Educational perspectives in cardiothoracic anesthesia in the United States using a survey of educators and learners

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Background: Cardiothoracic anesthesiology training presents learners with unique challenges, procedural skills, and the management of high-intensity critical scenarios. An effective relationship between educator and learner can serve as the backbone for effective learning, which is crucial for the development of budding anesthesiologists. Strengthening this educational alliance between teachers and trainees involves understanding the educational values educators and learners find most important to their learning experiences. This study aimed to identify the key educational values related to cardiothoracic anesthesia for both learners and educators. By identifying these values in separate cohorts (learners and educators), the importance of various educational values can be examined and compared between the trainees and teachers.

Methods: Two separate surveys (one for learners and one for teachers) were adapted from the Pratt and Collins Teaching Perspectives Inventory to establish the importance of various educational values related to cardiothoracic anesthesia. Surveys were sent to 165 Accreditation Council for Graduate Medical Education-accredited anesthesiology residency training programs in the United States to trainees (residents and cardiothoracic anesthesiology fellows) and educators (board-certified cardiothoracic anesthesiologists).

Results: Analysis of survey results from 19 educators and 57 learners revealed no statistical differences across the two groups, except Q15: “Let trainee perform critical technical steps” (P value = 0.02).

Conclusions: While learners and educators in cardiothoracic anesthesia hold similar values regarding cardiac anesthesia education, they differ in the degree to which critical technical steps should be performed by learners.

Keywords: Anesthesia, cardiac; Anesthesia, cardiac procedures; Fellowships and scholarships; Graduate medical education; Internship and residency; Thoracic surgery.

INTRODUCTION

A cardiothoracic (CT) operating room provides a potential space for some of the most transformative learning experiences that budding anesthesiologists will encounter in their training. Whether it is the opportunity for procedures such as...
as central venous catheterization and arterial line placement or the prospect of medical management of critically ill patients in high-risk situations, the unique challenges and educational milestones in cardiothoracic anesthesiology should be recognized as pivotal teaching moments.

For centuries, medical educators have reassessed and refined their approach to passing critical knowledge, theory, and techniques on to learners. Effective education in CT anesthesia transfers knowledge from experts to trainees in a way that resonates with the learners’ unique needs. In 1956, Bloom [1] described a hierarchy of learning objectives centered on the cognitive domain concerned with thinking and intellect. In 1964, Krathwohl and Bloom [2] introduced the affective domain of learning as an extension of Bloom’s work, which focused on feeling emotions. Less than a decade later, the psychomotor domain of learning was introduced, focusing on developing skills related to physical movement, coordination, and other motor skills [3].

Previous literature examining the intersection of andragogy and medical training has identified qualitative differences in how learners understand the subject matter [4]. Pratt et al. [5] built upon ideas demonstrated in previous educational literature, which suggested that learners conceived of teaching “in ways that were remarkably similar to one or more of five different perspectives on teaching.” These five perspectives were transmission, apprenticeship, developmental, nurturing, and social reform (Table 1).

Pratt and Collins [6] developed a Likert scale-formatted inventory consisting of five scales (each representing one of the five teaching perspectives) focused on actions, intentions, and beliefs related to education and instruction, called the “Teaching Perspectives Inventory,” which can be readily accessed online. This inventory can be adapted to elucidate further the unique qualitative differences among learners and educators in medical education, and in our case, cardiothoracic anesthesia education. We hypothesize that adaptation of the Teaching Perspectives Inventory to assess the learning environment, learner engagement, teaching session management, and teaching methods can help elucidate a more beneficial, relatable approach to anesthesiology education in cardiothoracic operating rooms that are well-suited for both educators and learners. Any clear differences between the educational views of learners and educators may serve as an indication to further investigate the relationship between teachers and learners in this sector of graduate medical education.

