

A Single-Center Survey on the Training Outcomes of Cardiovascular Anesthesiologists

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Abstract

Background: This study aimed to evaluate the effectiveness of the advanced training program in cardiovascular anesthesia for visiting physicians at Fuwai Hospital.

Methods: A regional, internet-based survey was conducted among physicians who underwent cardiovascular anesthesia training in the Department of Anesthesiology of Fuwai Hospital from 2020 to 2023.

Results: A total of 192 physicians were included, covering sex, age, marital status, number of children, previous work experience, and other aspects. After training, the trainees confidence in performing anesthesia for cardiac surgery and for non-cardiac surgery in patients with heart disease increased significantly. The improvement in confidence was mainly associated with the duration of clinical work before training and the length of the training period, whereas the effect of having a fixed teaching supervisor was not statistically significant. The possible reasons include that a longer training period facilitates in-depth learning and practice, while the influence of a fixed supervisor may be limited by differences in teaching styles and the need for comprehensive knowledge updating.

Conclusion: These findings indicate that the advanced training program in cardiovascular anesthesia at Fuwai Hospital has a positive effect on enhancing the professional competence and skills of physicians.

Background

Cardiovascular disease is a major global health problem, and its incidence is increasing year by year.^[1–2] Cardiovascular anesthesiologists play a crucial role in the cardiovascular surgical team; they are responsible for comprehensive cardiovascular monitoring and anesthetic management of patients, ensuring their safety and comfort during surgery.^[3–6] To improve the professional competence and skills of cardiovascular anesthesiologists, many medical institutions organize relevant advanced training programs.^[7–10] These programs are designed to help physicians learn the latest techniques and theoretical knowledge of cardiovascular anesthesia and to improve their clinical practice, so that they can better manage complex cardiovascular surgical procedures. However, cardiovascular anesthesia involves multiple disciplines, including cardiology, ultrasonography, electrocardiography, medical imaging,^[11–13] surgery, cardiopulmonary bypass, pharmacology, pathophysiology, and respiratory and circulatory management, and therefore requires more comprehensive and specialized knowledge, as well as continuous knowledge updating. Moreover, owing to hospital-, surgery-, and cardiopulmonary bypass-related factors, a certain proportion of anesthesiologists in China are still not fully competent in cardiovascular anesthesia.^[14–16] This article presents a single-center survey of the training outcomes of cardiovascular anesthesiologists who received advanced training at Fuwai Hospital, Chinese Academy of Medical Sciences, and explores its impact on the cardiovascular anesthesia competence of physicians. Through this survey and analysis, we hope to provide useful experience and insights for

other medical institutions, thereby promoting the professional development of cardiovascular anesthesiologists and improving medical care.

Methods

Study design

This study is a regional, internet-based, cross-sectional questionnaire survey,^[17] with the primary objective of evaluating the effectiveness of advanced training in clinical cardiovascular anesthesia.^[18] Relevant information was collected through a questionnaire, focusing on the respondents degree of mastery of and confidence in surgical anesthesia in different fields.^[19] Physicians who underwent cardiovascular anesthesia training in the Department of Anesthesiology of Fuwai Hospital from 2020 to 2023 completed the questionnaire voluntarily. The survey was completed anonymously online via Wenjuanxing (an online survey platform).

This survey followed the Declaration of Helsinki and, as an anonymous, non-interventional study of consenting healthcare professionals posing no potential harm, was exempt from ethics committee review under Article 32 of the Measures for the Ethical Review of Life Science and Medical Research Involving Human Subjects (National Health Commission of China, 2023). All participants were informed of the study purpose on the first page of the questionnaire and provided electronic informed consent before proceeding.

Data collection

The questionnaire was self-designed on the basis of literature research and interviews with physicians, and it covered the following contents:

General information: sex, age, marital status, number of children, previous work experience.

Training information: duration of training, specialty fields, training contents, whether transesophageal echocardiography (TEE) training was received, whether a fixed teaching supervisor was assigned.

Self-evaluation: the degree of mastery and confidence in anesthesia for simple congenital heart disease surgery, general cardiac surgery, major vascular surgery, complex congenital heart disease surgery, and non-cardiac surgery in patients with heart disease. Each item was evaluated separately before and after training, and the score was an integer ranging from 0 to 10.

The questionnaire contained a total of 44 questions, including 29 single-choice questions, 6 multiple-choice questions, 6 open-ended questions, and 3 matrix single-choice questions. The survey data were collected in November 2023. The questionnaire was distributed online via Wenjuanxing as an open, anonymous survey, and a deadline was set for data collection. Because the survey link was openly

accessible, the exact number of physicians who received the survey invitation could not be determined, and a response rate could not be calculated.

Statistical analysis

Descriptive statistical analysis was performed on the demographic characteristics, training information, and self-evaluation results.

Categorical variables are expressed as numbers (percentages), normally distributed continuous variables as mean $\pm$ standard deviation, and non-normally distributed continuous variables as median (interquartile range). The confidence scores of the trainees for different types of surgery before and after training were compared using the paired rank-sum test.

