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ORIGINAL ARTICLE

Student-led anatomy seminars improve knowledge of surgical anatomy and teaching skills: a follow-up study

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Abstract

Objectives To describe the differential effect of direct peer-to-peer teaching and observational learning in a student-led Advanced Anatomy Interest Group (AAIG) designed to promote medical student knowledge of surgical anatomy as a supplement to existing preclinical anatomy curricula.

Methods Student leaders identified "tidbits" related to a surgical subspecialty with medical student participants either serving as presenters or observers of 3–5 min presentations for each "tidbit" during a session. Invited surgical faculty provided expert commentary and moderated subsequent group discussion. Students completed a five-point Likert scale survey assessing the impact of participation on anatomy knowledge and surgical interest. Fisher's exact test was used to compare responses.

Results Thirty-six medical students, including 22 presenters, were surveyed. Notably, 100% of respondents agreed that the AAIG improved their understanding of surgically relevant anatomy. When stratified by presenter (P) vs. observer (O) status, statistically different response distributions were observed with increased agreement by presenters that this intervention enhanced preparedness to teach medical concepts to peers (P:100%; O:27%, $p < 0.001$) and network with mentors (P:95%; O:80%, $p = 0.02$). Presenters strongly supported incorporation of this model into the curriculum (P:52%; O:13%, $p = 0.01$).

Conclusion This model is an effective adjunct to the standard gross anatomy curriculum for all participants. Presenters derive more benefit than observers in the domains of building teaching skills and relationships with faculty and peers. The longitudinal effects of participation in this program on surgical clerkship performance, confidence in the operating room, and the decision to pursue surgical careers remains to be explored.

Keywords Surgical education · Anatomy seminars · Medical education · Peer mentorship

Introduction

A working knowledge of anatomy is the foundation of every surgeon's skill set. No surgeon can claim to be a master technician without advanced knowledge of the intricate structures they are operating on. Thus, one of the aims of medical school curricula is to give students a working knowledge of this discipline before they complete their preclinical coursework. However, with time, medical schools have decreased the amount of time dedicated to anatomy from a high of 800 h in 1909 to just 147 by the year 2012 [1, 2]. Many programs provide even less as condensed preclinical curriculums become increasingly popular. The decreased time in the anatomy lab has led to concerns from surgical specialists that students have less knowledge about anatomy compared to other medical subjects [3].

This sentiment was shared by the faculty instructors and surgeons at our institution, which led to the creation of an "Advanced anatomy interest group" in 2018 that served as a supplement to the traditional gross anatomy curriculum. It utilized student-led discussions with faculty moderation to teach surgically relevant anatomy in a small-group settings.

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After 2 successful years of operation, the results of this intervention were presented in 2020 [4]. Preliminary findings suggested that this supplemental anatomy curriculum could be highly successful in improving medical students' anatomic knowledge. This was in agreement with prior studies which found that active learning tools like flipped classroom, small group seminars, and peer or near-peer teaching could more strongly motivate learners in anatomy [5, 6]. Moreover, this educational model was found to facilitate the development of teaching competencies, which has been shown to be a benefit of other similar peer-assisted learning programs in anatomy [7, 8].

The results of this anatomy teaching model have been promising, but the effect of students taking on the roles of *presenter* or *observer* during these sessions were not yet delineated. This may mask differential impacts of the program [4]. The current study aims to revisit these findings by providing both an update and expansion of previous results. Novel questions have been added to the data collection tools and data from multiple meetings have been included to better understand the influence that sessions have on the medical student experience. These results are presented with the aim of highlighting the possible benefits of adopting a similar curriculum at medical schools seeking to improve the strength of their anatomy education and promote mentorship.

Methods

Advanced anatomy interest group

Details regarding formation of the Advanced Anatomy Interest Group (AAIG) as well as logistics of group meetings are fully described in our previous manuscript [4]. In brief, AAIG meetings are designed to familiarize students with advanced anatomical structures and their surgical relevance using an organ system-based, peer-teaching approach. Meetings are arranged approximately every 3 months and are initiated by the selection of an anatomical region most relevant to a surgical subspecialty. For instance, "advanced cardiac surgical anatomy." Student leaders, the authors of this study, define a list of 8–10 advanced anatomy "tidbits" related to the specific topic and faculty facilitators refine this list as needed.

Advanced anatomy tidbits are anatomical structures or relationships of high clinical relevance that are not typically emphasized in a standard gross anatomy course. A faculty member, typically an attending surgeon in the chosen field with interest in medical education, is invited to each session to serve as a moderator and share the clinical relevance of the tidbits. The student leaders email the student body of the medical school and interested students sign up through a cloud-based spreadsheet to either attend as observers or as presenters of a tidbit. Students who choose to present have the opportunity to collaborate with the student leaders on their presentation. The programming of AAIG runs in parallel with the traditional gross anatomy curriculum so that its advanced content builds on the foundation that students have from the gross anatomy lab.

