

UTILIZING LEARNING THEORIES IN DEVELOPMENT OF
PELVIC AND UROLOGICAL ANATOMY CURRICULUM FOR CLERKSHIP STUDENTS

by

Shivani Gaitonde, Rena Malik, Philippe Zimmern

DISSERTATION

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CHAPTER 1: INTRODUCTION

Recent years have brought a changing paradigm in medical education, moving towards more active teaching strategies. Educational psychology research has long tried to better understand how learning and knowledge acquisition occur in adults, including Kolb's Experiential Learning model, Self-Determination Theory, and Knowles' theory of Andragogy.¹⁻³ These theories have been applied with success to create curricular activities such as problem-, case- and team-based learning [PBL, CBL, TBL], which have been widely incorporated into medical school curricula.⁴⁻⁷

The first and most prominent learning theory originates from Kolb's model of Experiential Learning.³ According to this constructivist model, individuals have preferred styles of integrating knowledge into existing foundations.² Through what he described as the "learning cycle" [Figure 1], learners should be exposed to knowledge through varied tasks and activities to maximize their learning.⁸ This process first integrates new knowledge (*thinking*) with personal context and experiences (*feeling*), and then requires learners to apply novel information in a practical way (*doing*), such as through problem solving or simulation. Essential to achieving mastery is the opportunity for reflective observation (*watching*), allowing learners to recognize potential gaps in knowledge, identify relevance to real life, and create personal meaning for new knowledge.

Kolb also developed the Learning Style Inventory, a self-assessment tool which scores learners in four dimensions: active experimentation, concrete experience, abstract

conceptualization, and reflective observation.⁹ Learners have varying strength of each of these dimensions, manifesting as a preference for one of four distinct learning styles, represented by each quadrant of the learning cycle model. *Diverging* learners best utilize reflection and brainstorming where they are able to produce ideas that “diverge”.¹⁰ *Converging* learners, conversely, prioritize evidence-based reasoning where they can “converge” on a specific problem. *Assimilators* thrive when “assimilating” contradictory observations to fit a cohesive solution, while *accommodators* prefer learning more actively, adjusting their beliefs and ideas to “accommodate” new experiences.¹¹

Over the years, numerous studies have applied Kolb’s Learning Style Inventory to compare preferences between learners and experts, particularly in medical education. Internal medicine residents and faculty, for example, were found to be predominately *assimilating* learners, while the majority of pediatric residents were identified as *converging* learners.^{12,13} In other studies, family medicine residents were found to be largely *accommodating*, versus faculty who were predominately *converging*.^{11,14} Studies examining general surgery trainees found that medical students were significantly more *assimilating* than surgical residents or faculty, who were predominately *convergers* and *accommodators*.¹⁵⁻¹⁷ These learning style preferences carry over to specialty choices of graduating medical students – *convergers* tended to choose specialties like surgery, *assimilators* preferred internal medicine, and *divergers* chose psychiatry.¹⁸

Similarly, Knowles’ theory of adult learning, called “Andragogy”, describes six principles that influence the social context of learning: 1) learner’s need to know, 2) self-concept,

3) prior experience, 4) readiness to learn, 5) orientation to learning, and 6) motivation to learn.¹⁹

These principles address the attitudes towards and perceived significance of an educational intervention. This social context of curriculum is what provides adults with an incentive to learn, and curriculum will only be effective if the learners feel the curriculum is worth investing in.

Yet another model of adult learning, Self-Determination Theory, postulated by Ryan and Deci, further explores motivation behind learning.^{20,21} Motivation for learning may be extrinsic, such as through positive evaluations or rewards, or intrinsic, arising from within the learner themselves. Three essential components of intrinsic motivation are *relatedness*, *autonomy*, and *competence* [Figure 2]. For any curriculum to be optimally successful, the learner should feel that they have a respectful relationship with the teacher as a colleague, an idea that supports the use of near-peer teachers. Studies have found that proficient medical students are successfully able to teach less experienced peers, particularly for subjects such as anatomy, with mutual benefit to both students and near-peer teachers.²²⁻²⁴ Additionally, the success of incorporating cases and problem solving into curriculum may be due to increased sense of autonomy, as students can work through problems independently, and when successful, feel more competent.^{20,25,26}

According to Kolb, while each style of learner may prefer a different dimension of the learning cycle, all elements – feeling, watching, thinking, and doing – are essential in achieving mastery.²⁷ Evidence-based educational strategies may facilitate progression through the learning cycle. For example, discussion and open-ended questions are thought to enhance reflection and brainstorming skills.¹ Models, videos and other reusable learning objects can provide hands-on

and kinesthetic learning. Integrating problem solving with traditional lectures through case vignettes or audience-response systems allows learners to practice knowledge retrieval, conceptualization and application. Near-peer teachers, being closer to the novice level, more easily recall concepts they found challenging and can impart useful metacognitive and critical thinking skills.

In an effort to bridge the gap between medical students and faculty educators, utilizing learning theories and interactive elements as a basis for new curriculum development may improve student engagement and knowledge acquisition. The consensus drawn from the literature review of these three main learning theories is that quality curriculum should involve a supportive environment, allow learners to access prior knowledge and experience, integrate those with new concepts, organize and refine understanding through practice, and finally, provide opportunity for reflection and consolidation of new knowledge.² To obviate criticism surrounding exclusionary “style-matching” curricular approaches, this medical education project sought to more broadly integrate “traditional” lecture-based instruction with varied interactive and case-based elements, to meet the needs of all types of learners.

CHAPTER 2: OBJECTIVES

This project was specifically inspired by the need for a urological and pelvic anatomy review lecture during the UT Southwestern Surgery clerkship rotation. During the 8-week block, no lecture covered urologic conditions, and few students had the opportunity to rotate on a Urology service. Nevertheless, students are expected to know the pathophysiology and management of common urologic conditions, such as urinary retention, urologic malignancies, and surgical emergencies, for standardized exams. Because much of the existing didactic curriculum is lecture-based or self-study, we proposed that near-peer instruction might provide a more approachable social context, without time or financial constraints. Our goal was to apply these learning theories to create a pelvic and urologic anatomy review lecture during the Surgery clerkship, and if the feedback was positive, study ways to permanently integrate this new curriculum into medical student education.

CHAPTER 3: METHODS

Curriculum development strategies were adapted from the approach proposed by the Johns Hopkins University School of Medicine.¹

1. Problem Identification and General Needs Assessment

First, a curricular problem was identified. In this project, the UT Southwestern Surgery Clerkship rotation lacked a quality review course for anatomy, specifically offering no clinical lectures discussing pelvic and/or urologic conditions. Next a general needs assessment was conducted, to determine if educational intervention was warranted. Students on their Surgery block were informally queried. Anecdotally, many clinical students felt anatomy was one of their weakest areas during board exam and end-of-course exam preparation, as they had completed the gross anatomy course very early in preclinical education. With a busy schedule, students lacked the time, motivation, or aptitude to review anatomy from a textbook, in addition to completing required clinical duties and case preparation. However, anatomic landmarks are crucial for surgery, and residents and faculty frequently quiz students about these clinically relevant structures. Even students pursuing nonsurgical specialties, like internal medicine, emergency medicine, or pediatrics, will need to recognize and manage common urologic conditions.

