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Improving the efficacy of cadaveric demonstrations for undergraduate anatomy education

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Abstract

Objectives: The aim of this study was to investigate if student number is a factor for the efficacy of cadaveric demonstrations in undergraduate anatomy education.

Methods: For a female pelvic anatomy cadaveric demonstration lecture of second-year medical students at the anatomy laboratory of Hacettepe University School of Medicine, students were divided into 3 groups of 45, 30 and 15 participants. Each group was further divided into 3 subgroups. Thus, there were 3 groups with 15 participants, 3 subgroups with 10 participants and 3 subgroups with 5 participants (3×15, 3×10, 3×5). After the cadaveric demonstration, the participants were asked if they had seen the structure previously listed in the checklist or not.

Results: The number of medical students who missed small anatomical structures such as the umbilical artery, ureter or uterine artery during the cadaveric demonstration significantly decreased as the number of students per cadaver table decreased ($p<0.05$). Best results were obtained when the number of students per cadaver table was 5. On the other hand, no significant difference was found between the groups for missing gross anatomical structures such as the uterus, ovary or uterine tube, irrespective of the number of participants per cadaver table ($p>0.05$).

Conclusion: As the number of students per cadaver table decreases, the number of overlooked or missed structures will decrease.

Keywords: anatomy teaching; cadaver dissection; education; pelvic anatomy; undergraduate

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Introduction

Anatomy forms the basis of medical education and provides a general perspective of the full body for medical students. Additionally, a clinically integrated anatomy education also improves the skills gathered during clinical rotations. Cadaver dissection has an important role in teaching anatomy since centuries, not only for medical students, but also for post-graduate surgery residents.[1] Theoretical lectures, practical lectures on models and cadaver dissections are classical teaching anatomy methods. However, recently, many novel options are used in teaching anatomy such as computer-based programs, three-dimensional (3D) printed materials, augmented or virtual reality and radiology assisted techniques.[2] This multimodal education with traditional and novel techniques maintains an integrated and problem-based educational activity.

Cadaver dissection in the education of medical students provides a three-dimensional understanding which facilitates a better understanding of the relationship of anatomic structures in a real tissue architecture.[3] The medical curriculum of faculties follows a dissection-based education in many countries, though it is not usually feasible to allow all medical students perform a self-

dissection. The students usually examine and try to identify the structures on previously dissected specimens.

Nevertheless, the number of medical students per cadaver table will affect the quality of anatomy education. The aim of this study therefore was to evaluate the relation between the number of students per cadaver and the efficacy of cadaveric demonstrations.

Materials and Methods

This study was conducted during the female pelvic anatomy cadaveric demonstration lecture of second-year medical students at the anatomy laboratory of Hacettepe University School of Medicine in April 2019. A full pelvic dissection was applied to a formalin-embalmed cadaver by the authors of this study (DD, IT, IS) two days prior to the cadaveric demonstration lecture. A checklist for the anatomical landmarks was prepared (**Table 1**). The medical students were divided into 3 groups of 45, 30 and 15 participants. Each group was further divided into 3 subgroups. Thus, there were 3 groups with 15 participants, 3 groups with 10 participants and 3 groups with 5 participants (3×15, 3×10, 3×5). After the cadaveric demonstration lecture, the checklists were distributed to the students and they were asked whether they had observed the structure in the cheklist or not.

IBM SPSS Statistics for Windows (Version 21, Armonk, NY, USA) was used for statistical analysis. Percentages and frequencies were calculated and chi-square (χ^2) test was used to analyze the significance between the groups. $p<0.05$ was determined as statistically significant.

Results

During the cadaveric demonstration lecture, anatomical structures - umbilical artery, common iliac artery, external iliac artery, internal iliac artery, uterine artery, ureter, genitofemoral nerve, psoas major muscle, paravesical space, pararectal space, round ligament, broad ligament, infundibulopelvic ligament, proper ovarian ligament, uterine tube, ovary, uterus, rectosigmoid colon and bladder - were shown. The number of the medical students who missed the anatomical structures was determined after the cadaver lecture by a verbal quiz (**Table 1**). The results showed that the number of medical students who missed the anatomical structures during the cadaver lecture significantly decreased for small and isolated anatomical structures such as the umbilical

Table 1

Anatomical structures and number of medical students who missed the anatomical structures per group during the cadaveric demonstration lecture.