During the meeting, students and faculty are arranged in a roundtable format to promote discussion. After introductory remarks from the AAIG student leaders and a faculty moderator, the first student presenter proceeds to teach the group for approximately 3–5 min about an advanced anatomy tidbit. Other students then can ask questions and the faculty moderator will provide a 3–5-min supplementary explanation of how the tidbit applies to their surgical practice. This process is repeated until all presenters have shared. The AAIG student leaders serve to maintain time.

Post-session surveys

A 13-question electronic survey using a 5-point Likert scale (1 = "strongly disagree", 5 = "strongly agree") is administered to all students in attendance at the conclusion of all AAIG meetings (Table 1). This anonymous survey was designed to assess changes to students' perceptions, interest, attitude, and knowledge toward surgery as a result of attending the AAIG session. Survey responses were stratified based on whether the responding student was a session *observer* or a *presenter*. AAIG student leaders did not respond to post-session surveys.

Responses from all sessions during the 2021–2022 academic year were compiled and Fisher's exact test was used to compare survey responses between observers and presenters with statistical significance set at p value < 0.05, two-tail tests were performed. An Institutional Review Board (IRB) exemption was obtained (Pro00101966) to study the effectiveness of this model in improving student knowledge and interest with the subject material and surgical disciplines.

Results

The AAIG convened for four meetings during 2021–2022 academic year. Meeting topics included Advanced Spinal Anatomy, Advanced Cardiac Anatomy, Advanced Hepatobiliary Anatomy, and Advanced Head and Neck Anatomy. All sessions were well-attended with total attendance ranging from 8 to 15 individuals, including one surgical faculty member and at least one AAIG student leader per meeting. The first two meetings in the fall featured eight student presentations each while the third and fourth meetings in the spring had seven and five presentations, respectively. A total of 36 post-session survey responses ($N = 22$ presenters,

Table 1 Post-session student survey administered after Advanced Anatomy Interest Group Meetings from 2021–2022

Question ID	Survey question
Q1	"This session increased my interest in pursuing a career in surgery."
Q2	"This session improved my perceptions of surgeons."
Q3	"This session improved my enthusiasm for scrubbing into surgeries."
Q4	"This session improved my preparedness to scrub into surgeries."
Q5	"This session improved my understanding of surgically relevant anatomy."
Q6	"This session improved my ability to teach complex medical topics to my peers."
Q7	"This session improved my ability to learn complex medical topics from my peers."
Q8	"This session was an effective means to learn anatomy."
Q9	"This session was a valuable supplement to the standard medical school curriculum."
Q10	"I would like to see these sessions incorporated into the core medical school curriculum."
Q11	"I would recommend participation in these sessions to future medical students."
Q12	"This session improved my ability to connect with faculty mentors in surgery."
Q13	"This session improved my ability to connect with near-peer mentors in surgery."

$N = 14$ observers) were recorded for an overall response rate of 96%. Most survey responses were from first-year medical students (34/36, 94%) while the remaining were from third-year medical students (2/36, 6%).

Results from the post-session survey are shown in Fig. 1. Notably, 100% of respondents agreed or strongly agreed that the AAIG model improved their understanding of surgically relevant anatomy and 92% of respondents agreed that AAIG sessions increased their enthusiasm for scrubbing into surgeries. In addition, 100% of respondents agreed or strongly agreed that they would recommend participation in AAIG to future medical students. Students generally reported that AAIG sessions also improved their perceptions of surgeons and their ability to connect with faculty and peer mentors in surgical fields.

In stratifying responses by presenter (P) vs. observer (O) status, there were statistically significant differences in the distribution of responses to questions Q6, Q10, and Q13. Examination of the distributions suggests that presenters (P) perceived an improved ability to teach complex medical topics to relative to observers (P: 21/21, 100%; O: 12/15, 80%, $p < 0.001$). Additionally, 95% (20/21) of presenters reported agreement that they felt an improved ability to network with near-peer mentors compared to 80% (12/15) of observers ($p = 0.002$). Similarly, presenters generally agreed strongly that AAIG sessions should be incorporated into the core medical school curriculum (P: 11/21, 52%; O: 2/15, 13%, $p = 0.01$).

Discussion

Initiatives to improve medical student knowledge of clinically relevant anatomy are vital and there is important work examining the role of both gross dissection and adjunct approaches to this traditional strategy [5, 9, 10]. Recent graduates express a desire for more robust anatomic training during medical school and evidence suggests that practicing physicians agree with recent graduates that their anatomic fund of knowledge could be improved through innovative approaches to education [11, 12]. Peer teaching is known to be a valuable supplement for learners in a variety of domains, and is one such approach that may bolster students' anatomic readiness [6, 13].

