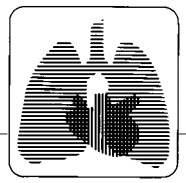

special reports

Pulmonary Artery Catheter*

Does the Problem Lie in the Users?

Pierre Squara, MD; David Bennett, MD; and Claude Perret, MD

The aims of this study were to look for the variability in the treatment of circulatory shock and to assess the extent to which this variability was reduced by pulmonary artery catheterization (PAC). At three international conferences in 1997–1998 (European Society of Critical Care Medicine, French Language Society for Critical Care [Société de Réanimation de Langue Française], and Society of Critical Care Medicine), a real-life clinical case was discussed in meetings among physicians and a panel of experts, with assistance from an expert computer program. A total of 417 physicians took part in the discussions. Following the clinical presentation, only 38% of physicians suggested the same treatment as the experts, and 35% suggested potentially harmful treatments. Complete hemodynamic data from PAC significantly decreased the range of suggested treatments, improved agreement among physicians themselves as well as the agreement between physicians and experts, and decreased the number of potentially harmful propositions. However, whereas almost 80% of participants finally agreed on the treatment after one to three invasive hemodynamic sets of measurements, at least 10% persisted in suggesting potentially harmful treatments. PAC improved interphysician agreement, but our data suggest that yet greater agreement could be achieved by improving the theoretical training of practitioners. ***(CHEST 2002; 121:2009–2015)***

Key words: hemodynamics; medical intelligence; right-heart catheterization

Abbreviations: ESICM = European Society of Critical Care Medicine; PAC = pulmonary artery catheterization; PEEP = positive end-expiratory pressure; PWP = pulmonary wedge pressure; SCCM = Society of Critical Care Medicine; SRLF = Société de Réanimation de Langue Française; SvO_2 = mixed venous saturation

Although > 3,000 publications in the medical literature focus on pulmonary artery catheterization (PAC) and > 45 million pulmonary artery catheters have been used since 1970, the method remains a matter of controversy.[1,2] There is strong evidence that PAC is helpful in the management of circulatory disorders,[3–5] especially when continuous monitoring is required.[6,7] However, the lack of controlled studies, due to numerous methodologic difficulties,[5,8,9] precludes a confident evaluation of the beneficial impact of PAC on survival. Four studies, all with serious methodologic weaknesses, found that PAC was associated with greater mortality.[10–13] Because of these uncertainties, and as part of a trend calling for evidence-based medicine and cost control, current practices regarding PAC have been challenged.[2,14] Controlled studies are required to resolve this issue. Nevertheless, when analyzing the potential adverse effects of PAC, it is necessary to determine what is due to the tool and what is due to misuse of the tool.[15] Ways to improve PAC use have been periodically reviewed.[16–18] Benefits may be greater when PAC is used by physicians who have the theoretical knowledge needed to interpret PAC data in an optimal manner.[19,20] PAC may have fewer adverse effects in the hands of clinicians who follow guidelines and are proficient in interpreting PAC data.[18,21]

There are many reasons to believe that the reproducibility of diagnoses based on hemodynamic data are poor even among experienced intensivists.[19,20,22]

*From Réanimation polyvalente, Hôpital Victor Dupouy, Argenteuil, France.
Supported by a grant from Baxter–Critical Care Division.
Manuscript received May 8, 2001; revision accepted October 24, 2001.
Correspondence to: Pierre Squara, MD, Réanimation polyvalente, Hôpital Victor Dupouy, 69, rue du lieutenant Colonel Prudhon 95100, Argenteuil, France; e-mail: squarap@worldnet.fr

It follows that physicians may differ regarding the management they feel is optimal in a given patient with or without PAC. We designed a study to look for variability in opinions about the best treatment in a real-life case and to assess the extent to which this variability was reduced by PAC.

Materials and Methods

On three different occasions, we asked physicians attending a conference and experts to discuss a real-life clinical case, and also noted diagnoses and treatment objectives suggested by an expert computer program (Hemodyn; P. Squara; Enghien, France) during the meetings.[22,23] The meetings took place as part of the official program of three international conferences held in 1997–1998: the 10th meeting of the European Society of Critical Care Medicine (ESICM; Paris, France; September 6, 1997), the 26th meeting of the French Language Society for Critical Care (Société de Réanimation de Langue Française [SRLF]; Paris, France; January 26, 1998), and the 27th meeting of the Society of Critical Care Medicine (SCCM; San Antonio, TX; February 6, 1998). Physicians attending these conferences were invited to register for the meetings, and during the meetings an interactive voting system was used to capture all participant answers in a computer.