Anatomical structure	Group 1 (n=15)			Group 2 (n=10)			Group 3 (n=5)		
Umbilical artery	11	9	8	5	6	3	1	1	2
Common iliac artery	10	9	10	4	7	5	2	0	1
External iliac artery	8	9	8	3	7	5	0	0	1
Internal iliac artery	8	9	9	3	4	2	0	0	1
Uterine artery	10	8	8	5	2	3	2	2	0
Ureter	9	9	7	4	5	5	0	0	1
Genitofemoral nerve	8	9	7	4	4	3	1	0	1
Psoas major muscle	7	7	8	3	5	3	0	1	1
Paravesical space	8	5	9	4	7	4	1	1	1
Pararectal space	7	5	7	4	5	4	1	1	1
Round ligament	6	4	5	3	3	4	1	0	0
Broad ligament	4	4	4	2	4	3	0	0	0
Infundibulopelvic ligament	4	4	3	2	2	3	0	0	1
Proper ovarian ligament	6	4	5	2	3	1	0	1	0
Uterine tube	5	2	4	2	4	1	0	0	0
Ovary	4	4	3	2	2	1	0	0	0
Uterus	3	4	3	2	2	1	0	0	0
Rectosigmoid colon	4	4	3	1	2	1	0	0	0
Bladder	3	4	2	1	2	1	0	0	0

artery, ureter and uterine artery when the number of participants per cadaver table decreased (p<0.05) (**Table 2**). Best results were obtained when 5 participants attended the cadaver table. On the other hand, no significant difference was found between the groups for overlooked/missed gross anatomical structures such as uterus, ovary and uterine tubes irrespective of the number of participants per cadaver table; 15, 10 or 5 (p>0.05) (**Table 2**).

Discussion

The practical cadaver dissection-based lectures focus on demonstrative education in medical curriculum and attendance to the anatomy laboratory lectures is mandatory for medical students. However, there is not a clear rule for defining the best practice methods in teaching anatomy. This study evaluates how medical students will gain the best knowledge during cadaveric demonstration lectures. During this study, the medical students were divided into three groups consisting of 45 (3×15), 30 (3×10) and 15 (3×5) participants totally. In each group, three subgroups with 15, 10 and 5 students per dissection table were evaluated to investigate if the students would miss less objects if the number of participants per cadaver decreased.

There is not a standardized approach in teaching anatomy among the universities and countries. Widespread use of user-friendly and repeatable methodologies brought a new insight to anatomy teaching. Anatomical Society of Great Britain and Ireland recommended a national guide on teaching anatomy that included the steps of dissection/prosection, interactive multimedia, practical procedures, surface and clinical anatomy, and radiological imaging.[4] Cadaver dissections present a hands-on approach for studying the anatomical subject and maintain a deeper understanding than textbooks and models. The key objective of cadaveric demonstration is its role on exploring the relevant anatomical structures in the field of dissection and identification of the relations between the planes and tissues.[5] Despite these facts, the best way to teach anatomy is still controversial and the novel approaches with the implementation of software technologies are drawing interest. With this point of view, the argument is on improving the effectiveness and quality of anatomy education.

Table 2

The percentage and comparison of missed anatomical structures per group during the cadaveric demonstration lecture.

