

## Pulmonary artery catheter – Dilemma is still on?

Pulmonary artery catheterization technique evolved and developed over the period since its invention by Swan and Ganz in 1970's. Its uses were widely described in literature. However, there are many controversies regarding usefulness of it because invasiveness related to its technique.

Pulmonary artery catheters (PACs) have been used in clinical practice to monitor the hemodynamic status of critically ill patients. This technology was introduced and commercialized without considerable testing to determine safety and efficacy. After years of common clinical use, investigators identified potential increase in mortality associated with PAC use. For the past decade, investigators have studied various patient populations to elucidate the safety and efficacy of the PAC. Frazier SK, *et al.* reviewed the historical context of PAC use, findings from recent clinical trials intended to determine safety and efficacy, issues with reliability and validity of PAC use, and complications associated with PAC use.<sup>[1]</sup> Navas-Blanco Jose *et al.*<sup>[2]</sup> said that complications associated to its use, the lack of consistency of the interpretation provided by the PAC among clinicians, the development of new hemodynamic methods and the deleterious cost profile associated to the PAC comprise some of the reasons behind the decrease in its use. However, information that we get from PA catheter would allow better understanding of the individual's hemodynamic profile which would trigger therapeutic interventions that should improve patient outcomes. Szabo C, *et al.*<sup>[3]</sup> agree that the use of PAC and the occurrence of positive clinical outcomes have a linear relationship with the appropriateness of the clinical use and the expertise of the clinician interpreting the data. Lately De Backer *et al.*<sup>[4]</sup> said it provides information on the adequacy of cardiac output by measurements of mixed-venous oxygen saturation (SvO<sub>2</sub>) and on left heart function through pulmonary artery occlusion pressure and right heart function with the measurement of pulmonary arterial pressure (PAP), right ventricular ejection fraction, and central venous pressure (CVP). Though many parameters and dynamicity of fluid mechanics get by floating PA catheter it causes various arrhythmias which at times are life threatening especially in critically ill coronary artery disease patients. Chances of complete heart block are more in patients with dual heart block which may

necessitate temporary pacing. Though its use peaked in the 1980s, many published studies suggestive of potential harm which resulted in a steady decrease in its use.

Canadian randomized controlled trial conducted by Sandham JD, *et al.* in 2003 on high-risk surgical patients to guide therapy with pulmonary artery catheter with standard care without use of pulmonary artery catheter. They found no benefit to therapy directed by pulmonary-artery catheter over standard care in elderly, high-risk surgical patients requiring intensive care.<sup>[5]</sup> Navas-Blanco Jose *et al.*<sup>[2]</sup> also mentioned of chances of damage to internal structures during its placement when it travels through RA, RV, PA. But these complications can be minimized by careful procedural handling of catheter under experienced personnel supervision. Advantages of PAC over other hemodynamic methods viz: (a) superior measurements of cardiac output when compared to pulse wave contour analysis (on which accuracy relies on frequent re-calibration), esophageal doppler, and bioimpedance,<sup>[6-8]</sup> (b) reliable measurements of venous saturation of oxygen (SvO<sub>2</sub>) [more accurate calculation of Fick when compared to central venous oxygen saturation (ScVO<sub>2</sub>)], and veno-arterial difference in carbon dioxide pressures (PvaCO<sub>2</sub>), when compared to central venous catheter measurements.<sup>[6,9]</sup> Even during off pump coronary artery bypass grafting surgery, monitoring of Pulmonary artery systolic and diastolic pressure plays a crucial role in decision making regarding choice of intervention whether mechanical or pharmacological. However, management of PA catheter in the postoperative period becomes technically difficult once patient is extubated. We have experienced spillage of drug infusions outside sheath due to patients' movements which necessitates closed attention in postoperative period.

The coiling of PA catheter intracardiac or extracardiac have also been reported. In our experience knotting of PA catheter in right atrium could not be retrieved through pulmonary artery sheath hence it required retrieval in cath lab under fluoroscopy through femoral vein approach. However, sometimes if it is not feasible to retrieve by any other manipulation then needs surgical assistance to retrieve.

Though various methods and techniques have come in recent few years; a Clinician and perioperative Physician and Intensivist always has to take a decision regarding the gadget or equipment to use as per patient's need and clinical surroundings. However, we will say that Pulmonary Artery Catheter is and will have its own place in critical care scenarios in spite of its pitfalls. With proper care of PA catheter will avoid all known complications related to it.

The practice guidelines for Pulmonary Artery Catheterization updated in 2003 does not support routine use of Pulmonary Artery Catheter when there is a low risk for hemodynamic complications. It further reveals that in high-risk situations it is subjective to individual circumstances and local conditions. Hence, all persons who use PA catheters should undergo high quality supervised training to establish competency. Recently, ESCAPE Trial (Evaluation Study Of Congestive heart failure and Pulmonary artery catheter Effectiveness) showed that basing the decision to administer vasodilator and diuretic therapy on PAC data plus clinical judgment was not superior to basing clinical judgment alone. However, later on both ESCAPE and Pac-MAN found PAC to be safe which suggests that previous retrospective reports of excess mortality with this monitoring device were confounded by severity of patient's disease where it's use was applied.

It is without doubt that routine use of the PAC is not recommended in all critically ill or perioperative patients in the presence of other lesser invasive modalities. But certain categories of patients may benefit from PAC use, provided it is inserted by clinicians trained and confident of its utility. Examples of such patients include those severely reduced ejection fraction (<30%) undergoing major cardiac/noncardiac surgery, those in severe cardiogenic shock and those with suspected or known pulmonary hypertension. In this complex set of patients, pulmonary artery pressure trends can be monitored during surgery and into the postoperative period. When inserted, the PAC should be kept only for the minimum required duration of time and removed once the patient condition improves to decrease the risk of complications.

In current practice, several newer minimally invasive modalities based on pulse contour analysis, echocardiography, doppler, and thoracic bioimpedance have been developed which provide similar if not all the parameters provided by

the PAC. More large and well-designed studies are required to validate and establish the goal-directed usage of these newer monitoring modalities before the PAC is relegated to the history museum. It is unlikely that any one present or future monitoring modality will be the one stop solution to all our hemodynamic problems. Thus, the PAC can act as part of a multimodal monitoring regimen to improve patient care.

Hence, we recommend that the use of Pulmonary Artery Catheter has still it's place in critically ill high risk surgical or nonsurgical situations as compared to minimally invasive, noninvasive methods. However, it should be used very cautiously and by skilled competent medical personnel considering its periprocedural known complications for better safety.

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