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Early Exposure to Clinical Imaging in First Year Medical Student Anatomy Curriculum: A Pilot of Radiology-Anatomy Laboratories using dynamic image review on a PACS teaching environment

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Disclosures

The authors have no pertinent disclosures

Purpose:

- To assess if early exposure to clinical radiologic imaging helps to reinforce traditional methods of teaching anatomy and can act as a bridge to early introduction of pathologic processes to first year medical students.

Materials/Methods:

- As part of a preclinical curriculum redesign increased instruction time was allotted for development of radiology curriculum during the first-year gross anatomy course.

- 3 radiology-anatomy laboratory exercises (Cardiothoracic, Abdominal and Pelvic) were developed with participation from a multispecialty curriculum committee to coincide with the relevant first-year anatomy dissection curriculum at NYU SOM.

- In each 90-minute lab, students (117 total) worked in small groups (of 2-3) reviewing selected anonymized clinical imaging (including CT and MR imaging) using teaching-environment PACS server accessible either on in-class desktops or personal laptop computers to identify the anatomic structures and relationships emphasized in anatomy class. (Figure 1)

Materials/Methods:

Figure 1: NYU SOM first year anatomy students working through CT cases during the Cardiothoracic Radiology anatomy laboratory, November 2017.

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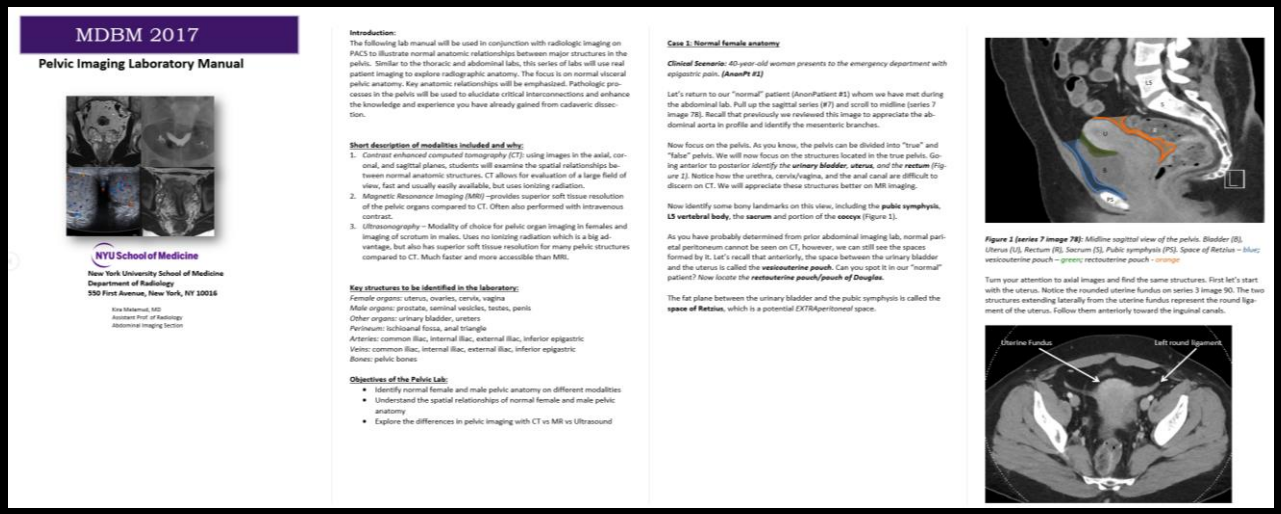
Materials/Methods:

- The students navigated through the cases with the help of laboratory manuals comprised of a series of clinical vignettes and detailed instructions to allow the students to find pertinent imaging anatomy independently. Radiology faculty, fellows and residents were available on site for further assistance. (Figure 2)

- Anonymous 14-question online survey consisting of Likert-scale type questions was distributed after completion of all three laboratory exercises to assess student-perceived attitudes and possible future applications of the experience.

- Image-rich radiology content from the lab exercises was incorporated into the Final anatomy examination (comprising approximately 36% of the multiple choice portion of the exam).

Materials/Methods:



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Pelvic Imaging Laboratory Manual

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Introduction:

The following lab manual will be used in conjunction with radiologic imaging on PACS to illustrate normal anatomic relationships between major structures in the pelvis. Similar to the thoracic and abdominal labs, this series of labs will use real patient imaging to explore radiographic anatomy. The focus is on normal visceral pelvic anatomy. Key anatomic relationships will be emphasized. Pathologic processes in the pelvis will be used to elucidate critical interconnections and enhance the knowledge and experience you have already gained from cadaveric dissection.

Short description of modalities included and why:

1. *Contrast enhanced computed tomography (CT)* using images in the axial, coronal, and sagittal planes, students will examine the spatial relationships between normal anatomic structures. CT allows for evaluation of a large field of view, fast and usually easily available, but uses ionizing radiation.
2. *Magnetic Resonance Imaging (MRI)* –provides superior soft tissue resolution of the pelvic organs compared to CT. Often also performed with intravenous contrast.
3. *Ultrasonography* – Modality of choice for pelvic organ imaging in females and imaging of scrotum in males. Uses no ionizing radiation which is a big advantage, but also has superior soft tissue resolution for many pelvic structures compared to CT. Much faster and more accessible than MRI.

