

Research Article

A Study on Pre-clinical Anaesthesia Elective in Shaping Medical Students' Knowledge and Career Perspectives

Jeffrey Hauck^{1,*} , Ivan Angelov¹, Kelli Silcox¹, Ali Khalifa^{1,2}

¹Baylor Medical School, Baylor College of Medicine, Houston, USA

²Department of Anesthesiology, Baylor St. Luke's Medical Center, Houston, USA

Abstract

Anesthesiology stands out as one of the rapidly growing and highly competitive medical specialties, necessitating students to cultivate an interest in anesthesia early and prepare extensively for clinical electives. Pre-clinical electives that introduce students to anesthesia and ready them for clinical settings in the early stages of their academic journey may confer benefits and enhance their competitiveness as residency applicants. This study implemented an eight-week pre-clinical elective titled "The History of Anesthesia" for first- and second-year students at Baylor College of Medicine. Eighty-eight students participated in the elective, with thirteen completing both pre-course and post-course surveys. The survey, consisting of thirteen questions related to anesthesia interest and relevant clinical knowledge, was analyzed, and statistical significance was calculated. The survey results demonstrated significantly elevated levels of self-assessed knowledge in the post-course survey compared to the pre-course survey ($p < .05$). Notably, topics considered more clinically relevant, such as modern anesthetic techniques, regional anesthesia, and obstetric anesthesia, exhibited significantly higher average survey results in the post-course compared to the pre-course results. The implementation of pre-clinical electives focusing on success in clinical settings appears beneficial for students aspiring to apply to an anesthesiology residency. Institutions should consider exposing students to anesthetic topics earlier in their academic journey to adequately prepare them for the competitive residency application process.

Keywords

Anesthesiology, Elective, Pre-Clinical, Knowledge, Confidence, Self-Assessment

1. Introduction

Anesthesiology is rapidly becoming one of the most competitive specialties for medical students. Recent data from the 2023 application cycle reveals a significant surge in interest, with 5,353 candidates vying for 2,060 residency positions, leaving only 9 spots unfilled [1]. This competitiveness, heightened after the COVID-19 pandemic, is not a new trend but a continuation of growing interest observed between 2016 and 2019, reflected in a 26% increase in anesthesia applicants,

placing it alongside sought-after specialties like dermatology [2].

Given this intensifying competition, early exposure to anesthesiology in medical students' academic careers is crucial. Unfortunately, many U.S. medical schools neglect pre-clinical anesthesiology exposure, with only 50% of surveyed programs engaging with students in their pre-clinical years [3]. This gap hinders students from acquiring early exposure to

*Corresponding author: Jeffrey.hauck@bcm.edu (Jeffrey Hauck)

Received: 24 February 2024; **Accepted:** 7 March 2024; **Published:** 19 March 2024



Copyright: © The Author(s), 2023. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

anesthesiology topics which may be necessary for excelling in their second- or third-year clinical electives. These clinicals electives, especially in the context of Step 1 clinical knowledge exam, becoming pass/fail, have become more dependent on, and have placed more emphasis on clinical performance [4-6].

Despite the evident need for early exposure, a substantial discrepancy persists in pre-clinical anesthesia education [7, 8]. Recognizing the need for early pre-clinical exposure, this study aims to evaluate the effectiveness of a pre-clinical history of anesthesiology elective at Baylor College of Medicine (BCM) in impacting first and second-year students' interest and competency in the field of anesthesiology. By providing students with practical knowledge early on, this elective seeks to empower them to make informed decisions about anesthesiology, enhancing their readiness for clinical electives and strengthening their residency applications.

2. Methods

A 0.5-credit anesthesia elective, titled "The History of Anesthesia" (MEMED 642), was established at Baylor College of Medicine and offered to 1st and 2nd-year pre-clinical

medical students during the fall semester of 2023. The course adopted a pass-fail grading system to create a low-risk environment for learning and to encourage maximum student engagement. The choice of the history of anesthesia as the course's theme aimed to introduce the rich historical context of early anesthetic techniques, capturing the interest of pre-clinical students and increasing their exposure to the field of anesthesiology. Moreover, the history of anesthesia encompassed broader humanities-oriented topics, fostering participation from students interested in non-anesthesia specialties such as medicine and surgery.

