

Development of a Near Peer Clinical Anatomy Review Session during the Surgery Clerkship: Pre- and Post-Test Results among Third Year Medical Students

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ABSTRACT

Introduction. Our institution created a review of anatomy relevant to general surgery for third-year medical students. This study was designed to evaluate this review program and determine if participation increased third-year medical students' anatomy knowledge and confidence identifying anatomical structures in the operating room.

Methods. A formalin-embalmed cadaver-based review of anatomy was created and taught in near-peer fashion to third-year medical students. An anonymous survey and anatomy test were administered to participants pre- and post-session. The survey and test were designed to evaluate anatomy knowledge as well as student confidence identifying structures in the operating room. Survey data were compared using the Wilcoxon signed rank test.

Results. Seventy third-year medical students completed the anatomy review. There was a statistically significant improvement in students' confidence levels identifying structures in the operating room ($p < 0.001$) and in anatomy test scores ($p < 0.001$). Subjectively, students were thankful for the review session and found it helpful.

Conclusions. This near-peer review session designed at our institution was successful in improving immediate anatomy test scores and confidence levels identifying structures in the operating room. A course similar to this could be included at other medical schools to improve medical student confidence in identifying relevant anatomic structures in the operating room. *Kans J Med* 2022;15:293-297

INTRODUCTION

Gross anatomy has been deemphasized in the modern medical education curriculum.^{1,2} In the last century, hours of gross anatomy in a medical curriculum have dropped from approximately 550 hours in 1902 to 50 hours in 2000.¹ Reasons for this curriculum change included the rapid expansion of medical knowledge as well as the cost of cadavers and lab maintenance.

Many physicians, especially surgeons, consider this significant decrease in anatomy instruction to be inadequate.¹⁻³ In a 1999 survey, postgraduate residency program directors in general surgery ranked gross anatomy knowledge first in order of importance more often than any other basic science.² Additionally, in that same survey, 62% of the general surgery residency programs indicated that incoming residents need a refresher on gross anatomy and 24% reported that they were seriously lacking.²

Medical students, too, recognize the importance of gross anatomy and its relevance in clinical care.⁴⁻⁵ However, knowledge retention and teaching context are potential barriers to the clinical application of anatomy knowledge. First, anatomy education commonly is

consolidated to the first and second years of medical education, and the students' retention of basic science material after the preclinical years is generally poor.^{3,6-7} Second, though students and faculty both acknowledge the effectiveness of gross anatomy dissection,^{5,8-9} anatomy knowledge has been delivered more and more via computer learning, small group case studies, and problem-based learning, rather than by lectures and dissections.² While these case-based learning methods provide clinical context, gross dissection provides a physical context most like the identification of structures in surgery.

The combination of reduced hours spent in the gross anatomy lab, poor retention of basic science material including gross anatomy, and a different context of teaching contributes to difficulty in the transfer of gross anatomy knowledge to real-time application in the operating room. The aim of this study was to design a review of gross anatomy relevant to general surgery to help third-year medical students feel more confident identifying structures in the operating room. Acknowledging medical student perception of the surgery clerkship as being intimidating due to stereotypes of surgeons and of surgery,¹⁰ the review sessions employed a near-peer teaching model to create a non-threatening learning environment and mentoring relationship.^{11,12} The purpose of this study was to assess the ability of a near-peer anatomy review session to increase learner confidence in identifying anatomical structures during their surgery rotation. If a near-peer anatomy review session is shown to increase learner confidence in identifying anatomical structures during their surgery rotation, similar review sessions could be implemented in other medical school programs.

METHODS

This survey study was approved for implementation by the Ascension Via Christi Hospitals Wichita, Inc., Institutional Review Board with a waiver of informed consent. The development of this anatomy review session was prompted by medical student feedback and institutional curriculum changes including a reduction of anatomy teaching and lab hours. The anatomy review curriculum was prepared and taught by a team of nine fourth-year medical students. Five cases were identified as being relevant to general surgery based on our institution's medical student case logs and surgery clerkship oral board topics. The cases were inguinal hernia repair, trauma exploratory laparotomy, mastectomy, carotid endarterectomy, and thyroidectomy. With the guidance of surgery attendings and residents, relevant anatomy within the context of these cases was identified and surgical dissections were prepared on formalin-embalmed cadavers.