2. Targeted Needs Assessment

Next, a targeted needs assessment was conducted to specifically define the intended learners and their needs, and how the proposed educational intervention would address those needs better than the previous curriculum. In this project, the targeted learners were UT

Southwestern Surgery Clerkship students, including both second- and third-year medical students. A need was identified for a clerkship level review of pelvic anatomy of surgical and urological importance, addressing expectations of faculty and testable elements on standardized exams. In the current curriculum, students review anatomy material on their own time, and faculty typically assess fund of knowledge during cases. However, a major flaw of this system is that it requires the discipline of taking time to go back to prior anatomy lectures during independent study time. In addition, students not proficient in anatomy may have trouble relating non-realistic illustrations or cadaveric images to real patient conditions. This new curriculum reintroduces key anatomical landmarks in the context of their clinical relevance.

3. Goals and Objectives

Our goal was to help students better understand urologic and pelvic anatomy, and relate this to the clinical setting. The objectives of this new curriculum were based on content from the American Urological Association Medical Student Curriculum.²⁸ These objectives represent the recommended knowledge base for all graduating medical students, regardless of chosen specialty, and were tailored for this curricular intervention based on time constraints, needs of learners, and faculty input.

4. Educational Strategies

This curriculum was created using principles of learning theory, specifically Kolb's Experiential Learning, Self-Determination Theory, and Knowles' Andragogy. Evidence-based learning tools were adapted to create an interactive review lecture. Specific educational strategies

included pelvic models, laparoscopic videos and photos, case-based learning, near-peer teaching, and audience-response systems integrated into the lecture.

5. Implementation

To successfully implement this curriculum, we first identified available resources, including faculty from the Departments of Surgery, Urology, and Cell Biology (Anatomy program), learning tools and technology available, and space and time available for teaching. During development of this project, Surgery clerkship students had weekly didactic days with hour-long lecture slots from 9:00 a.m. to 2:00 p.m. Pelvis models were available to use from the Anatomy program. Permission for reuse was requested for any copyrighted curricular content.

Next, the stakeholders, or people affected by this curriculum intervention, were approached early in curriculum development. Surgery clerkship faculty were contacted about adding this review lecture during available time slots. To relieve burden on faculty and better implement elements of learning theory, we proposed to make this a near-peer teaching session led by myself. Content was reviewed with the clerkship director, as well as faculty in the Urology and Anatomy departments. Students were then informed of a voluntary pilot session. To incentivize student attendance, we emphasized that the lecture would be “low-risk”, occur at a convenient time (i.e. lunch or during existing didactic days), and cover exam review material.

Logistics of creating a new curriculum were considered. First, administrative tasks were completed: requesting IRB exemption, completing a “pre-pilot” trial run with volunteer students in the Medical Education Track, and scheduling teaching sessions. Barriers identified during

development of this new curriculum involved competing expectations from different stakeholders, addressing the needs of both students and faculty, and tackling potential resistance and negative attitudes.

Initiation of this teaching session occurred in three phases. After the “pre-pilot” was conducted with a volunteer group of medical education students, a pilot trial of the review session was run as a lunch lecture with volunteer Surgery clerkship students. Finally, for the subsequent blocks of Surgery students, full-implementation of this one-hour lecture was scheduled during didactic days.

6. Evaluation and Feedback

The project was a pretest/posttest, pre-experimental design. Curriculum was evaluated using both quantitative and qualitative measures. Multiple choice pretest and posttest were administered to students before and after the teaching session. To maximize response rate and minimize testing fatigue, assessments were deliberately limited to five questions, completed on paper, and physically turned in following the teaching session. Data was analyzed using paired *t*-test, and effect size was calculated using Cohen’s *d*. Students were also given a feedback survey following the session, graded using a 5-point Likert scale (1 for “Strongly Disagree” to 5 for “Strongly Agree”), and an optional free-response section requesting comments and suggestions for improvement.

7. Curriculum Maintenance and Enhancement

Future curriculum maintenance depends on the cycle of feedback from students and faculty. With each iteration, revisions and enhancements should improve quality of the curriculum and congruence with needs of learners. Sustaining this curriculum in the distant future may require training interested near-peer teachers or video-recording a teaching session for online access. Ultimately, publishing this review lecture will allow dissemination of this material, which could be used in other clerkship courses or at other institutions.

CHAPTER 4: RESULTS

The curriculum developed in this study was initially piloted for a small “pre-pilot” volunteer group, $n = 5$, and subsequently implemented for a larger pilot group, $n = 22$. We then proceeded with full-implementation of the curriculum for 2 additional teaching sessions, $n = 102$ students. The course materials are located as follows: review lecture slides [Appendix and Supplemental Files], curriculum outline and objectives [Table 1], feedback survey [Figure 3] and pre/post-test assessment [Figure 4].

Feedback from the initial pilot and subsequent full-scale teaching sessions indicated that the curriculum was well received by participants. Student attendance was 75% for the pilot lecture and 100% for the full-implementation lecture. Pretest scores ranged from 20% (1/5) to 100% (5/5) correct, with a mean score of 70% and median score of 80%. On the posttest taken immediately following a one-hour teaching session, almost all participants scored 100% (5/5), with only one participant scoring 80% (4/5). Average improvement from pretest to posttests was 29 points, roughly a 41% increase in scores [Figure 5]. This improvement was statistically significant ($p < 0.01$) with a large Cohen’s effect size ($d = 2.00$).

On the blinded survey distributed after the teaching session, approximately 80% of participants responded [Table 2]. When asked if they enjoyed attending the session, 100% of participants reported either “Agree” or “Strongly Agree”, corresponding to an average 4.8 out of 5-point Likert scale. Participants reported on average 4.7 out of 5 when asked if the teaching session was helpful to them and if the session improved their understanding of pelvic and

urologic anatomy. When asked if the content of the session was at an appropriate level, participants reported on average 4.6 out of 5. Finally, when asked if they would recommend the teaching session for future students, participants agreed, reporting on average 4.8 out of 5.

Free-response feedback comments were also encouraged from participating students in an effort to improve weak areas of the curriculum. Three participants in the initial pilot session mentioned that the session was a little fast-paced and they would have liked “more time spent on anatomy”, “vasculature and buzzwords”, and “more time to review practice questions”. One student felt “use of pelvic models was unnecessary”, while another student noted, “I really enjoyed seeing the pelvic model in 3D”. Several students requested “a copy of the slides or a handout after the session to summarize topics”. Logistics of the session were commented on as well: “Use a pointer” and “Make front of room darker so we can see pictures more easily”. Students specifically expressed that my instruction style was “engaging” and “passionate”. These critical comments were utilized during curriculum development, and revisions were made accordingly. By the final teaching session, several students expressed that they “loved the lecture”; overall, students reported that it was “enjoyable”, “helpful”, and “useful”.

CHAPTER 5: DISCUSSION

In this medical education project, we created a new pelvic and urologic anatomy review curriculum using instructional strategies inspired by learning theories. We then successfully implemented this curriculum into the Surgery clerkship. Though the number of participating students was modest, we found significant improvement between pre- and posttest performance and received much positive feedback. Qualitative comments were essential in making curricular revisions. For example, lights were dimmed during presentation and videos to help students see slides better. The speed of the lecture overall was slowed, cutting out lower yield discussion points about specific surgeries and spending more time on reviewing questions. Curricular improvement was demonstrated, with overall more positive comments in later teaching session.

As this project's aim was to create and improve upon a new curriculum intervention, the assessments mainly served as a measure for the quality of the curriculum. Given that the Surgery clerkship included a mix of both second- and third-year students of varying expertise levels, and the sample size for each session was relatively small, using students as their own control yielded better information about the benefit of this review lecture. Though the 5-question mini assessment was understandably limited in gauging long-term knowledge retention as it was administered immediately following the teaching session, it did demonstrate that students objectively gained something from the lecture, at least in the short-term. Even so, confounding factors such as timing of the teaching session (closer to the beginning versus closer to the end of a block), previous services rotated on, and simultaneous independent study, may influence how students performed on these assessments.

