

Commentary

Perioperative optimization and right heart catheterization: what technique in which patient?

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Abstract

Recent years have seen the place of the pulmonary artery catheter in intensive care increasingly challenged, with one recent study reporting no difference in outcome in patients treated with or without a pulmonary artery catheter. However, this study has several methodological flaws and, although pulmonary artery catheterization should not be performed routinely on all patients, when used correctly by trained personnel in selected patients the pulmonary artery catheter continues to provide valuable information.

Keywords methodology, outcome, pulmonary artery catheter, SvO_2

More than 20 years ago, Shoemaker and coworkers [1,2] observed that perioperative alterations in oxygen transport were closely related to the development of organ failure and death. Subsequently, several studies reported that perioperative hemodynamic optimization guided by the pulmonary artery catheter may decrease morbidity and mortality [3–6]. Nevertheless, the use of the pulmonary artery catheter has been challenged because of its invasiveness and possibly the unwarranted interventions that may result from its use [7].

In a recent issue of the *New England Journal of Medicine*, Sandham and coworkers [8] reported the results of a multicenter Canadian study that investigated the effects of right heart catheterization on perioperative complications in high-risk patients undergoing noncardiac surgery. From 1990 to 1999, those authors randomly allocated 1994 American Society of Anesthesiologists class III and IV patients to conventional monitoring and therapy or to right heart catheterization and hemodynamic optimization. They observed that survival (up to 1 year of follow up) and hospital stay did not differ between the two groups. The incidence of perioperative complications was similar in both groups,

except for an increased incidence of pulmonary embolism in the pulmonary artery catheter group.

Although Sandham and coworkers [8] must be commended for their important undertaking, the study raises a number of important concerns. First, although the authors claimed that no patient selection was performed, the inclusion rate of a mean of only 22 patients/center per year was surprisingly low. For example, close to 1000 patients with American Society of Anesthesiologists class III and IV are operated on each year in our 760-bed institution. One of the inclusion criteria was the commitment of the surgeon and the anesthesiologist to adhere to the study concept; the most severely ill patients might therefore have been excluded, and this may explain the unexpectedly low mortality rate among the patients studied (a 15% mortality rate was included in the power calculation of the study).

Second, although the authors claimed that preoperative optimization was performed, in the vast majority of patients the goals were achieved only postoperatively (Fig. 2 of the paper, which reported the maximal value for the corresponding period) [8]. Only in a very limited number of

SvO_2 = mixed venous oxygen saturation.

patients were the resuscitation goals achieved in the preoperative and intraoperative periods. Unfortunately, the time from catheter insertion to initiation of surgery was not mentioned. Also, there was no indication as to when these values were achieved and for how long. Indeed, the time allocated to achieve optimization is crucial, because insertion of a catheter just before the beginning of surgery does not allow sufficient time to achieve hemodynamic optimization, and the catheter will then only be used to observe hemodynamic alterations. The low rate of attainment of hemodynamic goals contrasts with previous studies reporting beneficial effects of perioperative optimization. For example, all of the patients in the study conducted by Wilson and colleagues [5] achieved an oxygen delivery of at least 600 ml/min per m² throughout the study. In addition, the protocol used to achieve the hemodynamic end-points is not well defined. The authors used fluids and vasoactive agents, but the type and doses of these agents were not specified. It is likely that these elements varied from one institution to another.

Third, the incidence of pulmonary embolism may have been different in the two groups but it is surprising to read that no pulmonary embolism was diagnosed in the control group. If a pulmonary embolism had been diagnosed in only two of the 997 patients in the control group (certainly a realistic figure), then the statistical significance would disappear. Of note, the physicians involved in the diagnosis of pulmonary embolism were not blinded to catheter insertion. This may counterbalance the somewhat lower incidence of renal failure in the group of patients receiving the pulmonary artery catheter. One should also note that chance alone can explain one positive *P* value at the 5% confidence level when more than 20 statistical comparisons are performed.

Fourth and most important, the goals were not protocolized and were less than optimal. Why was there a maximal value for cardiac output? Were patients supposed to receive a β -blocking agent when cardiac output exceeded 4.5 l/min per m²? Also, why was such a high level (18 mmHg) of pulmonary artery occlusion pressure taken as an end-point? The analysis of the cardiac function curves could have resulted in a lower pulmonary artery occlusion pressure, and on this basis a lesser risk for pulmonary oedema. Also why was the mixed venous oxygen saturation (SvO₂) not taken as a valuable (and perhaps the best [9,10]) end-point? SvO₂ reflects the balance between oxygen supply and demand, and it is particularly useful when large changes in oxygen demand are expected to occur (e.g. in anesthesia, hypothermia, pain, etc.). The monitoring of SvO₂ may also limit the risk of over-treatment with vasoactive agents, because high doses of inotropic agents may worsen the balance between oxygen supply and demand even though cardiac output increases [10]. Oxygen extraction has already been used in various groups of surgical patients to assess the adequacy of resuscitation at the time of the protocol

design [11–16]. Recently, Rivers and coworkers [17] reported that mortality can be decreased when the central venous oxygen saturation is used to guide therapy in patients with severe sepsis and septic shock.

We believe that this important study highlights again that pulmonary artery catheters should not be inserted routinely in patients with limited risk for death [18] but it does not imply that it should be avoided in patients with a higher perioperative risk for death. Less invasive monitoring techniques, such as esophageal Doppler or lithium or transpulmonary dilution, may be required to optimize stroke volume in patients with limited risk for death [19].

Competing interests

None declared.

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