In this study, we show that the Advanced Anatomy Interest Group model serves as an effective adjunct to standard gross anatomy curricula by enhancing medical student competency in clinically relevant anatomical concepts and communication skills. It also promotes mentorship and community among aspiring surgeons. Peer-based learning in the presence of a surgeon content expert facilitated the formation of positive perceptions of surgical careers and relationships among medical students and faculty. Our analysis also provides early evidence that students who take on the presenting role may derive more benefit from these sessions than those who observe. This was demonstrated in the domains of teaching skills and relationships with peer mentors. This may be attributable to the brief but deep dive into anatomy content that is required for presenters to prepare their talks and is consistent with prior peer teaching studies which demonstrated benefit to the teacher as well as student [14, 15]. Presenting students also tended to contact AAIG student leaders or their own faculty advisors to ask clarifying questions about their talks which naturally lends itself to mentorship connections and may explain the enhanced impact.

There are some limitations of this study. First, the total number of survey responses is relatively low, and our response rate was not 100%. This lends to bias since the opinions of the students who did not respond are not captured and may differ systematically from responders. Still, the overall response rate was high. Second, the post-session

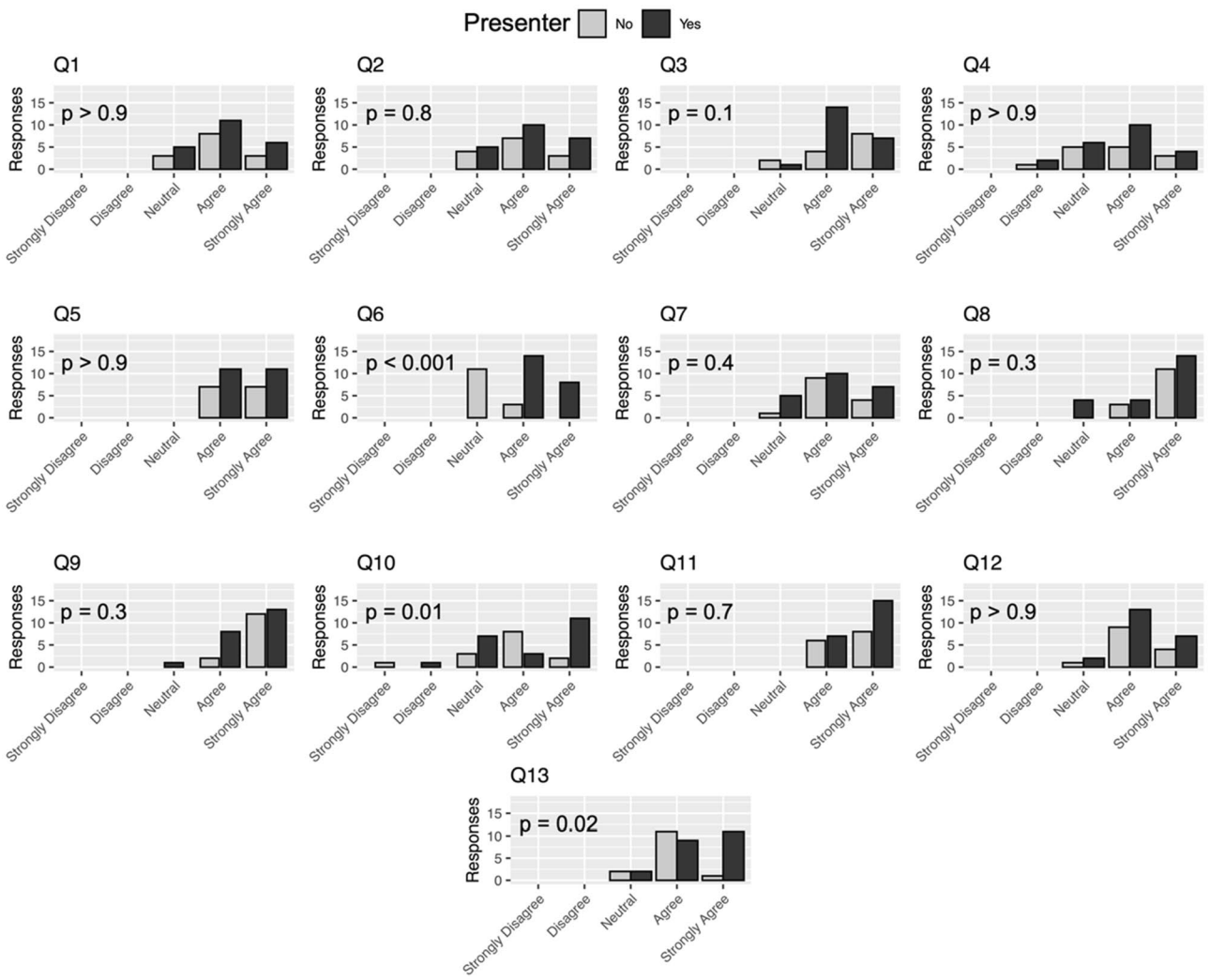

Fig. 1 Post-session survey responses separated by presenter status; *p* values obtained from Fischer's exact test. Refer to Table 1 for questions Q1–Q13