Additionally, quality and experience of the instructor plays a large role and may confound student perception of the curriculum overall. While I attempted to create a “script” with essential information that could be reproduced by another teacher, the social context of a learning experience depends immensely upon learner-educator dynamics¹⁹. As an experienced near-peer tutor and the creator of this curriculum, I was passionate about this topic; several students mentioned that they enjoyed my enthusiasm and my personal instruction style. To maintain a positive social context will require identifying and training future near-peer teachers, who are equally enthusiastic about urologic and pelvic anatomy.

Maintenance of any curriculum is essential to its survival and efficacy, through improvement of both the content and delivery over time. Due to time constraints and logistics, I was unable to continue teaching this curriculum in person over the fall semester. To address this issue, an electronic copy of the slides was posted on the Surgery Clerkship online portal. Students could thus still utilize this review curriculum, albeit without the complete interactive experience. In an effort to better engage learners through this completely online avenue, a review handout was created (Appendix). The benefit was two-fold: reiterate the most important learning objectives through cueing questions, as well as better incorporate the “active experimentation” dimension of the learning cycle. In the future, recruiting another motivated near-peer teacher, or video-recording myself delivering this lecture and providing it to future students as an electronic resource, may eliminate this “lecture-delivery” parameter.

While producing engaging and effective curriculum requires additional effort compared to traditional passive lectures, it can be very rewarding and mutually beneficial to both students and the educator. Although student's perceived enjoyment of a lecture may not be congruent with how much a student learns, it is more rewarding as an instructor to see students engaged, participating and applying knowledge. The major benefits of our near-peer style of curriculum are the relief on faculty members' time, improved flexibility, and more easygoing rapport between student and teacher. As nothing is available on MedEd Portal or other online curriculum databases regarding review of pelvic and urologic anatomy as it relates to clinical scenarios, or applications of learning theories to curriculum development, we hope other institutions will find this curriculum to be useful and easy to utilize.

CHAPTER 6: CONCLUSIONS

Given that all medical students should take away a solid basis of each field of medicine during their clerkships, bridging the gap between learners and educators is imperative. This project supports that exposing learners to information with varied educational strategies can facilitate learning and create a more enjoyable learning experience. Designing an interactive curriculum may encourage students of different personalities and learning styles to absorb new knowledge and possibly consider pursuing fields that they would have not otherwise considered. In the short term, students can gain better performance on standardized exams. In the long term, this improved instruction style can create better medical professionals, who have sufficient knowledge outside of their own field and can work with other specialists more seamlessly.

FIGURES

Figure 1. Kolb's Learning Cycle^{3,9}

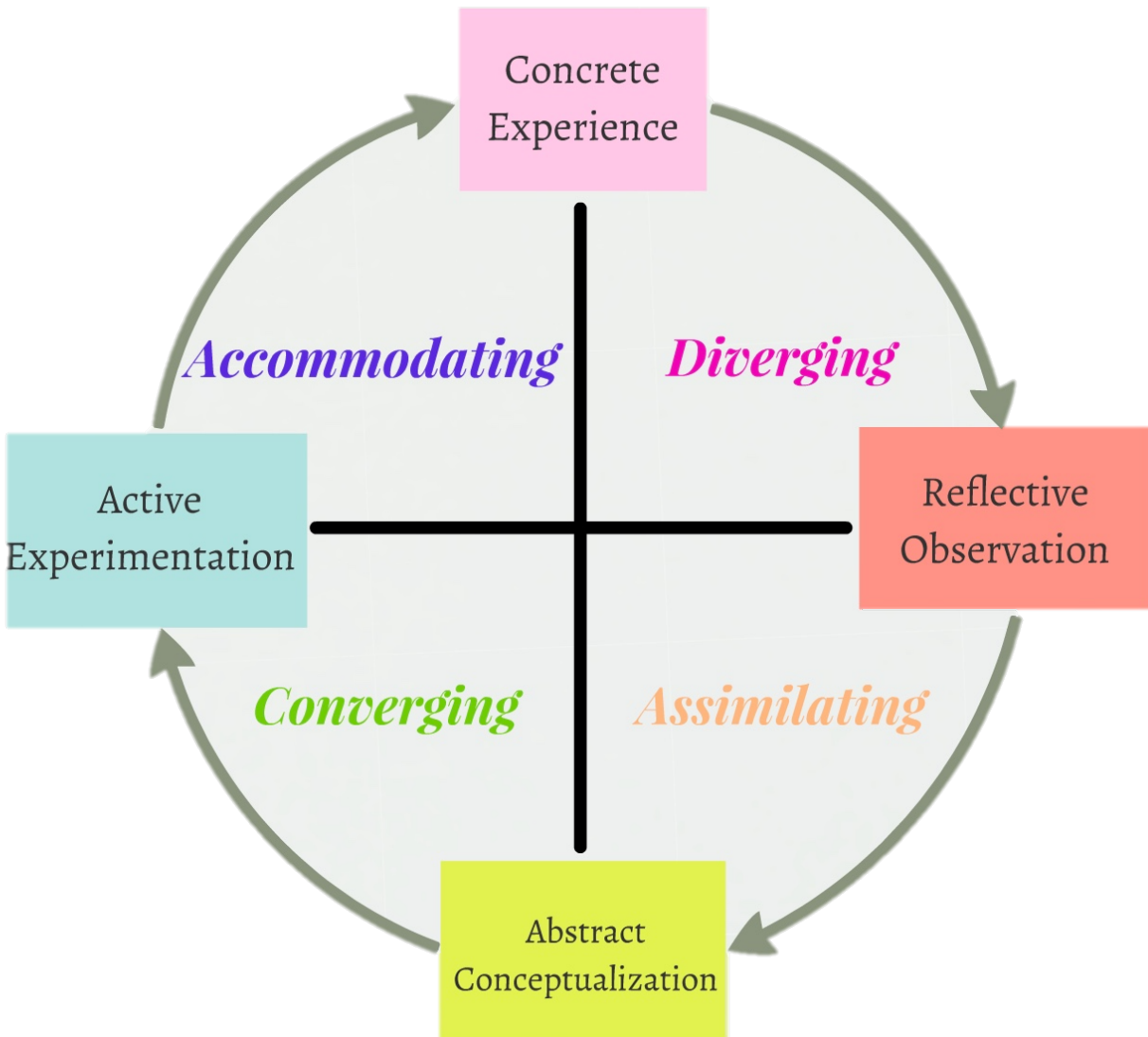


Figure 2. Self-Determination Theory and Intrinsic Motivation

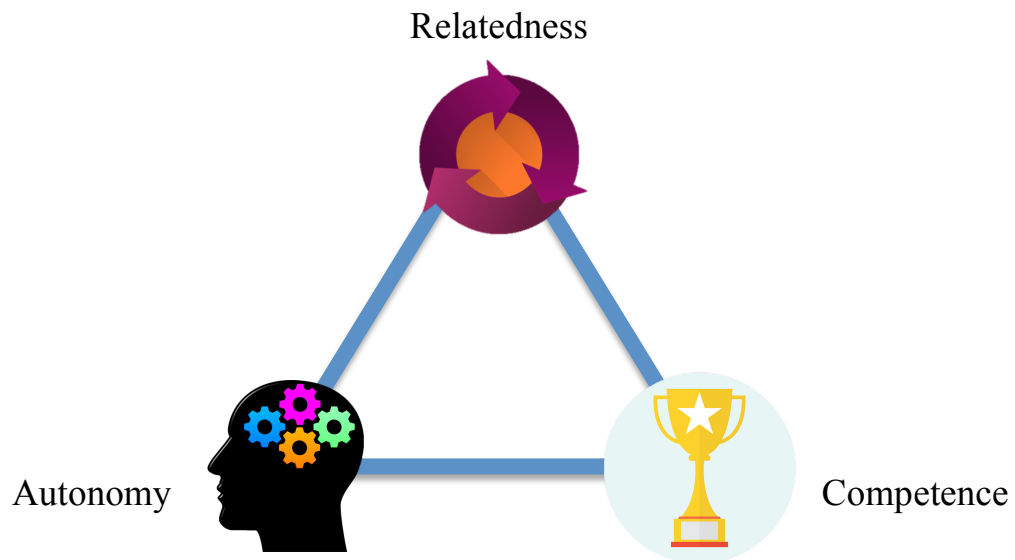


Figure 3. Post-test Feedback Survey (Likert-scale and Free Response)