Key structures to be identified in the laboratory:

Female organs: uterus, ovaries, cervix, vagina
Male organs: prostate, seminal vesicles, testes, penis
Other organs: urinary bladder, ureters
Perineum: Ischioanal fossa, anal triangle
Arteries: common iliac, internal iliac, external iliac, inferior epigastric
Veins: common iliac, internal iliac, external iliac, inferior epigastric
Bones: pelvic bones

Objectives of the Pelvic Lab:

- Identify normal female and male pelvic anatomy on different modalities
- Understand the spatial relationships of normal female and male pelvic anatomy
- Explore the differences in pelvic imaging with CT vs MR vs Ultrasound

Case 1: Normal female anatomy

Clinical Scenario: *40-year-old woman presents to the emergency department with epigastric pain.* ***(AnonPt #1)***

Let's return to our "normal" patient (AnonPatient #1) whom we have met during the abdominal lab. Pull up the sagittal series (#7) and scroll to midline (series 7 image 78). Recall that previously we reviewed this image to appreciate the abdominal aorta in profile and identify the mesenteric branches.

Now focus on the pelvis. As you know, the pelvis can be divided into "true" and "false" pelvis. We will now focus on the structures located in the true pelvis. Going anterior to posterior *identify the* ***urinary bladder, uterus,*** *and the* ***rectum*** *(Figure 1).* Notice how the urethra, cervix/vagina, and the anal canal are difficult to discern on CT. We will appreciate these structures better on MR imaging.

Now identify some bony landmarks on this view, including the **pubic symphysis**, **L5 vertebral body**, the **sacrum** and portion of the **coccyx** (Figure 1).

As you have probably determined from prior abdominal imaging lab, normal parietal peritoneum cannot be seen on CT, however, we can still see the spaces formed by it. Let's recall that anteriorly, the space between the urinary bladder and the uterus is called the ***vesicouterine pouch***. Can you spot it in our "normal" patient? *Now locate the* ***rectouterine pouch/pouch of Douglas***.

The fat plane between the urinary bladder and the pubic symphysis is called the **space of Retzius**, which is a potential *EXTRAperitoneal* space.

Figure 1 (series 7 image 78): *Midline sagittal view of the pelvis. Bladder (B), Uterus (U), Rectum (R), Sacrum (S), Pubic symphysis (PS). Space of Retzius – blue; vesicouterine pouch – green; rectouterine pouch - orange*

Turn your attention to axial images and find the same structures. First let's start with the uterus. Notice the rounded uterine fundus on series 3 image 90. The two structures extending laterally from the uterine fundus represent the round ligament of the uterus. Follow them anteriorly toward the inguinal canals.

Figure 2a: Select representation of the content within the Pelvic Imaging Laboratory Manual (pages 1-4)

Patient Name	Item Description	Comment
Pelv_001, Pelv_001	CASE 1: ANONPT #1	CT NORMAL female
Pelv_002, Pelv_002	CASE 2: ANONPT #2	MR Normal Female
Pelv_003, Pelv_003	CASE 3: ANONPT #3	MR Normal Male
Pelv_004, Pelv_004	CASE 4: ANONPT #4	MR female perineum uknown
Pelv_005, Pelv_005	CASE 5: ANONPT #5	CT female pelvic unknown
Pelv_006, Pelv_006	CASE 6: ANONPT #6	US scrotum

Figure 2b: Image of anonymized clinical cases available on PACS "educational server" used for the Pelvic Imaging Laboratory

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Results:

- All first-year students (n= 117) participated in small group hands-on radiology-anatomy laboratories.
- 79 students (68%) completed the post-lab survey.

Question (n= 79/117, 68%)	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Labs helped me understand spatial relationships between anatomic structures	76.9	18.0	3.9	0.0	1.3
Labs helped me understand clinical significance of anatomic relationships and how that may influence disease presentation	67.1	27.9	0.0	2.5	2.5
Labs are a good complement to our cadaver dissection	74.7	20.3	1.3	1.3	2.5
I feel comfortable using PACS: finding, viewing, and manipulating images	51.9	38.0	5.1	5.1	0.0
I liked the image quality of the PACS studies	81.0	17.7	0.0	0.0	1.3
There was appropriate time to complete the lab	33.3	16.7	12.8	18.0	19.2
The experience was fun	53.2	30.4	7.6	7.6	1.3

Results:

- In summary, the lab experience was positively received by the participating students. Majority of students agreed that:
  - Labs were a good complement to cadaveric dissection
  - Labs helped students understand spatial relationships and clinical implications
  - The experience was enjoyable.

- Areas for improvement:
  - Many students reported insufficient time to complete the activity during the assigned supervised classroom hours.
    - Re-evaluation of the quantity of material will certainly have to be assessed for future exercises of this kind, or alternatively increased radiology instruction time will be required.

Conclusions:

- Integration of real clinical radiologic imaging in an anonymized educational-server PACS environment proved to be a highly effective way to reinforce the material taught in traditional cadaveric dissection.
- Students perceived these exercises as valuable in understanding the clinical significance of anatomic relationships.
- This innovative approach demonstrates that radiology can play a pivotal role in early medical student education.
- To our knowledge, our experience is the first of its kind to provide an in-class real clinical multimodality radiologic imaging opportunity with individual hands-on navigation capability in an anonymized educational-server PACS environment for the purpose of enhancing anatomy education.

Future Directions:

- We are currently working on creating radiology-anatomy laboratories for head and neck and upper and lower extremities imaging to coincide with the anatomy curriculum taught to second year medical students, in early fall of 2018.
- We will continue to innovate and modify the existing laboratory exercises to meet the unique needs of first year medical students.
- Growing significance of early medical student exposure to radiology cannot be understated, and this hands-on model may serve as a template for adoption by other institutions.

Thank you!

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