# Swan-Ganz Catheter and Lack of Evidence: Does it Reflect Clinical Practice?

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The physician is faced with a septuagenarian patient with chronic heart failure (HF) of severe ischemic etiology. She progresses with a major hemorrhagic complication after attempted percutaneous revascularization. In spite of volume compensation, she shows signs of respiratory infection, and, notwithstanding adequate antibiotic therapy, she continues to deteriorate clinically with signs of hypoperfusion, albeit with borderline blood pressure levels.

Would indication of invasive hemodynamic monitoring be scientifically associated with reduced clinical outcomes in this case? Acute clinical syndromes imply a greater degree of difficulty for conducting clinical trials, and some approaches applied in practice have not yet been tested in the ideal Cartesian model. The case described above seems to be a good justification for this discussion.

The first group to publish a prospective study on the effectiveness of the Swan-Ganz catheter was SUPPORT, where 10% of the population had congestive HF, showing an increase in mortality associated with the use of the catheter.[1] Subsequently, in 2005, the ESCAPE study[2] was published, analyzing 433 symptomatic patients with HF and ejection fraction (EF) < 30%, without criteria for cardiogenic shock (CS), showing no reduction in mortality; however, in the outcomes there was a benefit in relation to improved symptoms and functional capacity. In an analysis of the use of pulmonary artery catheterization (PAC) in HF with reduced and preserved EF, a decline was observed in use between 2005 and 2010, with a subsequent increase between 2010 and 2014 and a concomitant decline in mortality throughout the period, which is possibly associated with improvement in HF therapy.[3] The decline in use was also observed by Hernandez et al.,[4] who retrospectively analyzed 9,431,944 hospital admissions due to HF or CS, finding that the use of PAC in HF was associated with greater mortality, whereas patients with CS showed an association with lower mortality (34.9% versus 37%; odds ratio 0.91, confidence interval 0.87 to 0.97; p = 0.001) and cardiorespiratory arrest (14.9% versus 18.3%; odds ratio 0.77; confidence interval 0.74 to 0.81; p < 0.001). These outcomes continued even after propensity score matching.

The complexity of some patients with HF, whether due to the wide range of comorbidities and aggravating factors or even advanced heart disease, can confound the evaluation of clinical status. In corroboration with this, a prospective analysis of 97 patients with decompensated HF compared the accuracy of physical examination with invasive hemodynamic assessment, classified using Lee Stevenson's clinical-hemodynamic profiles, with subsequent reclassification by means of PAC.[5] There was an extremely low rate of clinical identification for the cold and wet subgroup, as well as volume status and cardiac output, even among experienced cardiologists, and the Swan-Ganz catheter altered decision making in the majority of cases. Taking into consideration these challenges as well as the fact that congestion in HF is associated with mortality,[6] PAC monitoring provides information that contributes to more accurate volume optimization and pharmacological action. In line with this, an analysis of data from the ESCAPE study evaluated the 141 patients with the primary objective of observing the association of PAC use with days to death, heart transplantation, and cardiac hospitalization at 6 months. They found that pulmonary artery occlusion pressure (PAOP) was associated with an increase in the recommended outcomes (hazard ratio 2.03; 95% confidence interval 1.31 to 3.15; p < 0.01), whereas cardiac index did not have the same association.[7]

The classification of CS proposed by the Society for Cardiovascular Angiography and Interventions,[8] based on stages, introduces the notion of risk of HF progression to tissue hypoperfusion and instability. Following this logic, PAC monitoring assists in the categorization of phenotypes, leading to more accurate assessment, given that the tenuous transition from acute HF to CS may not be clinically perceptible, especially in cases of isolated right ventricular dysfunction or shock with normal blood pressure levels.[9,10] Furthermore, parameters for the assessment of right ventricular dysfunction, such as the ratio between right atrial pressure and PAOP (RAP/PAOP > 0.8), the pulmonary artery pulsatility index (PAPi < 1.0), and the right ventricular stroke work index (RVSWI < 600 mmHg × mL/m$^2$) are essential for diagnosis and prognosis in these patients.[11]

Regarding the use of PAC in HF, the recommendations provided by the American College of Cardiology Foundation/American Heart Association,[12] the European Society of Cardiology,[13] and the Brazilian Society of

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Cardiology[14] are restricted to patients who are being considered for mechanical circulatory support or heart transplantation, especially for evaluation of the reversibility of pulmonary hypertension. In these cases, assessment of the fixed component of pulmonary hypertension assists in planning advanced therapies and post-transplantation prognosis.[15]

The available evidence favors the use of Swan-Ganz catheter in CS; however, the evidence does not favor its routine use in decompensated HF, and the specialist's experience plays a fundamental role. In spite of the unfavorable mortality outcomes, it is worth remembering that PAC is a diagnostic tool and not a therapeutic measure, and its effectiveness will depend on the clinical decisions made by the professionals involved.

Returning to the initial case, PAC monitoring was performed in the septuagenarian patient, providing evidence of a hemodynamic profile compatible with CS. The application of an inotrope was justified, and it led to clinical improvement in fewer than 24 hours, leading to discharge from the intensive care unit in 3 days.

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