Echo is the preferred modality for hemodynamic monitoring in the cardiac intensive care unit

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ABSTRACT

The PAC has enabled major advances in understanding cardiac hemodynamics and pathophysiology. However its clinical utility is limited by data interpretation and serious complications. Echocardiography provides a useful alternative for hemodynamic assessment as well as identification of important concomitant findings. The combination of echocardiography with insertion of a central venous pressure catheter may be the optimal combination for hemodynamic monitoring.

Keywords: Hemodynamics; Pulmonary Artery Catheter; Echocardiography

1. INTRODUCTION

The pulmonary artery catheter (PAC) was developed to measure pressures, blood flow and oxygen saturation in the right heart. Although it is an important diagnostic tool in a wide variety of respiratory and circulatory conditions, it has serious limitations and its clinical utility remains unproven.

The feasibility of PAC use was first shown by Dr. Warner Forssman in 1929, when he threaded a catheter into his own heart [1], for which he shared the 1956 Nobel Prize along with Drs. Richards and Courmand. Bedside use was facilitated by the addition of a flow directed balloon to the catheter by Dr. Swan, and a thermistor tip by Dr. Ganz which enabled measurement of cardiac output [2]. Many classical studies were enabled by the use of the PAC such as the Forrester classification of acute heart failure to improve assessment of the risk of mortality in myocardial infarction [3,4], as well as the identification of complications of myocardial infarction such as acute mitral incompetence and ventricular septal rupture. The utility of pharmacological interventions as in the effect of furosemide [5] and nesiritide in pulmonary edema [6] as well as the efficacy of nitroprusside in acute mitral regurgitation [7] were enabled by the PAC.

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may be life threatening. The indwelling catheter may become infected and cause sepsis or endocarditis. The catheter can obstruct a pulmonary artery and cause a pulmonary infarction [8].

4. EVIDENCE-BASED MEDICINE AND THE PAC

It is thus not surprising that large randomized trials have not shown a clinical benefit with use of the PAC. The Canadian Critical Care group randomized 1994 high risk surgical patients to use of PACs, and there was no difference in mortality realized between the two groups [9]. In a French study 686 patients with adult respiratory distress syndrome or shock were randomized to use or non-use of PACs and there was no reduction in mortality, length of hospital stay and freedom from organ failure between the groups [10]. The PAC has not been useful in other critically ill patients. The English Pac-Man trial randomized 1014 patients with multi organ failure to use or non-use of PACs with no difference demonstrated in mortality or length of hospital stay [11]. In the FACTT trial 1000 patients with ARDS were randomized to use of PACs. Fluid resuscitation was dictated by protocol. There were more complications with PACs without any survival benefit [12]. In the ESCAPE trial 415 patients with severe heart failure were randomized to use of PACs. Fluid resuscitation was randomized to use of PACs. There were more complications with PACs without any survival benefit [12]. In the ESCAPE trial 415 patients with severe heart failure were randomized to use of PACs-guided treatment. There was no difference in survival or length of hospitalization with PACs. The PACs were associated with 21% adverse event and 12% infection rate [13]. Use of PACS has not been proven to improve any patient subset (Table 1).

5. ECHOCARDIOGRAPHY—THE ALTERNATIVE FOR HEMODYNAMIC MEASUREMENTS

Fortunately, a better alternative to PAC use is readily available. Echocardiography can provide the hemodynamic measurements non-invasively. Right sided pressures may be estimated by use of inferior vena cava size, tricuspid valve and pulmonic valve gradients. The aortic flow integral approximates the cardiac output [14]. The LVEDP may be assessed via tissue Doppler measurement of the E/E’ ratio [15] or by measurement of the velocity of the jet of aortic or pulmonary regurgitation. Critical concomitant findings may be noted during hemodynamic assessment including cardiac tamponade, pulmonary embolism or valvular pathology [16].

In conclusion, the PAC has enabled major advances in understanding cardiac hemodynamics and pathophysiology. However its clinical utility is limited by data interpretation and serious complications. Echocardiography provides a useful and safe alternative for hemodynamic assessment which can also identify important concomitant findings. The addition of a central venous catheter will increase the accuracy of the echocardiographic study while avoiding many of the complications of PACs.

REFERENCES