This eight-week course comprised one 1-hour Zoom lecture per week, featuring topics ranging from the origins of anesthesia to contemporary practices. The lectures were conducted by board-certified anesthesiology attendings at Baylor College of Medicine and covered areas including early anesthetic methods, modern-day anesthetic delivery, obstetric anesthesiology, and ethics. The complete class schedule and lecture objectives can be found in Table 1.

The elective is supported by one anesthesiology faculty member and three medical students who share logistical responsibilities.

Table 1. The lectures offered during the elective and their descriptions.

1.1 Session 1: Introduction to Anesthesia History	This session provided an introduction to the history of anesthesia. We explored the origins of anesthesia, the early understanding of pain management, and the challenges faced by surgeons before the advent of anesthesia. We also discussed the pioneering individuals who contributed to the development of anesthesia.
1.2 Session 2: Early Anesthesia Techniques and Agents	We examined the use of herbal remedies, narcotics, and alcohol as anesthetics. We explored the challenges and limitations of these early methods and discussed their impact on the development of modern anesthesia.
1.3 Session 3: Discovering Ether and Nitrous Oxide	This session focused on the discovery and introduction of ether and nitrous oxide as major breakthroughs in anesthesia. We explored the experiments of William T.G. Morton, Crawford Long, and Horace Wells, and their contributions to the use of inhalation anesthesia. We also discussed the widespread adoption of ether and nitrous oxide in surgical practice.
1.4 Session 4: Anesthesia during Wartime	This session evaluated the role of anesthesia during times of war. We looked at the challenges faced by military physicians in providing anesthesia on the battlefield, advancements in trauma anesthesia, and the impact of war on the development of anesthesia techniques and practices.
1.5 Session 5: Anesthesia in the Modern Era and Beyond	We discussed the development of intravenous anesthetics, the introduction of new inhalation agents, and the evolution of monitoring techniques. Additionally, we analyzed emerging trends in anesthesia, such as the use of simulation and technology, and discussed the future directions of the field.
1.6 Session 6: Regional Anesthesia and Local Anesthetics	In this session, we wanted to have an introduction to regional anesthesia and local anesthetics. We talked about the contributions of individuals such as August Bier and Carl Koller in developing spinal and peripheral nerve blocks. We also explored the discovery and use of local anesthetics like cocaine and the subsequent development of safer alternatives.
1.7 Session 7: Anesthesia in Obstetrics and Pain Management	This session wanted to show the specific applications of anesthesia in obstetrics and pain management. The lecture showed the challenges faced by anesthesiologists in providing safe and effective pain relief during childbirth. We examined the historical development of obstetric anesthesia techniques, including the introduction of epidural anesthesia and its impact on labor and delivery. Additionally, we wanted to overview the evolution of pain management techniques, from the use of opioids to more specialized approaches like patient-controlled analgesia and multimodal analgesia.

1.8 Session 8: Anesthesia and Ethical Considerations

Finally, we took some time to ponder over the historical and contemporary ethical dilemmas faced by anesthesiologists, including issues related to informed consent, end-of-life care, and the allocation of limited resources in critical situations. We discussed landmark cases and ethical frameworks that guide decision-making in anesthesia practice. This session aimed to foster critical thinking and reflection on the ethical dimensions of anesthesia, preparing students for the complex ethical challenges they may encounter in their future medical careers.

To examine the impact of the History of Anesthesia elective on the interest, understanding, and attitudes toward the field of anesthesia, 1st and 2nd-year pre-clinical BCM students who enrolled were asked to voluntarily complete both a pre- and post-course survey questionnaire. The survey was developed by analyzing previous surveys employed in surgical electives at Baylor College of Medicine for a similar purpose, and it was adapted to suit the context of the History of Anesthesia elective. Comprising thirteen questions, the survey utilized a one to ten scale, where a score of 1 denoted no interest or knowledge in the given question, and a score of 10 signified complete interest or knowledge. The administration of the survey was electronic, and participants were neither compensated nor graded for completing it. Thirteen students (N=13) completed both the pre-course and post-course survey, and their responses were anonymized for inclusion in this analysis. Table 2 illustrates the questions and their order in the survey. The means of the responses were calculated and compared using a one-tailed student's t-test with an assumption of similar variance.