After a 10-min introduction, including a brief presentation of the experts (listed in the Appendix) and of the expert Hemodyn software, participants were familiarized with the interactive voting system using three questions with a limited list of responses displayed on a screen: (1) what is your homeland (one answer allowed), (2) what is your main medical specialty (one answer allowed), and (3) what is/are, in your opinion, the most important PAC parameter(s) [one or more answers allowed]? The results of the voting were displayed immediately. A real-life case was then presented. This case was the same at the three meetings and was retrospectively considered of low complexity by the experts. It was a typical history of acute hypertensive pulmonary edema in a patient with normovolemic hypertensive cardiomyopathy in whom excessively aggressive emergency treatment induced critical hypovolemia and venous vasodilatation.

The case presentation was displayed on a screen using a video projector, and the computer captured all radio signal-transmitted answers. Participants were asked to vote after the presentation of clinical data (Table 1), and after the subsequent presentation of PAC data recorded 2 h, 14 h, and 27 h after hospital admission of the patient (PAC time points 1, 2, and 3, respectively; Table 2). Thus, votes were recorded on four occasions. On each of these occasions, participants were asked to choose one or more treatments among nine possibilities. The treatment actually administered and the clinical course between the two PAC time points were described (Table 3); based on this information, the participants were asked to suggest treatment changes. After each vote, the opinions of experts were displayed. The objectives and diagnoses generated by Hemodyn program were then displayed and freely discussed by the experts and participants. Finally, the experts were asked to classify the treatments suggested by the participants as "acceptable" or "potentially harmful."

Data Analysis

Although the κ concordance test allows standardization of agreement between two judges, no statistical tool is available for standardizing agreement between two groups of judges. Consequently, we expressed between-group agreement as the ratio of the number of concordant votes over the total number of votes. The variability in suggested treatments was expressed as the proportion of participants who selected each answer. Categories (participants, characteristics, and suggested treatments) were compared using the χ^2 test. We used Bonferonni's correction to compensate multiple comparisons.

Table 1—*Summary of the Clinical Presentation

Medical history
Age of 70 yr
Chronic arterial hypertension with hypertensive cardiomyopathy
Several episodes of acute pulmonary edema
Sudden major nocturnal dyspnea
First medical examination (at home)
Acute pulmonary edema; Spo_2 of 75%
No peripheral edema; no fever
BP, 190/120 mm Hg
Initial treatment (at home)
Sedation, intubation, and mechanical ventilation
IV bolus of 40 mg furosemide
IV bolus of 1 mg nitrate followed by a continuous IV infusion of 1 mg/h
10 μg/kg/min of dobutamine
Admission to the emergency department
Clinical signs of shock; oliguria
BP, 90/60 mm Hg; heart rate, 120 beats/min; nitrate infusion stopped
Chest radiograph showing bilateral infiltrates
Pao_2, 83 mm Hg; Sao_2, 96% with Fio_2 of 1; lactate, 3.4 mEq/L
Electrocardiography showing sinus tachycardia; otherwise normal
Echocardiography showing LV hyperkinesia and hypertrophy; no dilatation; RV normal

*Spo_2 = pulse oximetric saturation; Sao_2 = arterial oxygen saturation; Fio_2 = fraction of inspired oxygen; LV = left ventricular; RV = right ventricle.

Results

A total of 560 physicians attended the meetings: 248 physicians at the ESICM meeting, 62 physicians at the SRLF meeting, and 250 physicians at the SCCM meeting. The small number of physicians at the SRLF meeting was due to a technical problem that delayed the meeting by 1 h. Of these 560 physicians, 417 physicians participated in the voting: 167 physicians at the ESICM meeting, 58 physicians at the SRLF meeting, and 192 physicians at the SCCM meeting. These 417 participants were from 29 countries, most of which were in Western Europe (n = 199), North America (n = 132), Eastern Europe (n = 20), Northern Europe (n = 18), Japan (n = 17), and South America (n = 14). Their areas of interest were distributed as follows: critical care (n = 220), anesthesiology (n = 91), pulmonology (n = 38), cardiology (n = 27), emergency medicine (n = 21), pediatrics (n = 7), and others (n = 13).

Cardiac output was believed by the vast majority