moglobin saturation) and its relationship to oxygen demand. For example, a high cardiac output, 8 L/min, will have less DO₂ than a low cardiac output, 4 L/min, when the hemoglobin concentrations are 8 and 15 g/dL and the SaO₂ values are 90 percent and 100 percent, respectively. But how much DO₂ is necessary? Does it depend on VO₂? Does it depend on need? Is gastric tonometry an answer? Perhaps by explicitly recording oxygen delivery instead of cardiac output, there would be a more proper emphasis on this more important variable.

Previous studies have shown that physicians are poor predictors of central hemodynamics. However, does therapy based on central hemodynamics rather than on clinical status improve outcome? If based on central hemodynamics, what therapy should be used? Studies have shown that therapy aimed to achieve supranormal values improves outcome.

Rather than doing studies to show that pulmonary artery catheterization affects therapy, randomized studies, such as Guyatt et al are doing, comparing pulmonary artery catheterization with clinical judgment, different therapies, or different therapeutic goals should be conducted to see whether they affect outcome.

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To the Editor:

We have reviewed the comments by Dr Engoren and share his thoughts regarding the need for prospective studies to compare different therapeutic goals. As to his remarks concerning suboptimal performance classification and associated lowest mortality observed in groups 1 and 2, the review panel of critical care physicians concluded that these cases did not follow any logical management pattern that fit with the initial pathophysiologic measurements obtained. This may imply that pulmonary artery catheterization (PAC) information was ignored or distrusted, both of which are not necessarily unusual in patients with complicated conditions. Furthermore, this analysis was never intended to be an outcome study in a population whose mortality rates are high; we attempted only to determine how PAC data are interpreted and how information is used. The selected case-mix variables were chosen to eliminate other factors that may have affected the performance grade.

Undoubtedly, PAC has clearly provided insight into the metabolic and hemodynamic disturbances of septic shock. Measurements of cardiac output, blood oxygen consumption, and lactate do play a role in managing sepsis syndrome. Furthermore, measurement of PAWP may help to differentiate between hydrostatic and pulmonary edema of the lung and thus facilitate fluid management. It remains less clear, however, whether PAC should be performed in every patient with sepsis syndrome. The impact of invasive monitoring and its measurements of physiologic variables in sepsis syndrome are not well defined and perhaps only favorably affects survival if infection is eradicated. The prognostic significance of hemodynamic and metabolic disturbances in sepsis remains controversial. Which parameter should be monitored and treated in order to improve outcome? The prognostic value of changes in oxygen uptake and the response to oxygen delivery remains unclear in different clinical situations. Although several studies suggest that oxygen uptake is higher in survivors than in nonsurvivors, other studies do not support this view.

We agree with Dr Engoren that catheterization is unlikely to influence prognosis until more effective therapy is available. A strict treatment protocol based on standardization of physician skills and hemodynamically derived data accumulation is critical in any study to assist in defining efficacy of technique. The question of how capable certain physicians are in planning therapy without catheterization remains to be answered. Are there some who can do it as well without invasive monitoring? Certainly, there are subgroups of patients in whom PAC reveals otherwise unobtainable information. Further work is needed in large samples of patients with emphasis on outcome of clinical importance. An additional study to distinguish those patients whose hemodynamic status can be reliably predicted noninvasively from those whose hemodynamic status is unpredictable is warranted, the latter patients being more likely to benefit from invasive hemodynamic monitoring.

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