3. Results

The survey results revealed significantly higher average

scores on the majority of post-course survey questions compared to the pre-course survey. Questions addressing interest in anesthesiology as a specialty or interest in non-anesthesia specialties did not show statistically significant differences. These questions include, "What is your current level of interest in anesthesiology as a specialty," ($p=.024$), "What is your current level of interest in a surgical specialty," ($p=0.48$), and "What is your current level of interest in a non-surgical specialty ($p=0.47$).

However, there were notable increases in average scores concerning self-reported knowledge in the understanding of anesthesia as a specialty. Specifically, in lectures covering topics that might be deemed more pertinent to students during their clinical rotations—such as modern anesthesia techniques and pharmaceuticals, regional and local anesthesia techniques, obstetrics and pain management, and ethics in anesthesia—we observed statistically significant increases in self-reported knowledge between the pre-course and post-course survey, which had p-values of $3.05E-5$, 0.0003 , 0.0003 , and 0.003 , respectively. The corresponding p-values for these lectures are detailed in the table in Table 2. Finally, the survey question that asked about student's self-perceived confidence in talking to attendings about course material was significant higher in the post-course compared to pre-course survey.

Table 2. Table consisting of the questions students were asked on the pre-course and post-course survey. All questions were answered on a 1-10 scale.

Questions:	Pre-course survey mean (N=13):	Standard deviation	Post-course survey mean (N=13):	Standard deviation	P-value
What is your current level of interest in anesthesiology as a specialty?	4.77	2.92	5.54	2.40	0.24
What is your current level of interest in a surgical specialty?	5.08	2.99	5.15	3.31	0.48
2.1 What is your current level of interest in a non-surgical specialty?	6.69	2.87	6.77	2.49	0.47
2.2 What is your current level of understanding of anesthesia as a medical specialty?	4.62	2.33	6.69	1.38	0.005*
2.3 What is your current level of confidence in being able to discuss the history of anesthesia with physicians?	1.77	0.93	5.69	1.93	3.95E-07*
2.4 What is your current level of understanding in the everyday work life of an anesthesiologist?	4.85	2.30	6.07	2.06	0.082

Questions:	Pre-course survey mean (N=13):	Standard deviation	Post-course survey mean (N=13):	Standard deviation	P-value
2.5 What is your current level of understanding in early anesthesia techniques?	2.15	1.07	6.08	2.33	5.52E-06*
2.6 What is your current level of understanding in ether and nitrous oxide use as anesthetics?	2.31	1.18	6.23	2.55	1.95E-05*
2.7 What is your current level of understanding in anesthesia use during war time?	1.85	0.99	6.08	2.47	3.20E-06*
2.8 What is your current level of understanding in modern anesthesia techniques and pharmaceuticals?	2.46	1.66	6.31	2.32	3.02E-05*
2.9 What is your current level of understanding in regional and local anesthesia?	2.85	1.72	6.31	2.60	0.0003*
2.10 What is your current level of understanding in anesthesia in obstetrics and pain management?	3.15	2.035	6.61	2.36	0.0003*
2.11 What is your current level of understanding in ethical issues that could face the field of anesthesia?	3.69	2.36	6.62	2.50	0.003*

The means and p-values were analyzed and produced on the table. P-values with a score $<.05$ are marked with an asterisk (*).

4. Discussion

This study demonstrates the potential effectiveness of early exposure to relevant anesthesia topics earlier in medical education than previously considered. Existing literature highlights the value of providing students opportunities to engage with various specialties and the subsequent impact on their career choices. The implementation of specialty-specific electives during clinical rotations has demonstrated their positive influence on students' career decisions [9]. This data implies that earlier engagement in specialty-specific classes might shape students' specialty preferences.