Thank you for participating in this session! Your feedback is welcome and appreciated, as it will improve the quality of this medical education project.

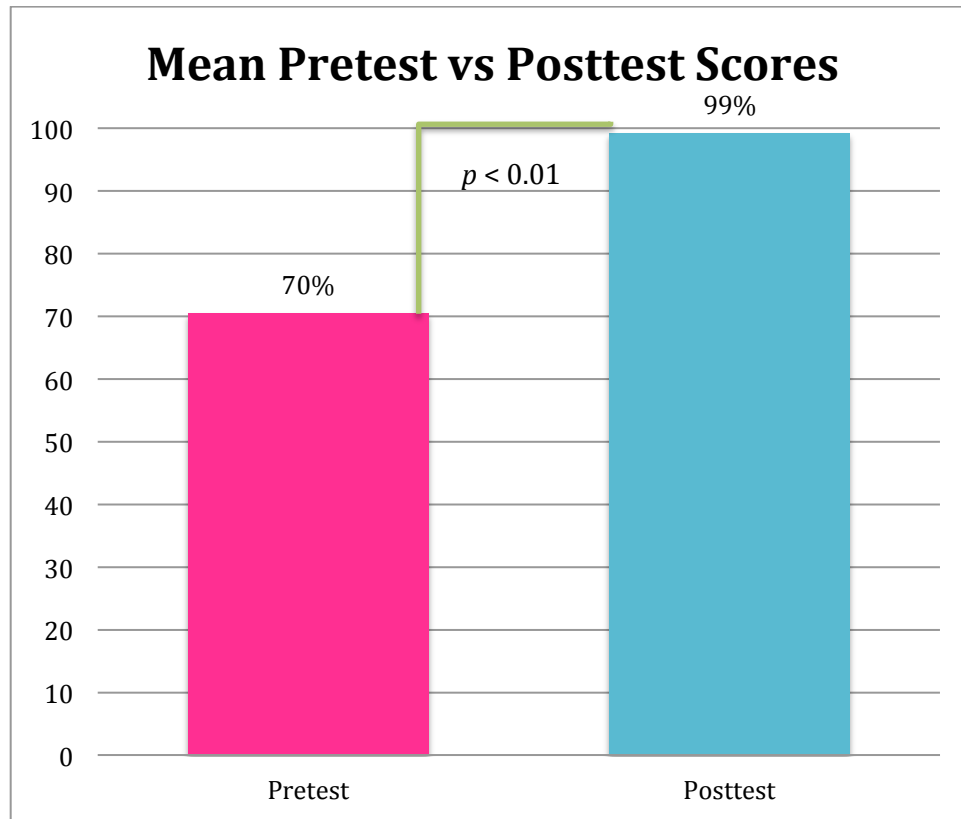
I enjoyed attending this session.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
This session helped me learn or review concepts.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
This session improved my understanding of urologic anatomy and pathology.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The content of this session was at an appropriate level.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would recommend this session to future students.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

What did you like or dislike? What should be changed? Any additional comments:

Figure 4. Pre- and Post-Test Assessment

<p>PELVIC ANATOMY PRETEST/POSTTEST</p> <p>You have 5 minutes to complete this assessment.</p> <p><i>Please do not record your name or personal identifiers on this sheet. Participation in this medical education project is voluntary and your scores will not have any affect on your grade.</i></p>	
1.	<p>A 60-year old man with coronary artery disease, hypertension, type 2 diabetes, and benign prostatic hyperplasia presents to Emergency Department at 9 pm with complaints of suprapubic pain and discomfort. For the last 6 hours, he has been going to the bathroom every 15 minutes to void. Vitals are significant for BP 145/85 and HR 105. Bladder scan shows 500 cc. What is the best <i>next step</i>?</p> <p>A. Observation</p> <p>B. Bethanechol</p> <p>C. Oxybutynin</p> <p>D. Catheterization</p> <p>E. Transurethral resection of the prostate [TURP]</p>
2.	<p>A 50-year old female presents to the Emergency Department in severe pain. She cannot lie still and has vomited three times in the last 12 hours. Vitals are significant for Tmax 101.4 and HR 110. WBC is 15,000. Non-contrast CT reveals an 8 mm obstructing stone at the ureteropelvic junction. The patient receives IV fluids and pain control in the ER, and is feeling better. What is the best <i>next step</i>?</p> <p>A. Observation</p> <p>B. Oral antibiotics</p> <p>C. Calcium-channel blockers</p> <p>D. Ureteroscopy with stent placement</p> <p>E. Laser lithotripsy</p>
3.	<p>A 74-year old male with atrial fibrillation, coronary artery disease, peripheral artery disease, type 2 diabetes and hypertension presents to clinic for annual follow-up. He has been consistently taking his medications, which include: Hydrochlorothiazide, Metformin, Lisinopril, Simvastatin, Aspirin, Warfarin, and Nitroglycerin.</p> <p>Labs are: Na 143, K 3.8, Cl 104, CO₂ 26, BUN 12, Cr 1.1, Hg 13.0, INR 2.2, HgA1c 7.3</p> <p>Screening urinalysis reveals: pH 5.8, Specific gravity 1.01, (-) glucose, (-) ketones, (-) protein, (-) nitrites, 50 RBC/hpf, 5 WBC/hpf, and 5 squamous epithelial cells. What is the best <i>next step</i>?</p> <p>A. Observation</p> <p>B. Repeat urinalysis in 2 weeks</p> <p>C. Stop warfarin</p> <p>D. Urine culture and CBC with differential</p> <p>E. Cystoscopy, urine cytology and CT Urogram</p>
4.	<p>A 55-year G4P4 presents to clinic complaining of incontinence. She admits that she has been having daily leakage of urine with exercise or laughing. She wears 2 pads per day that are moderately soaked. She denies urgency, frequency and nocturia. On exam, she has leakage with supine cough test. Urinalysis shows: pH 5.0, Specific gravity 1.008, (-) glucose, (-) ketones, (-) protein, (-) nitrites, 5 RBC/hpf, 2 WBC/hpf, and 2 squamous epithelial cells. Urine flow is measured at 12 mL/s. Post-void residual is 10cc. What is the diagnosis?</p> <p>A. Stress incontinence</p> <p>B. Overflow incontinence</p> <p>C. Urgency incontinence</p> <p>D. Mixed incontinence</p> <p>E. Valsalva incontinence</p>
5.	<p>A 10-year old boy comes to the Emergency Department with groin pain and swelling that started after recess. He has been very nauseous and vomits in the ED. Vitals show Tmax 99.7, BP 120/80, and HR of 105. Exam is difficult as patient is in severe pain, but left side of scrotum appears swollen and higher than right. He cries in pain with elevation of left testicle, and there is no change when the left inner thigh is stroked. Scrotal US shows lack of flow to the left testicle. What is the best <i>next step</i>?</p> <p>A. Observation</p> <p>B. NSAIDs</p> <p>C. IV Antibiotics</p> <p>D. Urine gonorrhea and chlamydia</p> <p>E. Scrotal exploration</p>