Participation in the anatomy teaching session was required of all third-year medical students during the first half of their eight-week, third-year surgery clerkship. Students were told that the session would be a review of anatomy relevant to general surgery but were not given the case topics ahead of time. Within each eight-week surgery clerkship, two teaching sessions were held in which the participating third-year medical students were split evenly between the two sessions to adhere to local COVID-19 gathering restrictions. The number of third-year

medical students per surgery rotation group ranged from 11 to 13 students and were split into groups of 5 to 7 per teaching session. Each teaching session lasted three hours during which the five cases were taught on two formalin-embalmed cadavers.

Pre- and post-session surveys, including an anatomy quiz, were administered to assess student level of confidence and to determine the level of student understanding before and after each teaching session. Completion of pre- and post-session surveys was voluntary, and students were assured that participation or non-participation would in no way affect their surgery rotation evaluations. One Likert-scale item was used to assess student level of confidence in identifying anatomic structures in the operating room (0 = poor, 1 = fair, 2 = okay, 3 = good, 4 = very good), and two multiple choice questions were created to assess knowledge of anatomy relevant to each teaching case for a total of ten multiple choice anatomy questions. One open-ended question was included for participants to leave feedback and additional comments (see Appendix).

Data Analysis. The Likert-scale and multiple-choice items were coded and compared with the Wilcoxon signed rank test to show the individual differences between the pre- and post-session survey responses. Responses from the open-ended question were compiled and analyzed using an inductive coding method. All analyses were run as two-tailed tests and results of analyses were considered significant if the resultant p value was less than or equal to 0.05. Analyses were performed using IBM® SPSS Statistics Software (version 19.0; IBM® Corporation, Armonk, NY).

RESULTS

Seventy third-year medical students completed the anatomy review sessions and pre-/post-session surveys during the six eight-week surgery clerkship rotations held throughout the 2020- 2021 academic year.

Confidence. When comparing pre- and post-session Likert scale responses, there was a statistically significant improvement in participant confidence level identifying structures in the operating room ($p < 0.001$; Table 1). The pre-session median confidence level answer was “Fair”, and most people answered between “Poor” and Fair” as the interquartile range was 0 - 1. The post-session median confidence level answer was “Okay”, and most people answered between “Fair” and “Okay” as the interquartile range was 1 - 2.

Table 1. Overall assessment.

Parameter	Pre-Session Score Median (IQR)	Post-Session Score Median (IQR)	p Value
Confidence	1 (0 - 1)	2 (1 - 2)	< 0.001
Overall Index Scores	7 (6 - 8)	8 (8 - 9)	< 0.001

Anatomy Quiz Scores. The 10 multiple choice anatomy quiz responses were combined to make a pre-session index score and post-session index score. When the pre- and post-session indices were

compared, there was a statistically significant improvement in anatomy quiz scores ($p < 0.001$; Table 1). The pre-session median score was 7 of 10 correct with an interquartile range of 6 - 8 and a range of 3 - 10. The post-session median score was 8 of 10 correct with an interquartile range of 8 - 9 and a range of 5 - 10.

When evaluating frequency of correct answers for individual anatomy quiz questions, 9 of 10 questions had improvement from pre-session to post-session; six demonstrated a statistically significant improvement (Table 2).

Table 2. Frequency of correct answers for individual questions.*

Question Number	Pre-Session Percent (n)	Post-Session Percent (n)	p Value
6	52.9% (37)	92.9% (65)	< 0.001
7	80.0% (56)	98.6% (69)	< 0.001
8	60.0% (42)	90.0% (63)	< 0.001
9	92.9% (65)	97.1% (68)	0.257
10	31.4% (22)	60.0% (42)	< 0.001
11	51.4% (36)	68.6% (48)	0.190
12	74.3% (52)	97.1% (68)	< 0.001
13	68.6% (48)	64.3% (45)	0.467
14	71.4% (50)	85.7% (60)	0.012
15	77.1% (54)	84.3% (59)	0.225

*See Appendix.

Quotes from Post-Session Surveys. A total of 49 third-year medical students left a comment on their post-session survey. Of those, one was “N/A”, which was omitted from further analysis, leaving a total of 48 comments. Responses were compiled and coded using inductive coding. Each comment was coded into one of three categories (i.e., thankful, helpful, or suggestions). Since a single response may contain multiple sentiments, one comment could have up to three codes. With that in mind, 58.3% of comments by 28 medical students contained a sentiment categorized as “thankful”. Just over one-half of comments (54.2%) by 26 medical students contained a sentiment categorized as “helpful”. Approximately one-third of comments (35.4%) by 17 medical students contained a sentiment categorized as “suggestions”. These are detailed in Table 3.