Anatomical structure	Group 1 45 p (n/%)		Group 2 30 p (n/%)		Group 3 15 p (n/%)		p (χ^2)
Umbilical artery	28/45	62.2%	14/30	46.7%	4/15	26.7%	0.015*
Common iliac artery	29/45	64.4%	16/30	53.3%	3/15	20.0%	0.012*
External iliac artery	25/45	55.5%	15/30	50.0%	1/15	6.6%	0.004*
Internal iliac artery	26/45	57.7%	9/30	30.0%	1/15	6.6%	0.001*
Uterine artery	26/45	57.7%	10/30	33.3%	4/15	26.7%	0.036*
Ureter	25/45	55.5%	14/30	46.7%	1/15	6.6%	0.004*
Genitofemoral nerve	24/45	53.3%	11/30	36.6%	2/15	13.3%	0.048*
Psoas major muscle	22/45	48.8%	11/30	36.6%	2/15	13.3%	0.052
Paravesical space	22/45	48.8%	15/30	50.0%	3/15	20.0%	0.096
Pararectal space	19/45	42.2%	13/30	43.3%	3/15	20.0%	0.251
Round ligament	15/45	33.3%	10/30	33.3%	1/15	6.6%	0.068
Broad ligament	12/45	26.6%	9/30	30.0%	0/15	0	0.061
Infundibulopelvic ligament	11/45	24.4%	7/30	23.3%	1/15	6.6%	0.322
Proper ovarian ligament	15/45	33.3%	6/30	20.0%	1/15	6.6%	0.090
Uterine tube	11/45	24.4%	7/30	23.3%	0/15	0	0.106
Ovary	11/45	24.4%	5/30	16.6%	0/15	0	0.098
Uterus	10/45	22.2%	5/30	16.6%	0/15	0	0.139
Rectosigmoid colon	11/45	24.4%	4/30	13.3%	0/15	0	0.074
Bladder	9/45	20.0%	4/30	13.3%	0/15	0	0.154

p: participant; χ^2; Chi square. *p<0.05.

Besides the new advances in medical education, the current perspective on teaching anatomy is the combination of mixed-modalities. However, there is no particular way of objective comparison for effectiveness between the teaching modalities. Cadaver dissection lectures are important as they provide a three-dimensional anatomy and a deeper understanding. However, Azer and Eizenberg[6] showed that perception of students for the importance of dissection-based learning decreased gradually and suggested that dissection-based learning should be replaced by recent novel methodologies. The research by Cottam et al.[7] revealed that less than one-third of new residents had adequate anatomy knowledge, since anatomy knowledge is essential in surgical practice. Selcuk et al.[8] described the importance of cadaver dissection courses in improving surgical anatomy knowledge and learning the basic steps of a surgical procedure. Consequently, the type of anatomy teaching should be determined according to the needs and demands of the target population and the primary methodology will change among medical students and residents. In this study, we designed a structured educational plan to demonstrate all the anatomical landmarks of female pelvic anatomy. All pelvic anatomical landmarks were determined before the cadaver lecture as a core syllabus. We showed the anatomical structures to the medical students with a checklist, so no objects were missed or forgotten during the lecture.[9] In this perspective, the major issue was to test whether the increased number of attendees per cadaver table negatively affected the efficacy of education or not.

The cognitive processes related to three-dimensional understanding of cadaver are tactile handling, visual scanning, appreciation of the form and storage in the memory. This educational strategy will structure a clinical competence.[10] High costs of cadavers and time spent to perform dissections with the smell, environmental and emotional conditions constitute the disadvantages of cadaver dissection lectures.[11] However, making cadaver dissection lectures more effective is more important. Students may observe and learn anatomical structures around the master table, so we deal with the question of optimally maintaining each student to get all the anatomical knowledge in the dissection area. This study proved that when the number of attendees per cadaver decreased, the medical students would miss fewer objects with the structured educational program, and the efficacy of cadaver educational lecture improved. In this study, the best results were obtained when students worked in groups of 5 per cadaver; however, when in groups of 10, there was a dramatic increase in the number of missed objects during the education. Additionally, students missed especially small structures such as the uterine artery rather than gross structures such as the broad ligament when the number of students per cadaver table increased.

Moreover, an optional anatomy course additional to the standard program, devoted to specific tasks with supplementation of active cadaver dissection, will break the deficiency in anatomy education in the undergraduate medical curriculum.[12] Many anatomy seniors still highly support the importance of cadaver dissections in education of medical students. On the other hand, many suggest dissection-based learning as a more suitable educational tool for post-graduate surgical training.[1,13] Despite the debate on this issue, cadaver dissection lectures are still highly important in undergraduate medical education, and improve learning anatomical structures with probable variations in a real tissue level.

Conclusion

Cadaver dissection is a fundamental issue in anatomy education and the number of students per cadaver table plays a major role in the efficacy of teaching and learning. Less number of students per cadaver table will decrease the number of missed objects in a structured educational plan and improve the efficacy.

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