Figure 5. Mean Pretest versus Posttest Scores, $n = 124$



TABLES

Table 1. Curriculum Outline and Objectives

Topic	Objective
Overview of the Pelvis	1. Recognize bony landmarks of the pelvis.
	2. Understand internal iliac arterial branching patterns in the pelvis.
Urologic Emergencies	3. Understand how to recognize and acutely manage the following urologic emergencies: acute urinary retention, obstructive pyelonephritis, gross hematuria with clot retention, priapism, penile fracture, Fournier's gangrene, and paraphimosis.
Kidneys	4. Review anatomic features of the kidney.
	5. Understand correlation between anatomy and clinical presentation of kidney stones and renal trauma.
	6. Compare presentation of acute renal colic and acute abdomen, and understand when surgical management of stones is necessary.
Ureters	7. Review anatomic location of the ureters.
	8. Understand classic presentation of ureteral injury and ureteral stones.
Bladder	9. Review anatomic features of the bladder and pelvic floor.
	10. Understand most common causes of micro- and gross hematuria, and basics of management.
	11. Know indications for cystoscopy in a patient with hematuria.
	12. Differentiate pathophysiology of stress, urge, and overflow incontinence, and basics of management.
Prostate	13. Review anatomic location and zones of the prostate.
	14. Understand presentation and pathophysiology of benign prostatic hyperplasia [BPH] and prostate cancer.
Scrotum	15. Review anatomy of the scrotum and spermatic cord, specifically as pertains to pathology including: trauma, infection, torsion, malignancy, or fluid collections.
	16. Understand causes of acute scrotal pain, and basics of management.

Table 2. Students' Perceptions Following Teaching Session (5-point Likert Scale), $n = 124$

Statement	Mean Response (1 = "Strongly Disagree", 5 = "Strongly Agree")
I enjoyed attending this session.	4.8
This session helped me learn or review concepts.	4.7
This session improved my understanding of urologic anatomy and pathology.	4.7
The content of this session was at an appropriate level.	4.6
I would recommend this session to future students.	4.8

REFERENCES

1. Thomas PA, Kern DE, Hughes MT, Chen BT. *Curriculum Development for Medical Education: A Six-Step Approach*. 3rd ed. Baltimore: Johns Hopkins University Press; 2016.
2. Taylor DC, Hamdy H. Adult learning theories: implications for learning and teaching in medical education: AMEE Guide No. 83. *Med Teach*. (1466-187X (Electronic)).
3. Kolb DA. *Experiential Learning*. Englewood Cliffs; 1984.
4. Ferguson KJ, Kreiter CD. Assessing the relationship between peer and facilitator evaluations in case - based learning. *Medical Education*. 2007;41(9):906-908.
5. Taylor D, Mifflin B. Problem-based learning: where are we now? *Med Teach*. 2008;30(8):742-763.
6. Michaelsen LK, Knight AB, Fink LD. Team-Based Learning: A Transformative Use of Small Groups in College Teaching. *Sterling VA*. 2004.
7. Onyon C. Problem-based learning: a review of the educational and psychological theory. *Clin Teach*. (1743-498X (Electronic)).
8. Yardley S, Teunissen PW, Dornan T. Experiential learning: AMEE Guide No. 63. *Med Teach*. 2012;34(2):e102-e115.
9. Kolb DA. *Learning Style Inventory Technical Manual*. McBer Boston, MA; 1976.
10. Torrealba DR. *Convergent and divergent learning styles*. Massachusetts Institute of Technology; 1972.
11. Plovnick MS. Primary care career choices and medical student learning styles. *J Med Educ*. 1975;50(9):849-855.

12. Adesunloye B, Aladesanmi O. The preferred learning style among residents and faculty members of an internal medicine residency program. *J Natl Med Assoc.* (0027-9684 (Print)).
13. Tuli SY, Thompson LA, Saliba H, et al. Pediatric Residents' Learning Styles and Temperaments and Their Relationships to Standardized Test Scores. *J Grad Med Educ.* 2011;3(4):566-570.
14. Sadler GR, Plovnick M, Snope FC. Learning styles and teaching implications. *Acad Med.* 1978;53(10):847-849.
15. Baker J, Reines H, Wallace C. Learning style analysis in surgical training. *Am Surg.* (0003-1348 (Print)).
16. Contessa J, Ciardiello K, Perlman S. Surgery resident learning styles and academic achievement. *Curr Surg.* (0149-7944 (Print)).
17. Engels PT, de Gara C. Learning styles of medical students, general surgery residents, and general surgeons: implications for surgical education. *BMC Med Educ.* (1472-6920 (Electronic)).
18. Bitran M, Zuniga D, Lafuente M, Viviani P, Mena B. Influence of personality and learning styles in the choice of medical specialty. *Rev Med, Chil.* (0034-9887 (Print)).
19. Knowles MS, Holton Iii EF, Swanson RA. *The adult learner: The definitive classic in adult education and human resource development.* Routledge; 2014.
20. Ten Cate T, RA K, Williams G. How self-determination theory can assist our understanding of the teaching and learning processes in medical education. AMEE guide No. 59. *Med Teach.* (1466-187X (Electronic)).

21. Ryan RM, Deci EL. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol.* (0003-066X (Print)).
22. Meller SM, Chen M, Chen R, Haeseler FD. Near-peer teaching in a required third-year clerkship. *J Biol Med.* (1551-4056 (Electronic)).
23. Naeger DM, Conrad M, Nguyen J, Kohi M, Webb E. Students teaching students: evaluation of a "near-peer" teaching experience. *Acad Radiol.* (1878-4046 (Electronic)).
24. de Menezes S, Premnath D. Near-peer education: a novel teaching program. *J Med Educ.* (2042-6372 (Electronic)).
25. Schumacher DJ, Englander R Fau - Carraccio C, Carraccio C. Developing the master learner: applying learning theory to the learner, the teacher, and the learning environment. *Acad Med.* (1938-808X (Electronic)).
26. Albanese MA, Mitchell S. Problem-based learning: A review of literature on its outcomes and implementation issues. *Acad Med.* 1993;68:52-52.
27. Cassidy S. Learning Styles: An overview of theories, models, and measures. *Educ Psychol.* 2004;24(4):419-444.
28. Kerfoot P, Turek P. Medical Student Curriculum. *AUAUniversity* 2018;
<https://www.auanet.org/education/auauniversity/medical-student-education/medical-student-curriculum>, 2018.

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APPENDIX

Review Handout

1. UROLOGIC EMERGENCIES - Match buzzwords, diagnosis, and best step in management.

Buzzwords	Diagnosis	Management
	Fournier's gangrene	
	Paraphimosis	
	Priapism	
	Obstructive nephrolithiasis	
	Gross hematuria with clot retention	
	Acute urinary retention	
	Penile fracture	

2. KIDNEYS

- Primary difference between L and R renal vein anatomy?
- What pathology correlates to L vs R venous obstruction?