survey responses were completely anonymous which prevented longitudinal tracking of individual student opinions as a result of repeat AAIG attendance. Lastly, although the target audience for AAIG sessions is junior medical students in their first and second years, nearly all survey responses were from first-year medical students which may limit the generalizability of our findings to medical students at other programs. It should be noted, however, that the first-year cohort at our institution is the only preclinical cohort at our program since we utilize a 1-year preclinical curriculum. Thus, the first-year population here may in fact be similar to the first- and second-year student populations at medical schools with a traditional 2-year preclinical curriculum. Future study will examine the benefit of attending AAIG sessions on surgical clerkship performance, confidence level in the operating room, and decision to pursue surgical careers with continued attention to the impact of presenting.

Conclusion

The Advanced Anatomy Interest Group model has been shown to achieve a sustained positive impact on students' anatomic fund of knowledge, perceptions of surgeons, interest in surgical careers, and ability to form mentoring relationships with both faculty and peers. Recent evidence suggests that presenting students derive additional benefit from their participation, specifically in the domains of teaching skills and mentor relationships. This model is generalizable and should be considered by medical and surgical educators alike who wish to strengthen medical students' foundation of anatomic knowledge while promoting strong mentor relationships.

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Declarations

Conflict of interest The authors have no disclosures relevant to the contents of this manuscript.

References

1. Bardeen CR. Report of the sub-committee on anatomy to the council on medical education of the American medical association. Anatomical Rec. 1909;3(7):415–39.
2. Drake RL, McBride JM, Pawlina W. An update on the status of anatomical sciences education in United States medical schools. Anat Sci Educ. 2014;7(4):321–5.
3. Staśkiewicz GJ, Walczak E, Torres K, et al. What do clinicians think of the anatomical knowledge of medical students? Results of a survey. Folia Morphol (Warsz). 2007;66(2):138–42.
4. Ferlauto HR, Fleming TL, Drysdale ND, Gilmore BF, Migaly J. A novel model for a student-led surgical anatomy seminar. J Surg Educ. 2021;78(2):382–5.
5. Muraleedharan A, Ragavan S, Nalini Bage N, Devi R. Perceptions of medical undergraduate students on curricular changes in anatomy: an embedded design mixed method study. J Adv Med Educ Prof. 2022;10(1):22–9.
6. Evans DJ, Cuffe T. Near-peer teaching in anatomy: an approach for deeper learning. Anat Sci Educ. 2009;2(5):227–33.
7. Dickman N, Barash A, Reis S, Karasik D. Students as anatomy near-peer teachers: a double-edged sword for an ancient skill. BMC Med Educ. 2017;17(1):156.
8. Andrew Jay E, Starkman SJ, Pawlina W, Lachman N. Developing medical students as teachers: an anatomy-based student-as-teacher program with emphasis on core teaching competencies. Anat Sci Educ. 2013;6(6):385–92.
9. Elizondo-Omana RE, Guzman-Lopez S, Garcia-Rodriguez ML. Dissection as a teaching tool: past, present, and future. Anat Rec B New Anat. 2005;285(1):11–5.
10. Drake RL, McBride JM, Lachman N, Pawlina W. Medical education in the anatomical sciences: the winds of change continue to blow. Anat Sci Educ. 2009;2(6):253–9.
11. Waterston SW, Stewart IJ. Survey of clinicians' attitudes to the anatomical teaching and knowledge of medical students. Clin Anat. 2005;18(5):380–4.
12. Fitzgerald JE, White MJ, Tang SW, Maxwell-Armstrong CA, James DK. Are we teaching sufficient anatomy at medical school? The opinions of newly qualified doctors. Clin Anat. 2008;21(7):718–24.
13. Ten Cate O, Durning S. Peer teaching in medical education: twelve reasons to move from theory to practice. Med Teach. 2007;29(6):591–9.
14. Orsini E, Quaranta M, Mariani GA, et al. Near-peer teaching in human anatomy from a tutors' perspective: an eighteen-year-old experience at the University of Bologna. Int J Environ Res Public Health. 2021;19(1):398.
15. Gongola A, Gowen JT, Reif RJ, et al. Anatomy scholars program for medical students entering a surgical residency. Med Sci Educ. 2021;31(5):1581–5.