### MATERIALS AND METHODS

For our study, a “learner” of CT anesthesia was defined as an anesthesiology resident or cardiothoracic anesthesiology fellow in an accreditation council for graduate medical education (ACGME)-accredited residency or fellowship program; an “educator” of CT anesthesia was defined as a board-certified cardiothoracic anesthesiologist currently involved in training residents. Contact information was gathered for 165 ACGME-accredited anesthesiology residency training programs in the United States, and a Research Electronic Data Capture (REDCap) link was provided for respondents to access their respective surveys and submit results (REDCap is a browser-based, secure software application used for the development of translational research databases). The REDCap link was sent to the program coordinators of ACGME-accredited anesthesiology training programs with a request to forward the survey links to educators and trainees. There were no incentives to respond to the survey. The results are expected to be collected in 2022.

To achieve our study goal, we adapted the Teaching Perspective Inventory (TPI), modifying the questions to relate them to cardiothoracic anesthesia education. Modifications were aimed at maintaining the overall purpose and essence of a specific question; however, language and minor details of the question should be modified to make the question more specifically applicable to CT anesthesia education. A survey of 26 questions was developed for learners of cardiothoracic anesthesia, and a second survey of 29 questions was developed for educators of cardiothoracic anesthesia in REDCap.
Educators and learners were asked to rate the importance of various values or educational processes related to cardiothoracic anesthesiology training in their respective surveys. Responses were scored from 1–4, with a score of four indicating the participant would “strongly agree” with the statement and a score of one indicating that the participant would “strongly disagree” with the statement.

The responses were recorded by both learners and educators for each survey. The responses to the questions in each survey were collected and analyzed. Statistical analyses were performed using STATA software version 16.1 (StataCorp LP). To compare the responses across the two groups, the authors grouped 22 common questions asked to learners and educators into four domains. These were the Learning Environment (Q1, 3, 4, and 5), Learner Engagement (Q7–Q11), Session Management (Q12–Q16) and Teaching Methods (Q17–Q24). The questions were divided into four groups to assist with the readability and interpretation of the survey responses. The questions were compared both individually and within the respective groups. Finally, the grouping of questions did not affect the overall results of the analysis.

We computed the average responses across the four domains and tested whether they were statistically different between the two groups using the Student’s t-test. To assess the responses to each of the 22 questions, we used Pearson’s chi-square test to determine whether the two groups’ responses differed. Statistical significance was set at P < 0.05.

RESULTS

Five radar charts were used to present the average responses for the four domains, as well as the average responses to each of the 22 questions across the two groups. Complete surveys were received from 19 educators and 57 learners. Our data revealed no statistical differences across the two groups, except Q15: “Let trainee perform critical technical steps” (P value = 0.02).

Since a Pearson Chi-square test was used to test for divergence of agreement between learners and educators, questions that were not asked in either the learner or educator surveys were ignored for this analysis. Five questions were ignored in the analysis for the following reasons: The five questions, followed by their respective average and standard deviation (SD) scores based on responses to the survey, are listed below.

- Create a supportive learning environment (educator) – average 3.73 (SD 0.45)
- Get to know the trainee’s learning objectives for the day (learner) - average 3.22 (SD 0.66)
- Model and encourage “thinking out loud” (educator) - average 3.31 (SD 0.67)
- Teach differently based on learner level (learner) - average 3.54 (SD 0.60)
- Engage in discussion of anesthetic technique (educator) - average 3.47 (SD 0.61).

DISCUSSION

Based on our statistical analysis of both surveys, learners and educators in cardiothoracic anesthesiology appeared to largely agree on the importance of most educational values. The exception was a statistically significant difference between learner and educator perspectives on allowing learners to perform critical technical steps related to cardiothoracic anesthesia care, which is further discussed below.

While the American Board of Anesthesiology (ABA) lists the minimum cardiac case requirements for residents to graduate from their training, experts would argue that there are no hard and fast numbers that equate to critical learning
**Fig. 2.** Learning environment. Red: learner, blue: educator, Q1: Get to know the trainee as a person/individual. Q3: Specify what is expected of me for each case. Q4: Encourage me to ask questions and voice any uncertainty. Q5: Allow for progressive trainee autonomy.

**Fig. 3.** Learner engagement. Red: learner; blue: educator, Q7: model respectful attitude toward the patient, Q8: model respect for all care team members, Q9: discuss rationale/evidence for operative decision making, Q10: discuss cases pre-operatively with trainee, Q11: ask trainee to describe course of anesthetic.

**Fig. 4.** Learning environment. Red: learner, blue: educator, Q12: address potential intraoperative pitfalls, Q13: review salient studies, Q14: demonstrate technical steps, Q15: trainee perform critical technical steps, Q16: provide immediate feedback. *P value < 0.05.

**Fig. 5.** Learning environment. Red: learner, blue: educator. Q17: refer to literature to support decisions, Q18: discuss topics relevant to the case, Q19: provide clear verbal instructions, Q20: demonstrate tolerance and patience, Q21: collaborative decision making, Q22: discuss case post-operatively, Q23: provide specific examples of what the trainee did well and what he/she needs to improve, Q24: make explicit plan for further learning.
and mastery. To further study the variation in perspectives between learners and educators in this field, we adopted and modified the TPI survey. We found no statistical difference largely between the learners and educators who participated. It is globally demonstrated that the values of both groups are mostly aligned. One point of statistically significant divergence was related to allowing learners to perform critical technical steps \( P = 0.02 \). As the survey was graded from strongly disagree to strongly agree, we found that the learner group more favored “strongly agree” than the educator group.

Cardiac anesthesia rotations are often a resident’s first foray into many new procedures, including but not limited to line placements, Swan-Ganz placements, and echocardiography. Many of these are performed in time-sensitive critical scenarios, such as going onto or coming off cardiopulmonary bypass. Ideally, a trainee would have unlimited time and number of attempts to practice line placement or obtaining transesophageal echocardiogram (TEE) images during a case because these patients are often critically ill or hemodynamically vulnerable. This may influence an educator’s decision to take over a procedure sooner rather than later when compared to other types of anesthetics. Although line placement is a fundamental skill for every anesthesiologist, echocardiography performance and report generation are considered critical steps that provide essential information in many cardiothoracic procedures, and these skills are typically relegated to those with TEE certification. Interpreting TEE images is an important part of resident-level education, but performing the exam is not explicitly required by the ABA graduation standards. Depending on the procedure, TEE is considered a critical step in cardiothoracic anesthesia. While TEE is performed frequently in cardiothoracic operating rooms, trainees may have little experience maneuvering a TEE probe or interpreting TEE images in other areas of anesthesiology training. Echo examinations are highly technical, time-sensitive, and provide critical information to the anesthesia and surgical teams; thus, educators may hesitate to allow resident-level learners to perform these steps. This may explain the statistically significant discrepancy between educators and learners in answering the survey questions.

The next step in research in which this project design model may be valuable is to define learners as fellows in an accredited cardiac fellowship. This will allow us to study the same variable in a group, all with more defined requirements for program completion, and allow for distribution of the survey through centralized means, such as the Society of Cardiac Anesthesia, rather than emails through program coordinators. Studying this group will enable us to focus on a more niche population, answer more nuanced questions, and acquire more robust results. The drawback of this type of advancement is that it further limits the sample size, which is already relatively small. Therefore, one could also consider disseminating this survey to international trainees undergoing cardiothoracic anesthesia. This may allow for a more robust response from trainees and educators with further investigation into differences in educational styles at the international level.

The limitations of this study include the limited sample size, particularly of educators in CT anesthesia. This may be related to the specific nature of our survey and the limited number of qualified cardiothoracic anesthesiologists at academic teaching hospitals who work on an educational basis with residents and fellows, given the profession’s degree of expertise. Given the small sample size of this study, a more robust examination of this topic with data stratification between cardiothoracic anesthesia fellows and residents may prove beneficial.

**Conclusion**

Our project revealed that while learners and educators hold similar values regarding cardiac anesthesia education, they differ in the degree to which the learner should perform critical technical steps. This discordance may arise from the highly challenging skill of echocardiography, the performance of which is optional by the ABA and may be of interest to learners pursuing further certification. While education in medicine has grown over the years, there is plenty of room for improvement, starting with an understanding of the learning theory, a grasp of the required domains, and further refinement with feedback.

**FUNDING**

None.

**CONFLICTS OF INTEREST**

No potential conflict of interest relevant to this article was reported.
DATA AVAILABILITY STATEMENT

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS


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