3. URETERS

- Where do stones most commonly obstruct the ureter?
- Where are ureters most commonly injured in surgeries?
- Which stones can be medically managed?
- Compare and contrast the presentation of acute renal colic and an acute abdomen:

	Acute Renal Colic	Acute Abdomen
History:		
Physical Exam:		

- What 4 symptoms make nephrolithiasis a surgical emergency?

4. BLADDER

- What is the primary component of the bladder wall and how is it regulated by parasympathetic and sympathetic innervation?
- What 4 muscle portions make up the pelvic floor?
- What tests are used to work up gross hematuria? How do you differentiate surgical vs medical renal disease?
- Match the type of urinary incontinence, buzzwords, and basic management:

Type of Incontinence	Buzzwords	Management
Stress		
Urgency		
Overflow		

- What are two conditions that you should always rule out in patients with new symptoms of incontinence?

5. PROSTATE

- What are the four zones of the prostate?
- Clinically, where is BPH versus prostate adenocarcinoma more likely to occur?

6. SCROTUM

- Compare and contrast arterial, venous and nervous branching of the testes versus scrotum.

Anatomic Structure	Testes	Scrotum (skin)
Arterial Supply		
Venous Flow		
Nervous Innervation		

- What are the 3 thermoregulatory mechanisms that occur in the scrotum? Why is thermoregulation clinically significant?

- Match the cause of acute scrotal pain with buzzwords and next step in management:

Differential	Buzzwords	Management
Testicular torsion		
Appendiceal torsion		
Epididymitis		
Trauma		
Testicular tumor		
Hernia		

PELVIC AND UROLOGIC ANATOMY FOR CLERKSHIP STUDENTS

Shivani Gaitonde
UT Southwestern Medical Center

PRE-TEST

Thank you for coming! Please complete the pre-test. No names or personal identifiers please!
Don't worry – it's not a grade!

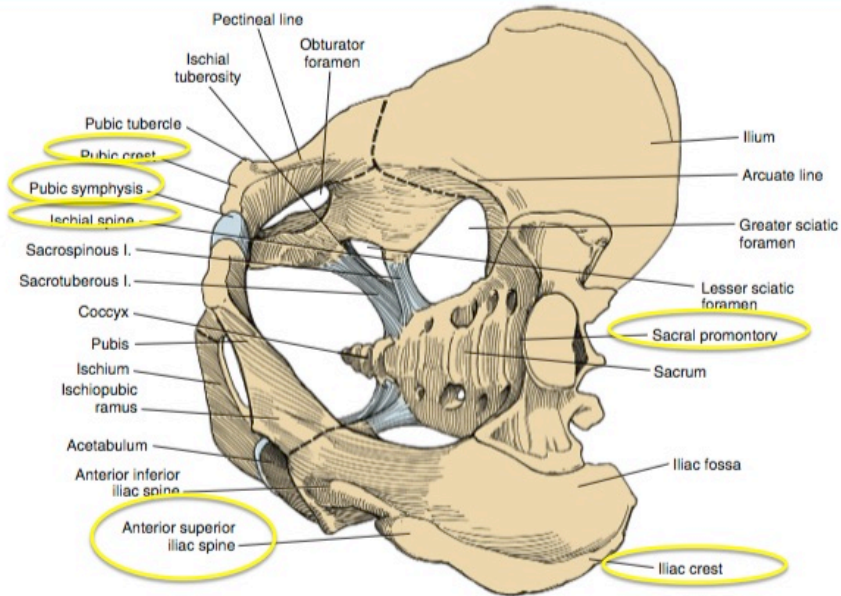
Overview of the Pelvis

Recognize bony structures and borders of the pelvis.
Understand arterial branching patterns in the pelvis.

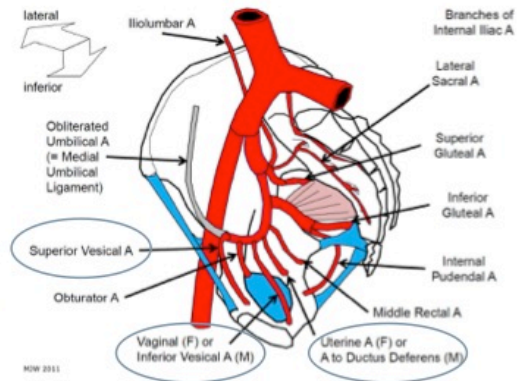
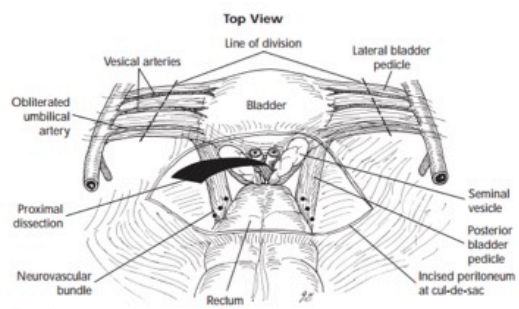
Objectives

- Overview of the Pelvis
- Urologic Emergencies
- Areas of focus:
 - ▣ Kidneys and Ureters
 - ▣ Bladder and Pelvic Floor
 - ▣ Prostate
 - ▣ Scrotum

Pelvic Landmarks



Blood Supply



A Laparoscopic Tour

https://youtu.be/h3mUMhtIZ_A?t=131

Urologic Emergencies

Recognize common urologic emergencies and basics of management.

Case 1: Urologic Emergencies

- 60 y man with BPH suddenly develops suprapubic pain, discomfort and cannot void. Bladder scan shows 500 cc.
Acute urinary retention → catheterization
- Elderly female with history of nephrolithiasis presents with flank pain, fevers, dysuria, and CVA tenderness.
Obstructive pyelonephritis → Non-contrast CT and surgery
- 75 y man with BPH s/p TURP continues to pass frank blood in urine. Now passing clots with increasing suprapubic pain and difficulty voiding.
Gross hematuria with clot retention → Foley catheter with bladder irrigation
- 20 y male with Sickle Cell presents in severe pain with erythematous, tender erection for last 4 hours.
Priapism → Corporal aspiration, alpha-1 agonist to constrict vessels
- Man says he "slipped and fell", heard snap with painful swelling. Imaging shows...
Penile fracture → Retrograde urethrogram and surgery
- 80 y woman with uncontrolled diabetes presents with hypotension, fever and chills. Pelvic exam shows...
Fournier's gangrene → Surgery and IV Antibiotics
- 35 y male presents with penile pain, difficulty voiding, and worsening swelling of foreskin. Exam shows...
Paraphimosis → Lidocaine followed by manual reduction

Kidneys and Ureters

Review the anatomy of the kidneys and ureters.

Understand correlates of common pathology: kidney stones, iatrogenic injury and trauma.

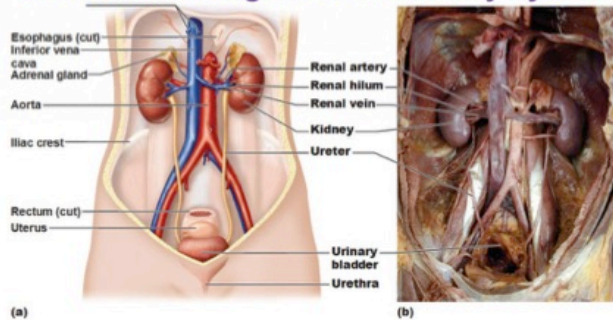
Compare acute renal colic and acute abdomen, and when surgical management is necessary.

Kidneys

- **Anatomy**

- Retroperitoneal, ~T11 to L3
- Left renal vein longer than right
 - Left testicular/ovarian and adrenal veins enter **left renal vein**
 - Veins on right side **enter IVC**

Orientation of Organs of the Urinary System



Ureters

- **Anatomy**

- ~25-30 cm in length, 10mm to 1mm in diameter
- **Retroperitoneal**, along psoas major muscle
- Runs from renal pelvis [UPJ] to trigone of the bladder [UVJ]



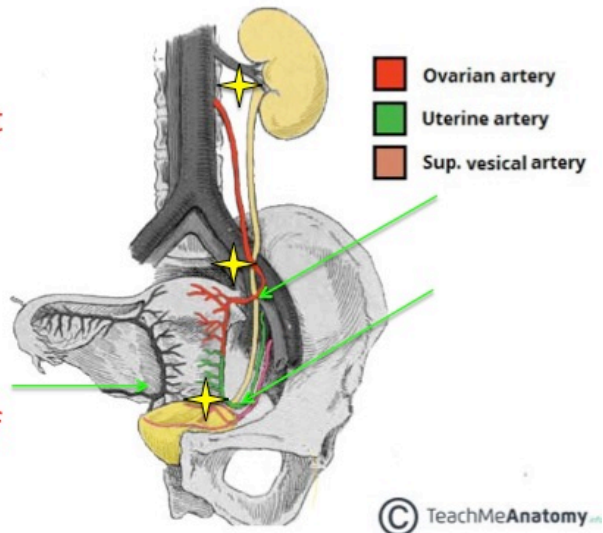
Kidneys and Ureters

□ Stones

- ▣ Where are stones most likely to obstruct ureter?

□ Iatrogenic

- ▣ 75% during gynecologic procedures
- ▣ Most common sites of injury to ureters?

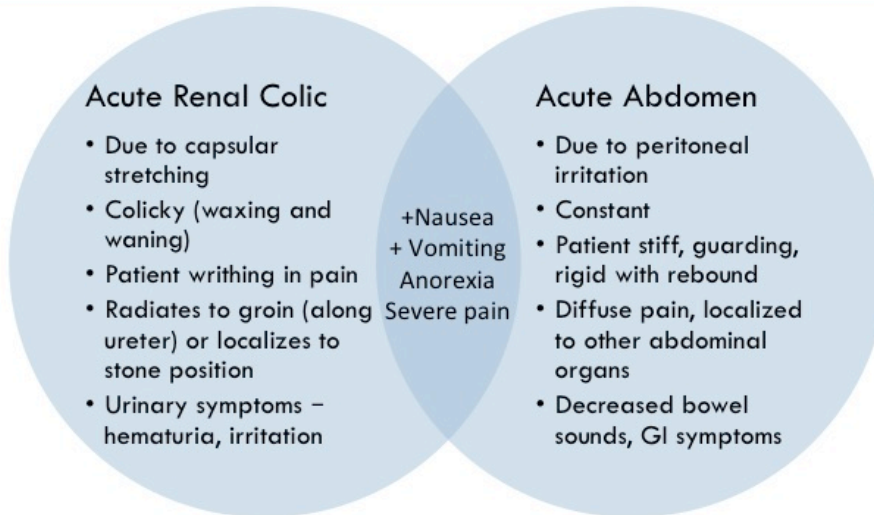


Kidneys and Ureters



Acute Renal Colic vs Acute Abdomen?

How might these present differently?



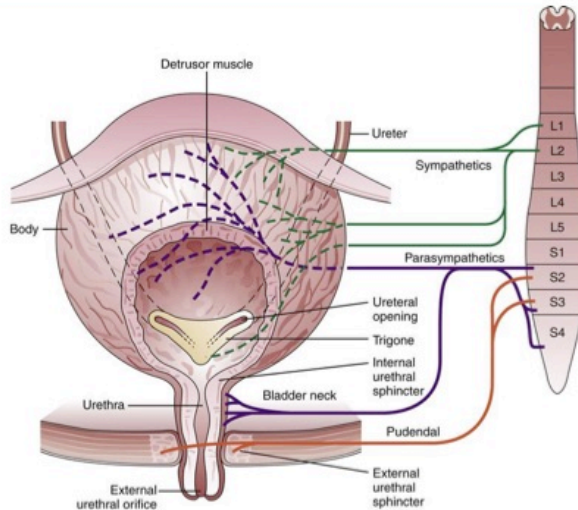
Concerning symptoms:
Fever, chills, active infection

Bladder and Pelvic Floor

Review the anatomy of the bladder and pelvic floor.
Understand common causes of hematuria and basics of management.
Differentiate types of incontinence.
Understand indications for cystoscopy.

Bladder

- Bladder:
 - *Urothelium* – barrier to urine with tight junctions
 - *Detrusor muscle* – spiral and circular smooth muscle contracts to expel urine
- Peeing = Parasympathetic
- Storing = Sympathetic
- Squeeze = Somatic



Pelvic Floor

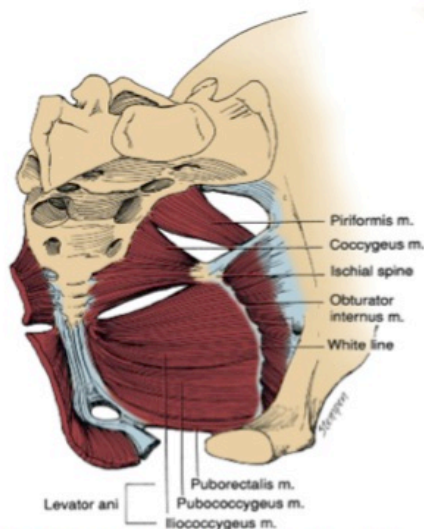


Figure 2-9. Muscles of the true pelvis (three-quarter view).

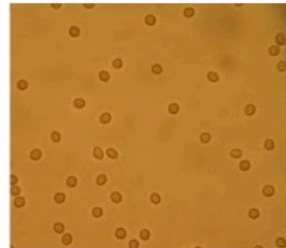
- Pelvic floor models
- How might childbirth affect a women's pelvic floor?

Hematuria

- >3 RBCs present in urine
 - ▣ What are common causes of hematuria?

- Causes of hematuria

- UTI
- Stones
- Polyps
- BPH
- Trauma
- Iatrogenic
- Cancer
- Glomerular or renal parenchymal pathology



- What tests would you order to work-up a patient with "gross" hematuria?
 - UA, CBC, Hg, platelets, urine cytology, BUN, Cr, urine culture if infected, PT/PTT
- What are some lab findings that distinguish medical renal causes of hematuria?
 - Dysmorphic RBCs, casts, proteinuria, elevated Cr

Bladder & Pelvic Floor

- Incontinence Pathophysiology:
 - Failure to store – sphincter deficiency, overactive bladder
 - Failure to empty – bladder obstruction, underactive bladder
- *Rule out UTI and glucosuria!*

Type of Incontinence	Buzzwords	Management
Stress	Triggered by exercise, laughing, sneezing Exam: Leakage with cough test	1. Behavioral modifications 2. Medical 3. Surgical
Urgency	"Gotta go, gotta go, gotta go right now" + Nocturia, frequency, has "accidents"	
Overflow	Constant dribbling, incomplete emptying PVR >400cc	Catheterization!

Question: In the setting of hematuria,
which patient would require
cystoscopy?

- A. 25y female with urgency, frequency and dysuria. UA is positive for nitrites and RBCs.
- B. 12y male with painless gross hematuria. Exam and urine culture is negative.
- C. 30y male with no medical history, who has bright red urine shortly after intense exercise. UA shows 1+ proteinuria and > 50 RBC but no casts.
- D. 60y male with atrial fibrillation and BPH, on warfarin.

Question: In the setting of hematuria,
which patient would require
cystoscopy?

- A. 25y female with urgency, frequency and dysuria. UA is positive for nitrites and RBCs. → UTI
- B. 12y male with painless gross hematuria. Exam and urine culture is negative. → Transient urethrorrhagia
- C. 30y male with no medical history, who has bright red urine shortly after intense exercise. UA shows 1+ proteinuria and > 50 RBC but no casts. → Repeat UA
- D. 60y male with atrial fibrillation and BPH, on warfarin.**

Prostate

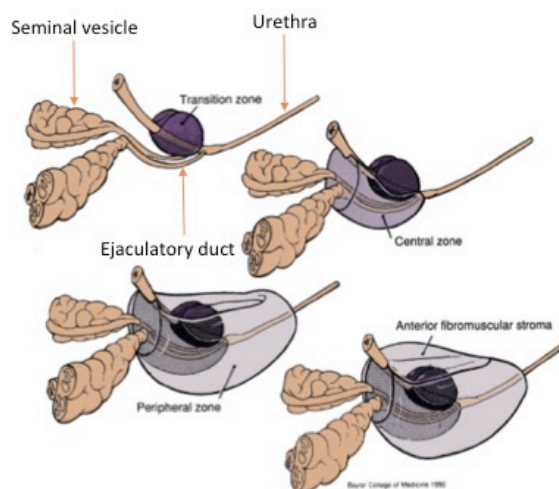
Review anatomic zones of the prostate.

Compare BPH and prostate cancer.

Prostate

□ Anatomy

- ▣ Zones
- ▣ Located below bladder and contains prostatic urethra
- ▣ Glands make prostatic fluid



Prostate

- Benign prostatic hyperplasia [BPH]
 - ▣ Increase in number of stromal and epithelial cells of prostate
 - Transition zone
 - ▣ Bladder outlet obstruction [BOO] presentation?
 - Elderly male with hesitancy, dribbling, weak flow, frequency, urgency
- What tests can be helpful in work-up?
 - ▣ DRE, neuro exam; UA/UTI, PVR, urodynamics

Prostate

- Prostate adenocarcinoma
 - Peripheral zone
 - Metastases via prostatic venous plexus
 - Hormone-sensitive
 - Most common solid organ cancer in men
- What is the role of PSA?
 - Prostate specific antigen or PSA is used as a serum screening tool!

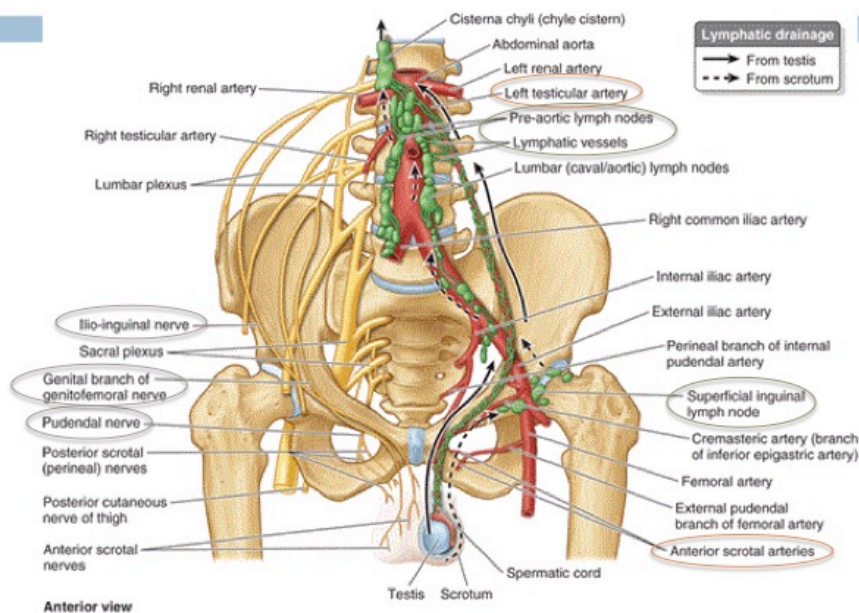
Scrotum

Review anatomy of the scrotum.

Understand anatomic correlation of common pathology: trauma, infection, torsion, malignancy, fluid or mass.

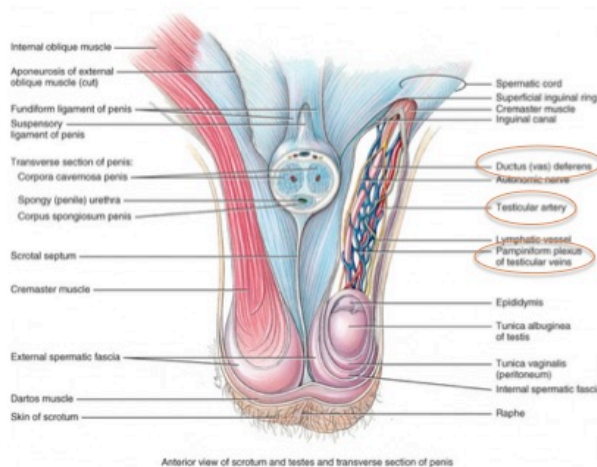
Understand causes and basic management of acute scrotal pain.

Acute Scrotum



Acute Scrotum

- Anatomy (superficial to deep)
 - Skin
 - Dartos muscle
 - Scarpas/Colles
 - External spermatic fascia
 - External oblique fascia
 - Cremaster m.
 - Internal oblique
 - Internal spermatic fascia
 - Transversalis fascia
 - Tunica vaginalis
 - Parietal peritoneum
 - Gubernaculum
 - Tunica albuginea



What are the most common causes of acute scrotal pain?

- Testicular torsion
- Infection
- Trauma
- Tumor
- Ischemia
- Hernia

Acute Scrotum

Differential	Key Features	Management
Testicular torsion	Rapid onset No cremaster reflex Absent blood flow on scrotal US	URGENT scrotal exploration, detorsion and bilateral orchiopexy.
Appendiceal torsion	Rapid onset Blue-dot sign Normal US and cremaster reflex.	Self-limited [appendage will atrophy] OR surgery to excise
Epididymitis	Gradual onset Pain improves with elevation of testis Hypervascular epididymis on US	Antibiotics and pain control
Trauma	Rapid onset Abnormal palpation, ecchymosis	Testicular rupture is surgical EMERGENCY
Testicular tumor	Acute-on-chronic onset Does not transilluminate Solid testicular mass on US	Inguinal approach to surgery
Hernia	Acute-on-chronic onset Does not transilluminate Bowel loops on US	Incarceration requires URGENT surgery

Case

A 70y man presents to the ED with nausea and vomiting for the past day, which has increased despite not eating for the last 12 hours.

Over the last few months, he noticed a painful lump around his left testicle, especially with coughing and bowel movements. When laying down or resting, it seemed to go away.

For the last few days, the lump has remained. He did not pass gas or have any bowel movements for the last 24 hours.

What is your differential?

On exam, he appears uncomfortable. Vitals are significant for Tmax 100.3 and HR 120.

Abdomen is distended but non-tender and bowel sounds are high-pitched. Left scrotum is very painful to palpation, with 2x2cm mass and overlying erythema.

Labs indicate WBC 14,700.

What is your diagnosis and why?

What additional tests or imaging would you order?

What is the difference between a direct and indirect inguinal hernia?

Post-test

Please complete the post-test and optional feedback questions (no names please). Thank you!

The complete Powerpoint file can be found in the Supplemental Files.