Table 3. Emerging themes from comments.

Frequency	Category	Definitions	Examples
28 (58.3%)	Thankful	Comments that expressed gratitude or a positive enthusiasm for the session.	<ul style="list-style-type: none"> • “Thank you so much for your time!” • “Need more lessons like this.” • “Good job!”
26 (54.2%)	Helpful	Comments which directly expressed the session “helped” or was “helpful”; included comments that expressed an improvement in knowledge or comments that pointed out a specific reason they found the session beneficial.	<ul style="list-style-type: none"> • “This was sooooo helpful!” • “I learned so much.” • “I like that this was shortly into rotation (not during orientation week).”
17 (35.4%)	Suggestions	Comments that provided constructive criticism or feedback as to how the sessions can be improved; included comments that “wish”; included comments that suggest a new program.	<ul style="list-style-type: none"> • “It would be nice to have a brief description of what will be covered during the session beforehand.” • “...wish I’d had this experience during my first two years of medical school.” • “...I feel that we could have another similar session like this toward the oral board, if people are available.”

DISCUSSION

Findings from this study demonstrated the benefits to third-year medical students of a near-peer clinical anatomy review session taught during the surgery clerkship. There was a statistically significant improvement in student confidence level identifying structures in the operating room, as well as statistically significant improvement in anatomy test scores. Student post-session comments supported these quantitative results and contained sentiments of thankfulness for the session, session helpfulness, and suggestions for session improvement.

Upon literature review, no studies detailed similar anatomy review programs within the third-year surgery clerkship. However, two studies detailed the use of cadavers in resident training. The first by Gordinier et al.¹³ explored whether a course in cadaver dissection could increase resident knowledge of pelvic anatomy significantly beyond that of current educational practices. Obstetrics and gynecology residents were assigned to a dissection group versus a control group and both groups completed a pre- and post-study examination. Both groups had statistically significant improvement on the post-test compared to the pre-test, but the dissection group scored nearly 50% higher on the test than did the controls. In their evaluation of the course, participants from the dissection group emphasized its educational value and urged that it be offered to residents as a regular part of their training. Though the evaluation of our review session did not include a control group, the pre- and post-session results and comments by third-year medical students were like those reported by Gordinier et al.¹³

Another anatomy program detailed in a study by Lewis et al.¹⁴ described the development of a cadaver-based educational program for general surgery residents. Overall, residents held a positive view of the cadaver sessions and believed them to be useful for learning anatomy (94% agree or strongly agree). They also reported that compared with other learning modalities, cadaver sessions were ranked first by respondents for learning surgical anatomy. Our results aligned with those of Lewis et al.¹⁴ in that third-year medical students found our institution’s anatomy review sessions helpful.

While there was a statistically significant increase in student con-

fidence level in post-session surveys compared to pre-session, this increase was small despite student comments containing sentiments of thankfulness and session helpfulness. This smaller than anticipated increase in confidence level may be the result of asking questions that were too general whereas our intervention included specific surgery cases. Perhaps student confidence level would have increased more if participants were asked more specific questions, such as to “Rate your confidence level identifying inguinal hernia anatomy in the operating room”.

Upon review of the student comments containing sentiments coded as “helpful”, most included a general comment such as “This session was helpful”. However, four comments included mention of the clinical context being helpful.

Specific sentiments within this theme included: “I really found this helpful within the context of surgeries to understand the procedures that I’m seeing.” “Felt this was very helpful, I liked how it was case based as well.” “Very helpful, especially in the context of questions commonly asked during procedures.” “It was good to go over some of the more common cases that we’ll see on this rotation.”

