improve major clinical outcomes [3-10], and in fact might increase mortality and morbidity [3,11]. Both the left ventricular stroke work index (LVSWI) and cardiac power (CP), however, have been found to be excellent prognosticators in cardiac surgery and AHF [12], and many feel that the pulmonary artery occlusion pressure may provide useful information on the function of the left ventricle. As such, the PAC device is still recommended in patients with heart failure [13].

Since the introduction of the PAC, newer technologies have emerged that allow less invasive assessment of cardiac function. One such device, the PiCCO™ (Pulsion Medical Systems, Munich, Germany), uses the TPT method to assess preload, cardiac output, filling volumes, extravascular lung water and parameters of cardiac function. The technique requires only central venous access and an arterial line, and therefore may be safer than the PAC. But many TPT metrics remain relatively untested with regards to gold standard techniques in the assessment and treatment of heart failure.

The study by Ritter and colleagues retrospectively compared metrics of cardiac function in patients with sepsis and AHF as determined by the PiCCO™ and by the PAC [1]. They compared the cardiac function index and the global ejection fraction – PiCCO™ metrics – with the LVSWI and the CP calculated from measurements taken by the PAC. Patients with AHF had a lower cardiac index, a lower LVSWI, a lower CP and a higher pulmonary artery occlusion pressure as determined by the PAC. These same patients had a lower cardiac function index and global ejection fraction as determined by the PiCCO™. Reasonable correlation of the

AHF = acute heart failure; CP = cardiac power; LVSWI = left ventricular stroke work index; PAC = pulmonary artery catheter; PiCCO™ = pulse contour cardiac output; TPT = transpulmonary thermodilution.

cardiac function index to the LVSWI and CP was observed. Additionally, the cardiac function index allowed identification of patients with cardiac dysfunction in both heart failure and severe sepsis. The study was small, retrospective and observational, limiting interpretation of the results. The authors, however, used repeated measures over steady-state periods in two very distinct patient populations and showed good correlation in measurements of cardiac function over the treatment course, which helped to compensate for some of these limitations.

Given that there are now reliable less invasive alternatives to the PAC that can accurately determine cardiac output, preload status, fluid responsiveness, and the etiology of shock, the need for routine use of the PAC in sepsis, in acute respiratory distress syndrome, and in most surgical settings has already been called into question [14]. It now appears in light of this present study and others that the PAC is not needed in the assessment of or the treatment of AHF or sepsis-related cardiomyopathy [3,4,7].

But what devices should we be using, and in what diseases? To effectively answer these questions, as the authors themselves have stated, we must now demonstrate efficacy of newer devices such as the PiCCO™ as compared with the PAC in large prospective outcome studies. The studies should be based on current treatment recommendations and/or new algorithmic approaches, since it is not just the device but also how it is used that potentially changes outcome. But should we continue to use the PAC until we have further proof? For the time being there appears to be enough evidence to say that the PAC adds little to information attainable by less invasive measures and should probably no longer be a part of routine management for conditions other than right heart failure, disorders causing abnormalities of pulmonary arterial pressure, and congenital heart disease.

## Competing interests

CRP is a member of the medical advisory board of Pulsion Medical Systems AG (Munich, Germany) and has received honoraria for presenting lectures. CV declares that they have no competing interests.

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