Despite this, this study did not reveal statistically significant changes in students' perceptions about choosing anesthesiology as a specialty, but that does align with prior research on the subject. It seems that pre-clinical electives may not significantly alter students' opinions, but they do contribute to increased knowledge about anesthesia in particular [10]. This contrasts with clinical elective experiences, which have been shown to enhance both students' interest and competency in anesthesiology [11]. The present study echoes the findings of previous pre-clinical elective attempts and suggests that students' attitudes toward selecting anesthesiology as a specialty may be more nuanced during their pre-clinical years but become more subject to change during clinical years as compared to other specialties.

Nonetheless, the aforementioned pre-clinical elective study demonstrated a significant increase in students' knowledge, with overall positive feedback from partici-

pants [10]. This is congruent with earlier studies on pre-clinical electives, showcasing their success and the favorable experiences students have had with them [12, 13]. Our study yielded similar results, indicating that despite attitudes not being notably impacted by pre-clinical electives, self-reported clinical knowledge is certainly influenced [14].

There are notable limitations to this study that warrant consideration. The small sample size of 13 participants suggests a need for improvement, and future investigations into this elective, or similar ones, would benefit from larger samples to enhance the study's reliability. Additionally, the reliance on self-reported clinical knowledge might not be the most effective method of measuring clinical proficiency. The inclusion of more standardized methods for teaching and assessing clinical knowledge could enhance the robustness of future studies. Furthermore, the survey questions provided to students may not have been sufficiently specific to accurately gauge clinical knowledge. The current survey focused on general topics covered in each lecture, and future surveys could be more beneficial with targeted questions addressing specific skills and clinically relevant areas. For instance, a question like, "How confident do you feel discussing the risks of anesthesia with a patient after these lectures?" would be more clinically pertinent, specific, and likely to elicit more accurate responses from students than general inquiries. A survey given at time-points further out, say at 1-month and 3-month, would also be helpful in identifying if students retained the material in the lectures and if they found it important enough to remember.

The authors assert that increased exposure to clinical lectures and teaching benefits not only students interested in pursuing anesthesia but also those exploring other

medical specialties. Pre-clinical electives serve a crucial role in showcasing potential career paths and introducing topics that students should commence studying if they are inclined towards a particular career trajectory [15]. Consequently, medical schools should consider expanding rather than reducing pre-clinical elective offerings, covering a diverse array of medical topics. This approach ensures that students are better prepared and more knowledgeable in their chosen specialties before entering clinical electives, which often play a pivotal role in determining their competitiveness.

5. Conclusion

This study underscores the potential effectiveness of introducing pre-clinical anesthesia electives to medical students, offering them early exposure to pertinent topics. While statistically significant shifts in students' specialty preferences may not be immediately evident, the notable increase in knowledge observed through these electives is a noteworthy outcome. Acknowledging limitations such as the small sample size and reliance on self-reported clinical knowledge, we recognize areas for refinement in future research. Nonetheless, the overwhelmingly positive feedback and success of the elective affirm the valuable role of pre-clinical electives in guiding students toward potential career paths. Our findings emphasize the importance of continuing to expand pre-clinical elective offerings encompassing a diverse array of medical topics to better equip students for their clinical years and enhance their competitiveness in their application into residency.

Abbreviations

BCM: Baylor College of Medicine

Ethics Approval and Consent to Participate

All participants in this study did so willfully and this study did not require IRB-approval because of the nature of the anonymous survey which contained no human identifiers. This study was conducted in accordance with the Declaration of Helsinki (1964).

Author Contributions

Jeffrey Hauck: Conceptualization, Validation, Writing - Original Draft Preparation

Ivan Angelov: Conceptualization, Validation, Writing - Review & Editing

Kelli Silcox: Validation, Writing - Review & Editing, Data management

Ali Khalifa: Methodology, Validation, Writing - Review & Editing, Supervision

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Jennifer A. Rock-Klotz, Thomas R. Miller; 2023 Residency Match: Anesthesiology Is One of the Most Competitive Specialties. *ASA Monitor* 2023; 87: 1–5
<https://doi.org/10.1097/01.ASM.0000949520.54783.93>
- [2] Brittany N. Burton, Nancy Boulos, Rodney A. Gabriel. Moderately to very competitive: The shifting interest in anesthesiology among medical students, *Journal of Clinical Anesthesia*, Volume 55, 2019, Pages 111-112, ISSN 0952-8180.
<https://doi.org/10.1016/j.jclinane.2019.01.005>.
- [3] Curry SE. Teaching Medical Students Clinical Anesthesia. *Anesth Analg.* 2018; 126(5): 1687-1694.
<https://doi.org/10.1213/ANE.0000000000002802>
- [4] Vinagre R, Tanaka P, Park YS, Macario A. Red Flags, Geography, Exam Scores, and Other Factors Used by Program Directors in Determining Which Applicants Are Offered an Interview for Anesthesiology Residency. *Cureus.* 2020; 12(11): e11550. Published 2020 Nov 18.
<https://doi.org/10.7759/cureus.11550>
- [5] Shah S, Con J, Mercado L, Smiley A, Weber G, Abramowicz AE. Predictors of Matching into Anesthesiology and Surgery: Analysis of One Program's Results. *J Surg Educ.* 2023; 80(9): 1231-1241. <https://doi.org/10.1016/j.jsurg.2023.06.021>
- [6] De Oliveira GS Jr, Akikwala T, Kendall MC, et al. Factors affecting admission to anesthesiology residency in the United States: choosing the future of our specialty. *Anesthesiology.* 2012; 117(2): 243-251.
<https://doi.org/10.1097/ALN.0b013e31825fb04b>
- [7] Chuang Z. Anesthesiologists in the modern medical school curriculum: importance and opportunity. *Can Med Educ J.* 2023; 14(2): 175-177. Published 2023 Apr 8.
<https://doi.org/10.36834/cmej.76188>
- [8] Naik VN. Pre-clerkship teaching: Are we missing an opportunity? *Can J Anaesth.* 2017; 64(1): 6-9.
<https://doi.org/10.1007/s12630-016-0763-2>
- [9] Sheu L, Goglin S, Collins S et al. How Do Clinical Electives during the Clerkship Year Influence Career Exploration? A Qualitative Study. *Teach Learn Med.* 2022; 34(2): 187-197.
<https://doi.org/10.1080/10401334.2021.1891545>
- [10] Kendra L Walsh, Abhishek Yadav, Michael Cradeur, et al. Impact of a Preclinical Medical Student Anesthesiology Elective on the Attitudes and Perceptions of Medical Students Regarding Anesthesiology, *Advances in Medical Education and Practice*, 14: 1347-1355,
<https://doi.org/10.2147/AMEP.S427974>

- [11] Galway UA. Designing an Optimally Educational Anesthesia Clerkship for Medical Students - Survey Results of a New Curriculum. *J Educ Perioper Med*. 2014; 12(1): E054. Published 2014 Jan 1.
- [12] Agarwal A, Wong S, Sarfaty S, Devaiah A, Hirsch AE. Elective courses for medical students during the preclinical curriculum: a systematic review and evaluation. *Med Educ Online*. 2015; 20: 26615. Published 2015 May 11. <https://doi.org/10.3402/meo.v20.26615>
- [13] Drolet BC, Sangisetty S, Mulvaney PM, Ryder BA, Cioffi WG. A mentorship-based preclinical elective increases exposure, confidence, and interest in surgery. *Am J Surg*. 2014; 207(2): 179-186. <https://doi.org/10.1016/j.amjsurg.2013.07.031>
- [14] Basukala A, Chaudhary K. Early Clinical Exposure in Pre-clinical Years of Medical School. *JNMA J Nepal Med Assoc*. 2021; 59(242): 1072-1074. Published 2021 Oct 15. <https://doi.org/10.31729/jnma.5341>
- [15] Smyth M, Toguri JT, Dow T, Haupt TS, Roberts A, Raju K. Medical student exposure to anesthesiology through the Pre-clerkship Residency Exploration Program: impact on career interest and understanding of anesthesiology. *Can J Anaesth*. 2019; 66(9): 1126-1128. <https://doi.org/10.1007/s12630-019-01403-x>