Upon review of the student comments containing sentiments coded as “suggestions”, a few themes emerged. First, 10 comments included suggestions regarding timing of the review session within the eight-week surgery clerkship. All suggestions were for the review session to be held during the first half of the clerkship (weeks 1 to 4), but within that the suggestions were split between the first week of the clerkship as an orientation to surgery and weeks 3 to 4 after students have seen several cases in the operating room and have a clinical context for the review session material. This year, scheduling was dependent on the fourth-year near-peer teachers’ availability, and the review session was held within weeks 1 to 5 of the surgery clerkship. Since completion of the academic year, anecdotal feedback has been provided by the third-year medical students during their mid-clerkship review with the surgery clerkship director that supported the suggestion for the review session to be held during the first week of the clerkship as part of orientation. In this coming academic year, the review session will be held during the

first week of the surgery clerkship.

Second, three comments included requests for a brief description of the cases to be covered and/or preparatory materials to review before the review session. While students were not provided with information ahead of the session, they were provided with teaching outlines and case notes to review after the session. Next, two comments included suggestions to split the teaching cases more evenly between the two cadavers. The third-year medical students attending the session were split among the two cadavers and the groups switched halfway through the session to complete the remaining cases. During the first several teaching sessions early in the year, two cases were taught on a female cadaver (breast and carotid endarterectomy) and three cases on a male cadaver (exploratory laparotomy, inguinal hernia repair, and thyroidectomy). This original set up was uneven in length of time with the male cadaver cases taking longer than the female cadaver cases. To remedy this imbalance, the thyroidectomy and exploratory laparotomy cases were prepared and taught on the female cadaver. Finally, two comments included recommendation for future years and that the teaching session become an official component of the curriculum. With school and surgery department funding, this has been made possible.

Limitations of this study included lack of control group and the lack of long-term participant assessment. Future research questions include investigating the use of soft-embalmed cadavers for teaching, assessing long-term retention of participant knowledge at five to six months post-session, and studying outcomes of anatomy understanding and student confidence level for near-peer teachers.

CONCLUSIONS

Overall confidence score in identifying anatomical structures in the operating room in this study increased significantly from pre- to post-course. Additionally, students increased anatomy quiz correct responses for 9 of 10 anatomy questions with significant improvement in proportion of correct answers on quiz questions in 6 of 10 questions. Based upon these results, we can conclude that this review session designed at our institution was successful in improving anatomy test scores and confidence identifying structures in the operating room in third-year medical students during their surgery clerkship. This course could be modeled and included at other medical school settings to improve medical student confidence in identifying anatomic structures relevant to general surgery.

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REFERENCES

- 1 Leung KK, Lu KS, Huang TS, Hsieh BS. Anatomy instruction in medical schools: Connecting the past and the future. *Adv Health Sci Educ Theory Pract* 2006; 11(2):209-215. PMID: 16729246.
- 2 Cottam WW. Adequacy of medical school gross anatomy education as perceived by certain postgraduate residency programs and anatomy course directors. *Clin Anat* 1999; 12(1):55-65. PMID: 9890730.
- 3 Kemeir MA. Attitudes and views of medical students toward anatomy learnt in the preclinical phase at King Khalid University. *J Family Community Med* 2012; 19(3):190-193. PMID: 23230386.
- 4 Malau-Aduli BS, Alele FO, Heggarty P, Teague PA, Sen Gupta T, Hays R. Perceived clinical relevance and retention of basic sciences across the medical education continuum. *Adv Physiol Educ* 2019; 143(3):293-299. PMID: 31246508.
- 5 Smith CF, Mathias HS. Medical students' approaches to learning anatomy: Students' experiences and relations to the learning environment. *Clin Anat* 2010; 23(1):106-114. PMID: 19941355.
- 6 Spencer AL, Brosenitsch T, Levine AS, Kanter SL. Back to the basic sciences: An innovative approach to teaching senior medical students how best to integrate basic science and clinical medicine. *Acad Med* 2008; 83(7):662-669. PMID: 18580085.
- 7 Alam A. How do medical students in their clinical years perceive basic sciences courses at King Saud University? *Ann Saudi Med* 2011; 31(1):58-61. PMID: 21245601.
- 8 Azer SA, Eizenberg N. Do we need dissection in an integrated problem-based learning medical course? Perceptions of first- and second-year students. *Surg Radiol Anat* 2007; 29(2):173-180. PMID: 17318286.
- 9 Bergman EM, de Bruin AB, Herrler A, Verheijen IW, Scherpbier AJ, van der Vleuten CP. Students' perceptions of anatomy across the undergraduate problem-based learning medical curriculum: A phenomenographical study. *BMC Med Educ* 2013; 13:152. PMID: 24252155.
- 10 Hill EJ, Bowman KA, Stalmeijer RE, Solomon Y, Dornan T. Can I cut it? Medical students' perceptions of surgeons and surgical careers. *Am J Surg* 2014; 208(5):860-867. PMID: 25092269.
- 11 Nelson AJ, Nelson SV, Linn AM, Raw LE, Kildea HB, Tonkin AL. Tomorrow's educators ... today? Implementing near-peer teaching for medical students. *Med Teach* 2013; 35(2):156-159. PMID: 23228108.
- 12 Knobloch AC, Ledford CJW, Wilkes S, Saperstein AK. The impact of near-peer teaching on medical students' transition to clerkships. *Fam Med* 2018; 50(1):58-62. PMID: 29346691.
- 13 Gordinier ME, Granai CO, Jackson ND, Metheny WP. The effects of a course in cadaver dissection on resident knowledge of pelvic anatomy: An experimental study. *Obstet Gynecol* 1995; 86(1):137-139. PMID: 7784009.
- 14 Lewis CE, Peacock WJ, Tillou A, Hines OJ, Hiatt JR. A novel cadaver-based educational program in general surgery training. *J Surg Educ* 2012; 69(6):693-698. PMID: 23111032.