The sum of the confidence scores for the five types of surgery after training minus the total confidence score before training was defined as the improvement value of the training.

Linear regression analysis was performed on the improvement value to explore its influencing factors. Univariate linear regression was conducted first; factors with P value < 0.1 in the univariate analysis, such as the duration of training and the specialty field, were included in the multivariable linear regression.

Unless otherwise specified, two-tailed tests were used for statistical analysis, and $P < 0.05$ was considered to indicate a statistically significant difference. All statistical analyses were performed using Stata 17.0.

Results

Baseline characteristics of the respondents

The baseline characteristics of the 192 respondents, including sex, age, educational background, marital status, number of children, professional title, years of clinical anesthesia experience (including non-cardiac anesthesia), number of cardiovascular anesthesia cases, and the grade and classification of their home institutions before training, are shown in Table 1.

Table 1
Respondents' sociodemographic data (N = 192)

Variable	Responses	Number of participants, N (%)
Sex	Male	88 (45.83%)
	Female	104 (54.17%)
Age group, yr	< 25	0 (0%)
	25–30	3 (1.56%)
	31–35	62 (32.29%)
	36–40	100 (52.08%)
	41–50	26 (13.54%)
	> 50	1 (0.52%)
Educational background	Bachelor degree	63 (32.81%)
	Master degree	117 (60.94%)
	Doctoral degree	12 (6.25%)
Marital status	Married	171 (89.06%)
	Unmarried	21 (10.94%)
Number of children, n	0	29 (15.1%)
	1	73 (38.02%)
	2	89 (46.35%)
	3	1 (0.52%)
Professional title	Resident doctor	9 (4.69%)
	Attending doctor	150 (78.13%)
	Associate chief physician	31 (16.15%)
	Chief physician	2 (1.04%)
Years of clinical anesthesia experience	1–3 yr	29 (15.1%)
	4–6 yr	26 (13.54%)
	7–10 yr	81 (42.19%)
	11–15 yr	43 (22.4%)
	≥ 16 yr	13 (6.77%)

Variable	Responses	Number of participants, N (%)
Annual cardiovascular surgical volume of the home institution, n	< 10	88 (45.83%)
	10–50	48 (25%)
	51–100	21 (10.94%)
	101–500	17 (8.85%)
	501–1000	12 (6.25%)
	≥ 1001	6 (3.13%)
Hospital grade	Tertiary Grade-A hospitals	171 (89.06%)
	Tertiary hospital	17 (8.85%)
	Secondary hospital	4 (2.08%)
Classification	General hospital	179 (93.23%)
	Specialized hospital	12 (6.25%)

General information of the respondents

The trainees came from provinces across China, mainly Guangxi, Henan, and Hebei. Regarding the average annual cardiovascular surgical volume of their home institutions before training, 9 (4.69%) had a volume of 0, 46 (23.96%) had 1–50, 63 (32.81%) had 51–200, 37 (19.27%) had 201–500, and 18 (9.38%) had more than 500.

Regarding the types of cardiovascular surgery performed in the respondents' departments, 152 institutions (79.19%) performed coronary artery bypass grafting, 163 (84.9%) performed valve surgery, 121 (63.02%) performed major vascular surgery, 101 (85.94%) performed congenital heart disease surgery, and 165 (10.42%) performed interventional procedures.

During the training period, 31 respondents (16.15%) participated in fewer than 150 cardiovascular anesthesia cases, whereas 161 (83.85%) participated in more than 150 cases.

Factors related to the improvement of confidence

During the training period, 93 respondents (48.44%) undertook a total of 10–20 duty shifts, and 49 (25.52%) undertook 20–40 shifts. A total of 142 respondents (73.96%) attended 10–60 theoretical lectures, and 31 (16.15%) attended 60–100 lectures. Ninety-one respondents (47.4%) had a fixed teaching supervisor, whereas 101 (52.6%) did not. Among all respondents, 111 (57.81%) hoped to have a fixed supervisor, and 136 (65.62%) expected the supervisor to hold the title of associate chief physician

or above. A total of 109 respondents (56.77%) considered 6 months to be the optimal duration of training. The confidence levels before and after training for the five types of surgery are compared in Table 2.

Table 2
Comparison of confidence levels before and after training

Simple congenital heart defect	Pre-training confidence level	Post-training confidence level	P value
	2 (0, 6)	8 (5, 9)	< 0.001
General cardiac surgery	3 (0, 7)	8 (6, 9)	< 0.001
Major vascular surgery	1 (0, 5)	6 (5, 8)	< 0.001
Complex congenital heart disease	0 (0, 3)	4 (2, 6)	< 0.001
Cardiac patients undergoing non-cardiac surgeries	6 (3, 8)	8 (7, 9)	< 0.001
Note: The degree of confidence is expressed as median (interquartile range).			

Improvement value of confidence and analysis of its influencing factors

Age, sex, province, highest educational background, number of children, and hospital grade had no statistically significant effects on the improvement value of confidence ($P > 0.1$). In contrast, the duration of theoretical courses during training, whether a fixed teaching supervisor was assigned, the range of working years, the overall satisfaction with the training, the duration of training, and whether TEE training was received showed statistically significant associations ($P < 0.1$; see Table 3). After these significant factors were included in the multivariable regression analysis, the range of working years and the duration of training were identified as influencing factors for the improvement of the trainees' confidence, whereas whether a fixed teaching supervisor was assigned showed no association. The statistical results are shown in Table 3.

Table 3
Linear regression results of the improvement value of confidence

Factor	Univariate regression analysis		Multivariable linear regression	
	Coefficient value (95% CI)	P value	Coefficient value (95% CI)	P value
Learning of theoretical knowledge	1.78 (0.15 to 3.42)	0.033		
Fixed teaching supervisor	-2.80 (-6.05 to 0.44)	0.091	-2.92 (-6.08 to 0.26)	0.071
Range of working years	1.70 (0.25 to 3.16)	0.022	1.93 (0.49 to 3.36)	0.008
Overall satisfaction	-4.10 (-7.08 to -1.12)	0.007		
Duration of training	2.84 (0.56 to 5.13)	0.015	2.95 (0.70 to 5.20)	0.01
Note: TEE: transesophageal echocardiography. Because most physicians who underwent combined TEE training had a training duration of 9 months to 1 year, which was collinear with the training duration to some extent, only the training duration was retained in the multivariable linear regression analysis.				

Discussion

The results of our survey showed that after completing the training, the vast majority of the trainees improved considerably in the field of cardiovascular anesthesia and reported substantially increased confidence^[8] in anesthesia for cardiac surgery and for non-cardiac surgery in patients with heart disease. The improvement value of the training was mainly associated with the duration of clinical work before entering the host hospital for training and with the duration of training, whereas a fixed clinical teaching supervisor was not an independent influencing factor.^[20, 21]

The duration of clinical work at the local hospital before training may affect the improvement value of confidence. 1) Senior trainees have greater clinical experience^[22] and a solid foundation in anesthesia. 2) In addition, clinically experienced physicians may pay more attention to the improvement of advanced competencies, such as the ability to manage difficult and critically ill patients and the ability to manage and lead the operating room medical team. 3) Moreover, according to the questionnaire, only a small proportion of physicians with senior professional titles participate in external training. These physicians are usually the backbone of their departments and have fewer opportunities for advanced training; therefore, they may cherish such opportunities more and prepare in advance.

In the multivariable regression analysis, the duration of training was a significant factor associated with the training outcomes. The possible reasons are as follows: 1) A longer training period gives trainees sufficient time to consolidate their knowledge and skills through repeated practice and covers broader content, including theoretical knowledge, practical skills, problem solving, and clinical decision-making. 2) Cardiovascular surgical anesthesia involves multiple disciplines with overlapping knowledge and

requires systematic and comprehensive learning. 3) The 1-year training program includes 3 months of TEE training; in addition, a combined program of 6 months of anesthesia plus 3 months of TEE training is available. TEE training helps to further deepen the understanding of cardiac anatomy and physiology,^[23–26] which greatly contributes to improving learning confidence. 4) Departmental teaching has increasingly shifted online;^[27, 28] therefore, physicians with longer training periods can complete more online courses.

Although a considerable proportion of the trainees (57.81%) believed that a fixed teaching supervisor might be more conducive^[29] to improving their cardiovascular anesthesia competence, the effect of a fixed supervisor was not statistically significant in the multivariable analysis. Several factors may explain this finding: rotating supervisors expose trainees to broader and more systematically updated content; teaching styles vary among supervisors, and no single style suits every trainee; and other factors, such as clinical exposure, case complexity, and the degree of trainee participation, may also influence the training outcomes.

Limitations

This study has some limitations. When evaluating training outcomes, multiple dimensions should be considered, such as the evaluations of cardiovascular surgeons and of other anesthesiologists in the department; however, this study only used the confidence score as the key evaluation indicator.^[30] The training outcomes of the trainees may be affected by many factors, such as family and financial factors, personal physical and psychological status, and external factors affecting the surgical volume and teaching quality of the home institution; these factors are difficult to quantify in regression analysis.^[17] In addition, the level of cardiovascular surgery and the training goals vary among the trainees' home institutions.

Conclusions

Physicians who underwent advanced training in cardiovascular anesthesia at Fuwai Hospital showed substantial improvements in cardiovascular anesthesia–related competencies, clinical decision-making ability, and clinical confidence after training. The training outcomes were associated with the trainees' previous work experience and the duration of training.

Declarations

Ethics approval and consent to participate: This study was conducted in accordance with the Declaration of Helsinki. As an anonymous, non-interventional survey of consenting healthcare professionals that involved no clinical interventions and no sensitive personal data, the study qualified for exemption from ethics committee review under Article 32 of the Measures for the Ethical Review of Life Science and Medical Research Involving Human Subjects (issued by the National Health Commission of China, effective 2023); accordingly, ethics committee approval was not required, and no ethics committee was

involved. All participants were informed of the study purpose on the first page of the questionnaire, and electronic informed consent was obtained from all respondents before survey initiation.

Consent for publication: Not applicable.

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