

Current Use of the Pulmonary Artery Catheter in Cardiac Surgery: A Survey Study

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Objective: Because of its invasive nature, debated effect on patient outcome, and the development of alternative hemodynamic monitoring technologies, the intraoperative use of the pulmonary artery catheter (PAC) has significantly decreased. The authors conducted a survey of the members of the Society of Cardiovascular Anesthesiologists (SCA) to assess current use of the PAC and alternative hemodynamic monitoring technologies in patients undergoing cardiac surgery.

Design: A survey study.

Setting: Hospitals in North America, Europe, Asia, Australia, New Zealand, and South America.

Participants: SCA members in North America, Europe, Asia, Australia, New Zealand, and South America.

Interventions: The survey was e-mailed by the SCA to roughly 6,000 of its members.

Measurements and Main Results: The survey was left open for 30 days. Respondents accessed the survey via a secured web-based database. A total of 854 questionnaires were completed. A total of 705 (82.6%) were from North American members. Four hundred twelve of the respondents (48.1%) worked in a private practice setting, while 350 (40.9%) were from an academic practice. A majority of the respondents (57.9%) were from hospitals that performed more than 400 cardiac surgeries a year, a subset of which

(29.6%) did more than 800 cases annually. For cases using cardiopulmonary bypass, 583 (68.2%) of the respondents used a PAC more than 75% of the time, while 30 (3.5%) did not use the PAC at all.

Ninety-four percent of respondents used transesophageal echocardiography (TEE) as part of the intraoperative monitoring. When not using a PAC, FloTrac/Vigileo was the alternative cardiac monitoring modality in 15.2% of the responses. Similar trends in monitor preferences were seen in off-pump coronary artery bypass grafting and minimally invasive/robotic heart surgery.

Conclusions: The results of this study suggested that a majority of the respondents still prefer to use the PAC for most cardiac surgeries. Subgroup analysis of the data revealed that geographical location, type of practice, and surgeon support played a significant role in the decision to use a PAC. Although most respondents prefer to use TEE as a complimentary tool, TEE also remains the most popular supplemental/alternative hemodynamic monitoring technology.

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KEY WORDS: pulmonary artery catheter, cardiac surgery, hemodynamic monitoring

COMPREHENSIVE HEMODYNAMIC MONITORING and optimization of cardiac function provide the foundation for critical care and perioperative patient management. Numerous strides have been made to improve hemodynamic monitoring of patients undergoing cardiac surgery. Perhaps the largest came in 1970 when Swan et al¹ first used the pulmonary artery catheter (PAC) at bedside to assess cardiac function. Through subsequent advances in technology and some simple calculations, the PAC now allows routine measurements of central venous pressure, pulmonary artery pressure, continuous cardiac output (in specially designed catheters), systemic vascular resistance, and mixed venous oxygen (SvO₂ with oximetric PAC).² These measurements allowed for better characterization of preload, afterload, contractility, and tissue oxygenation. Although it was first introduced for use in critically ill patients, use of the PAC quickly expanded into the operating room such that hemodynamic monitoring with a PAC has become an integral aspect of the anesthetic management of cardiac surgery patients. It provides invaluable information both intra- and postoperatively in the intensive care unit (ICU). However, because of its invasive nature-associated complications, debated effect on patient outcome and the development and clinical introduction of alternative, less invasive hemodynamic monitoring technologies, the intraoperative use of the PAC has decreased significantly over the years.³⁻⁵ The authors conducted this survey of the Society of Cardiovascular Anesthesiologists (SCA) members to assess the current usage of the PAC and other hemodynamic monitoring technologies in patients undergoing cardiac surgery.

METHODS

A 17-question survey was developed by the authors and approved by the SCA to assess the current use of hemodynamic monitoring technologies during cardiac surgery (Table 1). Three questions were related to demographic data and practice type. One question was included to evaluate the opinion of the cardiac surgeon with respect to alternative hemodynamic monitoring technologies. The remaining questions were related to the types of procedures and monitoring technologies used. Before dissemination, a pilot questionnaire was sent to cardiac anesthesia faculty at the authors' institution to evaluate the survey's clarity and reliability. The survey then was e-mailed by the

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This work was supported by the Department of Anesthesiology and Pain Medicine, University of California Davis Health System (H.L.). This study was also supported by grant from Jiangsu Province's by Key Provincial Talents Program, China (F.J.), by Jiangsu Province's six major peak talents program, China (F.J.), and by Suzhou Science and Technology Bureau's program No.SYS201111 (F.J.) from China. The authors thank Ms. Joyce Schamburg for her technical support and artwork.