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Pre/Post Session Survey & Anatomy Quiz

1. Create your own unique Study ID using the first two initials of your mother's maiden name followed by the two digits of your birth month. ____ _
2. What week of your surgery clerkship is the cadaver teaching session being held? _____

For questions 3 through 15, circle the letter of the correct answer.

3. Is the teaching session held virtually or in person?
a. Virtually b. In person
4. Is this the pre or post session survey?
a. Pre-session survey b. Post-session survey
5. Rate your confidence level in identifying anatomical structures in the operating room.
a. Poor b. Fair c. Okay d. Good e. Very Good

Answer the following anatomy quiz questions to best of your ability. This quiz is for research only and will not be a part of or influence your clerkship grade.

6. What is the first branch off the external carotid artery?
a. Superior thyroid artery b. Facial artery
c. Inferior thyroid artery d. Esophageal artery
7. What nerve at risk during a carotid endarterectomy, causes tongue deviation toward the side of the lesion if damaged?
a. Vagus nerve b. Facial nerve
c. Hypoglossal nerve d. Accessory nerve
8. To what layer depth is tissue removed during a simple mastectomy?
a. External intercostal muscles b. Pectoralis minor
c. Pectoralis major d. Rectus abdominus
9. What nerve at risk during axillary lymph node dissection, courses along the lateral chest wall in the midaxillary line and causes scapular winging if damaged?
a. Medial pectoral nerve b. Lateral pectoral nerve
c. Thoracodorsal nerve d. Long thoracic nerve
10. The inguinal ligament arises from which anterior abdominal wall structure?
a. External oblique muscle aponeurosis b. Internal oblique muscle aponeurosis
c. Transverse abdominus muscle aponeurosis d. Rectus abdominus muscle aponeurosis
11. Describe the relative location of the groin hernia that requires elective surgery because it has the highest risk of incarceration.
a. Superior to the inguinal ligament, lateral to the femoral vein b. Inferior to the inguinal ligament, lateral to the femoral vein
c. Superior to the inguinal ligament, medial to the femoral vein d. Inferior to the inguinal ligament, medial to the femoral vein
12. What are the three structures within the hepatoduodenal ligament?
a. Hepatic vein, hepatic artery, cystic duct b. Hepatic artery, portal vein, common bile duct
c. Hepatic vein, portal vein, cystic duct d. Hepatic artery, gastroduodenal vein, common bile duct
13. Which of the following structures is a primary branch off of the celiac trunk?
a. Left gastric artery b. Right gastric artery
c. Short gastrics d. Gastroduodenal artery
14. What is the indication for cricothyroidotomy? And through what structure is this procedure performed?
a. Prolonged intubation; cricothyroid membrane b. Emergency airway; cricoid cartilage
c. Emergency airway; cricothyroid membrane d. Prolonged intubation; 2nd and 3rd tracheal rings
15. What nerve is at risk during the ligation of the inferior thyroid artery?
a. Inferior laryngeal nerve b. Superior laryngeal nerve
c. Hypoglossal nerve d. Recurrent laryngeal nerve
16. If this is your post-session survey, then feel free to include any session feedback or additional comments below: