

**COURSE: GROSS ANATOMY
2004-2005**

**STRUCTURAL BASIS OF
MEDICAL PRACTICE**

**ANATOMY
EMBRYOLOGY
RADIOLOGY
CLINICAL CORRELATE**

<http://www.humangrossanatomy.ws>

**THE STRUCTURAL BASIS OF MEDICAL PRACTICE/
PATIENTS, PHYSICIANS AND SOCIETY**

Week 1	Week 2	Week 3	Week 4
Gross Anatomy	Physical Diagnosis Clinical Correlate Radiology	Block Exams # 1, #2	Clinical Interviews

Week 5	Week 6	Week 7	Week 8
	Block Exams # 3, #4		Block Exams # 5, #6

Week 9	Week 10	Week 11
	Block Exam #7	Block Exams #8, #9

**The Structural Basis of Medical Practice
Co-Director: Drs. Ian Zagon and Donald Mackay**

<u>Component</u>	<u>Instructor</u>	<u>Room Number</u>	<u>Phone Number</u>
Gross Anatomy	Dr. Zagon	C3729	X8650
	Dr. Leure-duPree	C3710	X8650
Radiology	Dr. Hartman	CG525	X6891
Embryology	Dr. Zagon	C3729	X8650
Clinical Correlate	Dr. Bollard	C6860	X8390
	Dr. Berlin	C7833	X8006

**Patients, Physician and Society
Co-Directors: Drs. John George and Michael Green**

<u>Component</u>	<u>Instructor</u>	<u>Room Number</u>	<u>Phone Number</u>
Physical Diagnosis	Dr. Bahadori	4100UPC	X8161
Clinical Interviews	Dr. Lewis	C1619	X8752

Associate Dean of Medical Education	Dr. Richard Simons	C1708	X3876
Curriculum Coordinator	Glenda Shoop	C1704	X3877

STRUCTURAL BASIS OF MEDICAL PRACTICE

INVENTORY

Gross Anatomy

Lecture: 38 hours
Small Group/Lab: 126 hours

TOTAL: 164 hours (80%)

Radiology

Lecture: 5 hours
Small Group/Lab: 7 hours
Review: 4 hours

TOTAL: 16 hours (7.8%)

Embryology

Lecture-Basic: 7 hours
Clinical: 6 hours

TOTAL: 13 hours (6.3%)

Clinical Correlate

Lecture/Small Group: 12 hours

TOTAL: 12 hours (5.9%)

SUBTOTAL: 205 hours

Exams

17 hours

TOTAL: 17 hours

STRUCTURAL BASIS OF MEDICAL PRACTICE

GRAND TOTAL: 222 hours-11 week schedule

STRUCTURAL BASIS OF MEDICAL PRACTICE

1. Required Dissecting Instruments:

- Mayo-pattern dissecting scissors, 5 1/2"
- Sharp scissors, 4 1/2"
- Scalpel handle, Bard-Parker #4 (equivalent)
- Scalpel blades, Bard-Parker #22 (or equivalent)
- Huber probe
- Flexible probe
- Forceps sharp, 4 1/2"
- Forceps, thumb dressing, 5"
- Kelly hemostat, 5 1/2"

2. Laboratory Coat and Gloves:

A white, knee-length coat, **reasonably clean** and in good condition, must be worn in the dissecting laboratory **at all times**. **Gloves are required for dissection.**

3. Required Textbooks:

Rosse, C. and P. Gaddum-Rosse, Hollingshead's Textbook of Anatomy, 5th ed., Lippincott-Raven
Sadler, T.W., Langman's Medical Embryology, 9th ed., Lippincott, Williams & Wilkins

4. Required Dissector:

Sauerland, E.K., Grant's Dissector, 12th ed., Williams and Wilkins

5. Required Atlas (only one is required):

Abrahams, P.H., McMinn's Color Atlas of Human Anatomy, 5th ed., Mosby
Clemente, C.D., Anatomy: A Regional Atlas of the Human Body, 4th ed., Williams & Wilkins
Agur, A., Lee, N., Grant's Atlas of Anatomy, 11th ed., Williams and Wilkins
Netter F., Atlas of Human Anatomy, 3rd ed., Novartis
Rohen, J.W., C. Yokochi, and E. Lutjen-Drecoll, Color Atlas of Anatomy, 5th ed., Williams & Wilkins

6. Recommended Dictionary:

Stedman, Stedman's Medical Dictionary, 27th ed., Williams and Wilkins
Dorland, Dorland's Illustrated Dictionary, 30th ed., Saunders

7. Recommended Supplies:

Masks (optional) Clipboard Pens/Colored Pencils

8. **Problems with taking exams:**

In the event a student becomes ill and cannot be present for an examination, a doctor's excuse must be presented to the Curriculum Coordinator (Ms. Tanya Heatwole, C1704B) **prior** to the exam, and arrangements can be made to reschedule the examination.

9. **Bone Boxes**

Each table will be assigned a numbered bone box to utilize during the lab portion of this course. As a group you will be responsible for the appropriate use and safe return of the material upon the completion of the final exam. *Note: the bone box must be returned in order to receive your final exam and course grades.*

Bone boxes are to be stored in the storage cabinets provided. Cabinet keys will be issued with a \$5.00 deposit. *Note: Nothing except bone boxes can be stored in the cabinets. Other materials including lab coats, supplies, books, gloves, etc. will be discarded during periodic checks.*

If the box is returned with broken or missing specimens, a repair/replacement cost will be determined and divided equally among group members. Notices regarding monies due will be distributed to students in November. *Should action not be taken by you in accordance with the due date specified in the memo, a "hold" will be placed on your student loan and additional course registration until either the outstanding material or fee is received.*

Sample replacement costs (These are estimated – students are responsible for actual replacement costs).

Skull	\$800	Articulate Hand	\$150	Fibula	\$40
Clavicle	\$30	Tibia	\$60	Complete box	\$2,300

10. **Course Evaluations**

Students will need to complete course evaluations prior to receiving course grades.

TEACHING FILMS

The Dissection of the Thorax

Thoracic Wall (24 min.) – 2 copies
Pleurae and Lungs (24 min.) – 2 copies
Middle Mediastinum (32 min.) – 2 copies
Posterior and Superior Mediastina (17 min.) – 2 copies

The Dissection of the Lower Extremity

Anterior Aspect of the Thigh (15 min.) – 2 copies
Posterior Aspect of the Thigh (10 min.) – 2 copies
Anterior Aspect of the Leg and Dorsum of the Foot (10 min.) – 2 copies
Posterior Aspect of the Leg (Calf) (9 min.) – 2 copies
Plantar Aspect of the Foot (15 1/2 min.) – 2 copies

The Anatomy of the Arm

An Appreciation of Shoulder and Arm Anatomy (40 min.) – 2 copies

The Anatomy of the Hand

The Functional Anatomy of the Hand (33.5 min.) – 2 copies

The Osteology of the Skull Series

Osteology of the Skull: An Introduction (26 min.) – 2 copies
Osteology of the Skull: The Cranial Cavity (28 min.)
Osteology of the Skull: The Temporal Bone (30 min.) – 2 copies
Osteology of the Skull: Inferior Surface of the Cranium (26 min.) – 2 copies

The Human Embryology Series

The Placenta & Fetal Membranes (24 min.) – 2 copies
The Development of the GI Tract (40 min.) – 2 copies

The Anatomy of the Human Eye Series

The Extraocular Muscles (17 1/2 min.) – 2 copies

The Abdomen, Pelvis & Perineum

The Female Pelvic Viscera (18 min.) – 2 copies

Acland's Video Atlas of Human Anatomy

Tape 1. The Upper Extremity

Tape 2. The Lower Extremity

Tape 3. The Trunk

Tape 4. The Head and Neck, Part 1

Tape 5. The Head and Neck, Part 2

Tape 6. The Internal Organs

ALL FILMS ON RESERVE IN THE LIBRARY

**STRUCTURAL BASIS
OF MEDICAL
PRACTICE**

COURSE OBJECTIVES

STRUCTURAL BASIS OF MEDICAL PRACTICE

OBJECTIVES OF BLOCK

1. Describe and identify the essential features of normal human anatomy at the tissue, organ, and system level.
2. Identify the position and extent of normal structures in radiographs, contrast studies, air studies, angiograms, echograms, cross-sections, CT scans, magnetic resonance images, and osteology material.
3. Describe the embryological development of organs and organ systems in a manner sufficient to understand the underlying defects in major congenital malformations.
4. State the anatomical basis of clinical procedures and pathological processes and seek an anatomical solution to a clinical problem.

STRUCTURAL BASIS OF MEDICAL PRACTICE

OBJECTIVES FOR STUDENT LEARNING

1. **Make competent physicians.**
2. **Present fundamental information of basic science with clinical overtones.**
3. **Encourage independence.**
4. **Develop rigorous thinking and work habits.**
5. **Develop skills in working with others.**
6. **Orient students to patient care.**
7. **Display role models for responsibility, compassion, and knowledge.**
8. **Provide a firm background of knowledge for application of today's medicine.**
9. **Provide a firm background of knowledge for application of tomorrow's medicine.**
10. **Give a broad based educational experience and generate individual training with general knowledge rather than small pockets of information or superficial skills.**
11. **Learn to be a keen observer.**
12. **Emphasize small group learning and interaction.**
13. **Learn problem solving.**
14. **Learn structural terminology - 10,000 new terms.**
15. **Learn pronunciation of medical terms.**
16. **Emphasize that accomplishment of terminology/pronunciation is the basis for communication to colleagues.**
17. **Learn resources such as CD ROMS, internet, MEDLINE, email.**

18. Understand human body and its construction so as to be a correlative basis for physical diagnosis.
19. Integrate knowledge from gross anatomy, embryology, radiology, histology, clinical correlates, and physical diagnosis.
20. Train physicians to make complicated decisions and evaluate facts.
21. Emphasize accurate diagnosis.
22. Relate that future medical practice will rely on physical diagnosis and skills of the physician rather than expensive testing.
23. Emphasize variability of the human body.
24. Emphasize disease processes and the seamless transition of basic science skills to clinical practice.
25. Examine students using broad range of testing material: essay, short answer, and photographs/diagrams.
26. Stress organizational skills for acquiring knowledge.

LEARNING OF THE STRUCTURAL BASIS OF MEDICAL PRACTICE

- 1. Lecture**
- 2. Laboratory**
- 3. Textbooks**
- 4. Peer interactions**
- 5. Instructors**
- 6. Films**
- 7. WEB site - questions and discussions**
- 8. Review questions**
- 9. Previous tests**

REVIEW QUESTIONS - LOWER LIMB

1. If the common peroneal nerve is damaged as it passes around the neck of the fibula, what would characterize the gait of the patient?
2. What would be the effect of damage to the tibial nerve and what would characterize the gait of the patient?
3. Why does the extensor muscle in the leg become extremely painful (shin splints) if they swell to any extent?
4. What tendons do you feel on the medial side of the knee? On the lateral side? Can you feel the ilio-tibial tract or the abductor tubercle?
5. What are all the muscles which can aid in plantar flexion? In dorsiflexion?
6. How does the fascia lata, the valves and the communication of the deep veins contribute to the saphenous veins commonly becoming varicosed?
7. Pains on the upper lateral thigh could indicate irritation of what nerve?
8. Loss of sensation between the first two toes, but not over the other toes would indicate damage to what nerve?
9. Loss of the dorsalis pedis pulse would indicate occlusion of what artery? If the medial malleolar pulse were also absent, where might the occlusion be?
10. Loss of sensation over the back of the leg and the lateral dorsum of the foot would indicate damage to what nerve?
11. What are the four ligaments of the sacroiliac joint and what movements are each designed to prevent?
12. Where is the center of gravity of the body at lumbo-sacral, hip and knee joints respectively?
13. In walking, what movement is checked by the iliofemoral ligament?
14. Can you think of three reasons why the lateral meniscus of the knee is less frequently damaged than the medial one?
15. What is the locking mechanism of the knee joint? Of the hip joint?
16. Why do intrascapular fractures of the neck of the femur ('broken hip') commonly lead to necrosis of the head of the femur, but extrascapular fractures do not?
17. What ligamentous structures support the arches of the foot.

REVIEW QUESTIONS - LOWER LIMB- Continued

18. Where does flexion and extension of the foot take place? What limits each?
19. Where does aversion and inversion of the foot take place? What muscles aid in each movement?
20. What exercise could you use to strengthen the short muscles of the foot to improve their support of the arches?
21. Paralysis of gluteus medius and minimus seriously effect walking in what way?
22. Damage to the common peroneal nerve abolishes what action in walking?
23. What will happen to the arches of the foot if gastrocnemius and soleus are paralyzed?
24. What effect will spasm of the peroneal muscles have on the arches?
25. Why does the ankle almost invariably sprain on its lateral side?
26. What if the lateral malleolus is fracture, in what position will the foot of the patient be?
27. Which would be the most serious loss, the destruction of the superior or the inferior gluteal nerve? Give reasons for your answers.
28. How do you determine the position of the sciatic nerve in the buttock of a patient?
29. What two muscles can assist the hamstrings in extension of the hip joint?

REVIEW QUESTIONS - THORAX

1. A three-year-old child was rushed to the emergency room, having aspirated a peanut. Where would you expect to find it? Why?
2. What is the level of the inferior border of parietal pleura in the midaxillary line during full inspiration?
3. What are the anatomical differences between the right and left lungs?
4. What is the primary function of the fibrous pericardium? Of the serous pericardium?
5. What chambers of the heart are visible anteriorly?
6. What was the fossa ovalis in the embryo? What was its function?
7. What are the features which distinguish the right ventricles?
8. What is the blood supply of the interventricular septum?
9. Where are the four heart valves best heard?
10. Which valves are thicker, the aortic or pulmonary? Why?
11. Where does heart muscle refer pain?
12. What is the action of the papillary muscles?
13. What nerves give sensory supply to the diaphragm? How can this information be useful in a clinical situation?
14. The inferior vena cava penetrates the central tendon of the diaphragm, while the esophagus passes through the muscular portion, surrounded by muscle of the right crus. What is the significance of this anatomical arrangement?
15. Where does the thoracic duct terminate?
16. Outline the general route for venous drainage of the thoracic wall.

REVIEW QUESTIONS - ABDOMEN

1. What forms the semilunaris? What is its superior limit?
2. What is the purpose of the tendinous intersections in rectus abdominis?
3. Where would you find the accurate line?
4. What is the inguinal ligament? What is its purpose?
5. What is the sensory supply to the umbilicus?
6. You want to make a vertical incision through the rectus sheath and its contents to gain entry into the peritoneal cavity. Explain where you would make the incision, how would you proceed, and what important structures you would want to avoid.
7. What structure gives the most strength to the posterior wall of the inguinal canal?
8. What is the relationship of the inferior epigastric artery to the deep inguinal ring?
9. How would you distinguish anatomically between a direct and an indirect inguinal hernia?
10. What is the blood supply to the stomach and in what mesenteries are the vessels found?
11. What is the marginal artery?
12. What are the characteristics of the colon?
13. What is the lymphatic drainage of the colon?
14. What is the relationship of the first part of the duodenum?
15. What was the ligamentum teres in the embryo?
16. What holds the liver in place?
17. Where can you palpate the liver?
18. Where is the functional division between right and left lobes of the liver located?
19. What is the blood supply of the pancreas?
20. What are the posterior relationships of the pancreas?
21. Why does a ruptured spleen refer pain to the shoulder?
22. What is the relationship of the transverse mesocolon to the pancreas?
23. What are the hepatic veins?

REVIEW QUESTIONS - PERINEUM & POSTERIOR ABDOMINAL WALL

1. Name four structures which lie against the kidney posteriorly.
2. What male/female structures cross the ureters near the bladder?
3. What suspends the bladder to the umbilicus anteriorly?
4. What lies posterior to the bladder in the male and female?
5. What is the significance of the sympathetic innervation of the trigone?
6. What are the boundaries of the perineum?
7. What ligament is adjacent to the coccygeus?
8. What does Camper's fascia become in the perineum?
9. What does Scarpa's fascia become in the perineum?
10. List the contents of the superficial perineal pouch in the male.
11. What defines the superficial perineal pouch?
12. What are the boundaries of the ischiorectal fossa?
13. What are the three branches of the pudendal nerve and what do they innervate?

REVIEW QUESTIONS - PELVIS

1. What structures can be palpated anterior to the rectum in the male? In the female?
2. What separates the internal sphincter of the anus from the external sphincter?
3. How do the external sphincter and the puborectalis muscles contribute to continence of the anus? What is the nerve supply to each?
4. What structures make up the pelvic diaphragm?
5. What are the special actions of the levator prostaticus and puborectalis parts of the levator ani?
6. If the levator ani is weak and a hernia occurs, where would you find the loop of intestine?
7. What are the three areas supplied by the inferior rectal nerve? Of what clinical significance is its sensory distribution?
8. What attachment site must not be damaged if the levator ani is to function properly?

REVIEW QUESTIONS - PELVIS Continued

9. What is the relationship of the internal pudendal artery to the dorsal nerve and the perineal nerve?
10. What three factors help hold the kidney in place?
11. What is meant by renal sinus, renal hilum, and renal pelvis?
12. What is the relationship of the ureters to the common iliac arteries?
13. What are the anterior relationships of the right kidney?
14. What structure crosses over the ureter as it enters the bladder in either sex?
15. What is the position of the uterus relative to the vagina? What structures help to maintain this relationship?
16. Where is the inferior limit of peritoneum in the pouch of Douglas?
17. What is the relationship of the uterine artery to the ureter? Why is this important?
18. Name 6 structures enclosed within the folds of the broad ligament?
19. What might be the consequences of a torn perineal body in the female?
20. What is the usual route of lymphatic drainage of the vulva?
21. What is the purpose of the urogenital diaphragm in females?

Human Gross Anatomy Review Questions

Abdomen, Pelvis, Perineum

Recommended Text: Hollinshead and Rosse plus lecture notes

1. Discuss the anatomy (relations - 6 directions, boundaries, vertebral levels, structure, surfaces, vessels, innervation - motor and sensory, support, function, clinical significance) of the:
 - A. stomach
 - B. liver
 - C. gall bladder
 - D. pancreas
 - E. spleen
 - F. duodenum (parts 1 - 4)
 - G. jejunum
 - H. ileum
 - I. parts of the colon including flexures
 - J. rectum
 - K. suprarenal glands
 - L. kidneys
 - M. abdominal aorta
 - N. diaphragm
 - O. uterus and ovaries
 - P. vagina
 - Q. urinary bladder
 - R. prostate gland
 - S. urogenital diaphragm
2. Discuss the anatomy and clinical significance of the right and left hypogastric nerves.
3. Discuss the ligaments derived from the external oblique aponeurosis. Relate three of these ligaments to the course of a femoral hernia.
4. Discuss the anatomical course followed by secretions traveling from the testis to the seminal vesicle and then continuing to the penile urethra.
5. What are the relations of the left colic flexure?
6. Discuss the actions and innervations of the muscles that contribute to ejaculation.
7. What spinal levels mark the inferior extent of the diaphragm as it crosses the aorta, psoas major, and quadratus?

8. Discuss the course taken by each of the arteries that contribute blood supply to the colon (large bowel).
9. Discuss the vascular supply (including lymphatics) to the uterus?
10. What is the significance of portacaval shunts (anastomoses)? Where are they located?
11. What is the location of cell bodies that provide: 1) preganglionic parasympathetic fibers, 2) preganglionic sympathetic fibers, 3) postganglionic parasympathetic fibers, and 4) postganglionic sympathetic fibers to each of the following areas? In addition, discuss the anatomical pathways (plexuses) followed by autonomic fibers traveling to each area.
 - A. stomach
 - B. duodenal cap (part 1)
 - C. ascending duodenum (part 4)
 - D. kidney
 - E. right colic flexure
 - F. left colic flexure
 - G. rectum
 - H. cervix of uterus
 - I. ovary
 - J. testis
 - K. head of the epididymus
 - L. corpora cavernosum
12. What relation must the surgeon consider when ligating the uterine artery?
13. What structures support the urinary bladder within the pelvis?
14. Discuss the anatomy that could explain symptoms of vomiting paired with left renal failure.
15. What fascial layers lie anterior to the rectus abdominus muscle at levels below the arcuate line and at levels above the umbilicus?
16. What critical vessels must the surgeon preserve when removing the spleen?
17. What is the cremasteric reflex and what nerves (including spinal levels) are involved?
18. Discuss the vascular supply (arteries, veins, lymph) of the urinary bladder.
19. What are the relations of the psoas major muscle within the abdomen?
20. Where would you test cutaneous sensation to assess spinal cord damage at the levels of: 1) T8, 2) T10, and 3) T12?

21. During the course of worsening appendicitis there is a characteristic progression in the experience of pain. Explain.
22. Discuss the course of the pudendal nerve and its branches. Include mention of key relations.
23. What prevents a direct hernia from entering the scrotum? What fascial layers are involved?
24. What is the relation of the conjoint tendon to a direct hernia?
25. Short definitions
 - A. median arcuate ligament
 - B. arcus tendineus
 - C. esophageal vein
 - D. minor duodenal papilla
 - E. ligamentum venosum
 - F. intestinal arcade
 - G. vasa recta
 - H. mesoovarium
 - I. lumbar splanchnic nerve
 - J. neurovascular plane
 - K. parietal pelvic fascia
 - L. floating gall bladder
 - M. inferior anterior and posterior pancreaticoduodenal arteries
 - N. medial inguinal fossa
 - O. lateral inguinal fossa
 - P. suprapubic fossa
26. Discuss the anatomy that explains why are femoral hernias are prone to strangulation.
27. What are the relations of an indirect hernia from its neck to its lowest extent in the scrotum?
28. How is the puborectalis muscle different from the pubococcygeus?
29. What is the difference between a pelvic splanchnic nerve and a sacral splanchnic nerve?
30. In terms of the component autonomic fibers, what is a primary difference between the superior mesenteric plexus and the inferior mesenteric plexus?
31. Compare the autonomic innervation of the tail of the epididymus to autonomic innervation of the testis.
32. Discuss the anatomy of the prostatic urethra.

33. What is the anatomic pathway followed by parasympathetic nerves that innervate the corpora spongiosum of the male.
34. What facial layers are penetrated by a stab wound through the rectus abdominus muscle at the level of the umbilicus. Assume that the penetrating injury stopped within the peritoneal cavity.
35. Discuss the anatomy of the transverse colon including the left and right colic flexures. Include structure, relations, vascularization, innervations.
36. Explain the anatomy of the "caput medusa" that results from portal hypertension.
37. Where is the primary lymph drainage from the following areas?
 - A. fundus of the uterus
 - B. cervix of the uterus
 - C. scrotum
 - D. testis
 - E. ovary
 - F. first part of duodenum
 - G. fourth part of duodenum
 - H. tail of pancreas
 - I. rectum below pectin line
 - J. superior third of rectum
 - K. middle third of rectum
 - L. anus
 - M. distal third of vagina
 - N. upper 2/3 of vagina
 - O. left colic flexure
 - P. right colic flexure
 - Q. kidney
38. What structure(s) are between:
 - A. psoas major and the fifth lumbar vertebra
 - B. lateral arcuate ligament and quadratus lumborum
 - C. stomach and pancreas
 - D. superior fascia of UG diaphragm and inferior fascia of pelvic diaphragm
 - E. lumbosacral trunk and S1 (usually)
 - F. tunica albuginea and the head of the epididymus
 - G. anterior and posterior lamina of broad ligament
 - H. superior and inferior fascia of the urogenital diaphragm in the female
 - I. lumbosacral trunk and S1 (usually)
 - J. layers of the hepatoduodenal ligament
 - K. The uncinate process and the head of the pancreas

39. Discuss the anatomy of the prostatic urethra.
40. Within the rectus sheath and below the arcuate line, what fascial layers lie posterior to the rectus abdominus muscle? Above the arcuate line?
41. Discuss the anatomy of the posterior free edge of the UG diaphragm?
42. Along what part of the gastrointestinal tract is there an anastomosis between the celiac arterial supply and the superior mesenteric arterial supply. Along what part of the gastrointestinal tract is there an anastomosis between the superior mesenteric supply and the inferior mesenteric arterial supply. What arteries directly contribute to these anastomoses?
43. Discuss the parasympathetic innervation to the hindgut.
44. Extravasation of urine into the superficial pouch will fill a potential space limited by the boundaries of Scarpa's fascia and its derivatives. What are these derivatives and boundaries?
45. Explain why the transverses abdominis muscle does not contribute a tunic to the spermatic cord.
46. How does strengthening the anterior abdominal wall muscles help to stabilize the vertebral column?
47. What major vessel is associated with the bare area of the liver?

GROSS ANATOMY

LEARNING OBJECTIVES

Subinguinal Region, Anterior and Medial Thigh

- I. **Osteology:** bones of the pelvic girdle [pelvic bones: ilium, ischium, pubis; sacrum, coccyx] and lower limb (femur, patella, tibia, fibula)

- II. **Thigh**
 - A. **Superficial Fascia:**
 - Cutaneous nerves (lateral and posterior femoral cutaneous and ilioinguinal nerves, genital and femoral branches of the genitofemoral nerve, cutaneous branch of the obturator nerve, medial and intermediate cutaneous nerves of the thigh; origin, area of distribution)
 - Great saphenous vein: valves, origin, course
 - B. **Deep Fascia** (fascia lata): medial and lateral medial intermuscular septa, fascial (functional, neurovascular) compartments, iliotibial tract, saphenous hiatus
 - C. **Muscles**
 1. Anterior compartment: sartorius, rectus femoris, vastus lateralis, medialis, and intermedius, iliopsoas, pectineus, articularis genu
 2. Medial compartment: adductor longus, brevis, and magnus, gracilis, obturator externus
 3. Attachments, actions, innervation
 - D. **Nerves**
 1. Femoral nerve: cutaneous branches (saphenous nerve, medial and intermediate cutaneous nerves of the thigh), motor branches
 2. Obturator nerve: anterior and posterior branches
 3. Origin (segmental division), course, structures innervated
 - E. **Vessels:** femoral, profunda femoris (lateral and medial circumflex femoral, perforating), and obturator (abnormal obturator artery) vessels; origin, course, blood supply to the head vs. the shaft of the femur; arterial anastomoses around the hip joint (cruciate anastomosis)
 - F. **Lymphatics:** superficial and deep inguinal lymph nodes; pattern of drainage
 - G. **Subinguinal compartment** (lacunae), femoral triangle, adductor canal

- III. **Functional, Living, and Imaging Anatomy**
 - A. **Functional anatomy:** functional muscle groups, quadriceps mechanism
 - B. **Living anatomy**
 1. Palpable landmarks: iliac crest, anterior superior iliac spine, pubic tubercle, inguinal ligament and fold, tendon of the quadriceps femoris at the knee, tibial tuberosity, iliotibial tract

2. Surface projections: projections of the courses of the femoral artery, great saphenous vein, and femoral nerve, area of the femoral triangle (femoral nerve, artery, vein, and canal, saphenous hiatus), and dermatomes to anterior and medial thigh

C. Imaging anatomy: normal: radiographs (AP, lateral) and MRI selected sequential images (coronal, transverse (axial), sagittal, oblique) of the thigh and hip

IV. **Clinical Anatomy**

A. Diagnoses

1. Musculoskeletal: intermittent claudication, femoral hernia

2. Vascular: varicose veins, occlusive atherosclerosis, thrombophlebitis, aneurysms

B. Diagnostic procedures: femoral artery/vein catheterization, Trendelenburg test for the competence of valves of the superficial veins of the lower extremity

C. Therapeutic procedures: vein harvest for coronary artery bypass grafting

D. Preventive procedures: quadriceps exercises

GLUTEAL REGION AND ISCHIORECTAL FOSSA

LEARNING OBJECTIVES

Gluteal Region and Ischiorectal Fossa

- I. **Osteology:** bones of the pelvic girdle [pelvic bones: ilium, ischium, pubis; sacrum, coccyx] and lower limb (femur), and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment
- II. **Arthrology:** iliopsoas bursa
- III. **Gluteal Region**
 - A. Cutaneous Nerves: superior, middle, and inferior clunial nerves, origin, area of distribution
 - B. Sacrospinous and Sacrotuberous Ligaments: attachments, role in resisting movement at the sacroiliac joints
 - C. Greater and Lesser Sciatic Foramina: boundaries, structures transmitted
 - D. Muscles:
 1. Gluteal muscles: gluteus maximus, medius, and minimus, tensor fasciae latae
 2. Lateral rotators: piriformis, obturator internus, superior and inferior gemellus, quadratus femoris
 3. Attachments, actions, innervations
 - E. Nerves: sciatic, superior and inferior gluteal, posterior femoral cutaneous, and pudendal nerves, nerve to the obturator internus, nerve to the quadratus femoris; origin (segmental derivation), course, structures, innervation
 - F. Vessels: superior and inferior gluteal vessels; origin, course
 - G. Trochanteric and Ischial Bursae
- IV. **Functional, Living, and Imaging Anatomy**
 - A. Functional Anatomy: functional muscle groups
 - B. Living Anatomy
 1. Palpable landmarks: posterior superior iliac spine, sacrum, coccyx, ischial tuberosity, greater trochanter, gluteal fold
 2. Surface projections: projection of the course of the sciatic nerve
 - C. Imaging Anatomy
 1. Normal: radiographs (AP, lateral) and MRI selected sequential images of the hip
 2. Pathological: hip fracture, avascular necrosis of the head of the femur

V. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: fractures of the femur (avascular necrosis of the femoral head), paresis of gluteal muscles (Trendelenburg's sign)

2. Nervous: sciatica, gluteal, obturator

3. Infectious/Inflammatory: ischial bursitis, gluteal abscess

B. Therapeutic procedures: intramuscular gluteal injections, hip replacement surgery

LEARNING OBJECTIVES
Thigh and Popliteal Fossa

I. **Osteology:** bones of the pelvic girdle (pelvic bones - ilium, ischium, pubis; sacrum; coccyx) and lower limb (femur, patella, tibia, fibula), and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment

II. **Posterior Thigh and Popliteal Fossa**

A. **Superficial Fascia:** cutaneous nerves: lateral and posterior femoral cutaneous, obturator, medial cutaneous of thigh, lateral sural cutaneous nerves; origin, area of distribution

B. **Deep fascia (fascia lata):** medial and lateral intermuscular septa, fascial (functional, neurovascular) compartments

C. **Muscles**

1. Posterior compartment: biceps femoris, semitendinosus, semimembranosus

2. Attachments, actions, innervation, vascular supply

D. **Nerves**

1. Femoral nerve: cutaneous branches (medial and intermediate cutaneous nerves of the thigh)

2. Sciatic nerve: tibial and common peroneal divisions

3. Obturator nerve: cutaneous branches

4. Origin (segmental derivation), course, structures innervated

E. **Vessels:** femoral, profunda femoris (lateral and medial circumflex femoral, perforating) vessels; origin, course

F. **Lymphatics:** superficial and deep inguinal lymph nodes; pattern of drainage

G. **Popliteal Fossa:** boundaries, contents

III. **Functional, Living, and Imaging Anatomy**

A. **Functional Anatomy:** functional muscle groups

B. **Living Anatomy**

1. Palpable landmarks: ischial tuberosity, medial and lateral femoral condyles, tendons of the semimembranosus, biceps femoris, semitendinosus, popliteal fossa, tibial and fibular collateral ligaments, head and neck of the fibula, pulse of the popliteal artery in the popliteal fossa, individual muscles can be palpated by placing the fingers on the skin superficial to the muscle belly and then performing the action of the muscle against resistance

2. Surface Projections: projections of the courses of the sciatic, tibial, common peroneal, superficial peroneal, and deep peroneal nerves, projections of the courses of the femoral and popliteal arteries, dermatomes on the skin of the posterior thigh and popliteal fossa

C. **Imaging Anatomy**

1. Normal: radiographs (AP, lateral) and MRI selected sequential images of the thigh and knee, femoral and popliteal arteriograms (MRA) and selected

venous phases, MRI selected sequential images of peripheral nerves

2. Pathological: occlusion of the femoral artery

IV. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: strains (pulled hamstrings)

2. Nervous: sciatica, tibial and common peroneal nerve palsies

3. Vascular: atherosclerosis, thrombophlebitis, aneurysms, lymphedema, compression syndromes (adductor hiatus)

4. Infectious/Inflammatory: ischial bursitis

B. Diagnostic Procedures: monitoring function of hamstrings

C. Therapeutic procedures: therapy for bursitis/tendinitis, amputations, knee replacement, nerve blocks, femoropopliteal bypass, femoral artery compression, resection of a popliteal aneurysm

LEG

LEARNING OBJECTIVES

Leg

I. **Osteology:** bones of the lower limb (femur, tibia, fibula, tarsals, metatarsals, phalanges), bony landmarks, including articular surfaces and areas of muscular/tendinous attachment

II. **Arthrology:** muscle groups producing movement, knee and ankle joints

III. **Leg**

A. Superficial Fascia

1. Cutaneous nerves: saphenous, superficial peroneal, lateral and medial sural, and sural nerves; origin, area of distribution