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1053-0770/2601-0001\$36.00/0

<http://dx.doi.org/10.1053/j.jvca.2014.07.016>

Table 1. Society of Cardiovascular Anesthesiologists Survey Questions

1. How many cardiac surgeries does your hospital do per year?
2. Practice type.
3. Geographical locations of your practice.
4. What percentage of your patients is monitored intraoperatively with a PAC for cardiopulmonary bypass (CPB) surgery?
5. Do you use another monitor during cardiopulmonary bypass surgery?
6. If you answered yes to question 5, which monitors do you use besides PA catheter?
7. If you do not use a PAC, which alternative hemodynamic do you use most often?
8. Do you routinely do off pump CABG?
9. What percentage of your patients is monitored intraoperatively with a PAC for off pump CABG?
10. If you do not use a PAC for your off pump CABG, which alternative hemodynamic monitors do you use most often?
11. Does your hospital routinely perform minimally invasive/robotic assisted CABG?
12. What percentage of your patients is monitored intra-operatively with a PAC for your minimally invasive/robotic assisted CABG?
13. If you do not use a PAC for your minimally invasive/robotic assisted CABG, which alternative hemodynamic monitors do you use most often?
14. Does your hospital perform minimally invasive/robotic assisted valve cases?
15. What percentage of your patients is monitored intraoperatively with a PAC for your minimally invasive/robotic assisted valve cases?
16. If you do not use a PAC for your minimally invasive/robotic assisted valve cases, which alternative hemodynamic monitors do you use most often?
17. If using alternative hemodynamic monitoring other than pulmonary artery catheter, what is the opinion of your CT surgeon?

Abbreviations: CABG, coronary artery bypass graft; CPB, cardiopulmonary bypass; CT, computed tomography; PA, pulmonary artery; PAC, pulmonary artery catheter.

SCA to roughly 6,000 of its members. The survey was left open for 30 days (January 17-February 16, 2012) and respondents accessed the survey via a secure web-based database (Survey Monkey, Palo Alto, CA, USA). Categorical data were analyzed and expressed as percentage of respondents using a given type of hemodynamic monitoring.

RESULTS

The overall response rate was approximately 14%. Of the 854 questionnaires completed, 705 (82.5%) were from North American members. European members completed 81 (9.5%) (Fig 1). The majority of all respondents were working in the private sector (48.1%), but academic practice was very common as well (40.9%). Government hospital employment represented 11% of the respondents (Fig 2). Subgroup analysis revealed that the majority of the private and academic practitioners were in North America (Fig 3). A majority of the respondents (57.9%) worked at hospitals that performed more than 400 cardiac surgeries a year, a subset of which did more than 800 annually (Fig 4).

For procedures using cardiopulmonary bypass (CPB), 583 (68.2%) of the respondents used a PAC more than 75% of the

■ South America ■ Australia & New Zealand ■ Asia ■ Europe ■ North America

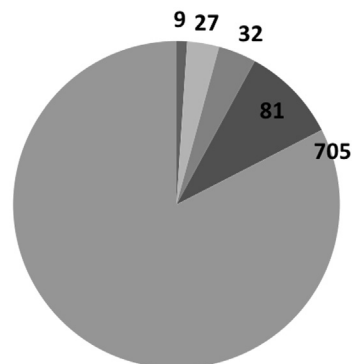


Fig 1. Number of respondents from each geographic location.

time (Table 2). Subgroup analysis by practice type revealed that for CPB cases, 79.2% of private practitioners used a PAC more than 75% of the time (Table 3). This percentage declined in academic practice (64.5%) and more substantially (34%) in the government practice subgroups (Tables 4 and 5). Similarly, as summarized in Table 2, the use of a PAC remained comparably frequent in off-pump coronary artery bypass grafting (CABG) and minimally invasive cardiac surgery as well. However, the percent of patients in whom a PAC was never used increased from 3.5% for CPB cases to more than 13% for minimally invasive cardiac procedures. This percentage of no PAC monitoring for minimally invasive procedures was comparable in the private and academic practice settings but markedly increased (40%) for respondents practicing in government hospitals.

Transesophageal echocardiography (TEE) was the most commonly (97.9%) used complementary hemodynamic monitor to the PAC during cardiac surgery (Fig 5). When not using a PAC during CPB, 94% of respondents used TEE as the complementary and/or alternative monitor (Table 6). Similarly, TEE remained the most commonly used complementary and/or alternative hemodynamic monitoring technology in both off-pump CABG and minimally invasive cardiac surgery (Table 6). More than 56% of the respondents stated that the cardiac surgeons were not supportive of alternative hemodynamic monitoring technologies and preferred the PAC (Fig 6). Subgroup analysis demonstrated that cardiac surgeons in the private sector were least likely to be supportive of alternative monitor technologies, while a majority of the surgeons

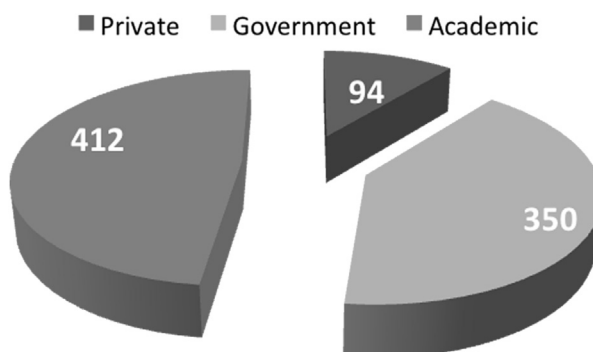


Fig 2. Practice type of respondents.

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