2. Great and small saphenous veins: origin, course

B. Deep (Crural) Fascia: intermuscular septa (anterior, posterior, transverse), fascial (functional, neurovascular) compartments

C. Muscles

1. Anterior compartment: tibialis anterior, extensor hallucis longus, extensor digitorum longus, peroneus (fibularis) tertius

2. Lateral compartment: peroneus (fibularis) longus, peroneus (fibularis) brevis

3. Posterior compartment: superficial muscles (gastrocnemius, soleus, plantaris), deep muscles (popliteus, flexor hallucis longus, tibialis posterior, flexor digitorum longus)

4. Tendocalcaneus (Achilles tendon)

5. Attachments, actions, innervations

D. Nerves

1. Tibial nerve

2. Common peroneal (fibular) nerve: superficial and deep peroneal (fibular) nerves

3. Origin (segmental derivation), course, structures innervated

E. Vessels: popliteal (superior, middle, and inferior genicular vessels), anterior tibial, and posterior tibial (peroneal/perforating branches) vessels; origin, course, arterial anastomoses around the knee

IV. **Functional, Living, and Imaging Anatomy**

A. Functional Anatomy: dynamic anatomy of the knee and ankle joints (range of motion, weight-bearing axes, locking/unlocking mechanisms of the knee), functional muscle groups, quadriceps mechanism

B. Living Anatomy

1. Palapable landmarks: head and neck of the fibula, common peroneal nerve lateral to the neck of the fibula, subcutaneous medial surface and anterior border of the tibia, medial and lateral malleoli, tendons of the tibialis anterior, extensor hallucis longus, extensor digitorum longus, and peroneus tertius on the dorsum of the foot, tendons of the tibialis posterior and flexor digitorum longus posterior to the medial malleolus, tendons of the peroneus brevis and longus posterior to the lateral malleolus

2. Surface projections: projections of the courses of the sciatic, tibial, common peroneal, superficial peroneal, and deep peroneal nerves on the skin of the lower limb, projections of the courses of the anterior tibial, posterior tibial, and peroneal arteries, projections of the great and small saphenous veins, dermatomes

C. Imaging Anatomy

1. Normal: radiographs (AP, lateral) and MRI selected sequential images of the leg, arteriograms of the vessels in the leg

2. Pathological: fractures of the tibia and fibula

V. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: crucial compartment syndromes, Achilles/plantar tendon rupture

2. Nervous: common/deep/superficial (foot drop) nerve palsies

B. Diagnostic Procedures: patellar/Achilles tendon reflex, pressure monitoring of the fascial compartments

FOOT, ARCHES, AND GAIT

LEARNING OBJECTIVES

Foot, Arches, and Gait

I. **Osteology:** bones of the lower limb (femur, tibia, fibula, tarsals, metatarsals, phalanges) and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment

II. **Foot**

A. Dorsum

1. Superficial fascia: cutaneous nerves (saphenous, superficial peroneal, sural); origin, area of distribution; dorsal venous arch

2. Deep fascia: retinacula (flexor, superior and inferior extensor, superior and inferior peroneal)

3. Muscles: extensor digitorum brevis, extensor hallucis brevis; attachments, actions, innervation

4. Deep peroneal nerve: course, structures innervated

5. Dorsalis pedis artery: origin, course

6. Extensor expansions: composition, muscular insertions

B. Plantar Aspect

1. Superficial fascia: cutaneous nerves (medial calcaneal, medial and lateral plantar); origin, area of distribution

2. Deep fascia: plantar aponeurosis, fibrous tendon sheaths

3. Muscles: first layer (abductor hallucis, flexor digitorum brevis, abductor digiti minimi), second layer (tendon of the flexor digitorum longus, tendon of the flexor hallucis longus, quadratus plantae, lumbicals), third layer (flexor hallucis brevis, adductor hallucis, flexor digiti minimi brevis), fourth layer (plantar and dorsal interossei); attachments, actions, innervation

4. Nerves: medial and lateral plantar nerves; origin (segmental derivations), course, structures innervated

5. Vessels: medial and lateral plantar vessels, plantar arch; origin, course

C. Arches: transverse, longitudinal

III. **Functional, Living, and Imaging Anatomy**

A. Functional Anatomy: principles of gait, dynamic anatomy of the joints of the lower limb (range of motion, weight-bearing axes), functional muscle groups, biomechanics of the arches of the foot (passive and dynamic support)

B. Living Anatomy

1. Palpable landmarks: tendons of the tibialis anterior, extensor hallucis longus, extensor digitorum longus, and peroneus tertius on the dorsum of the foot, tendons of the tibialis posterior and flexor digitorum longus posterior to the medial malleolus, tendons of the peroneus brevis and longus posterior to the

lateral malleolus, talus, calcaneus, sustentaculum tali, navicular, cuneiforms, cuboid, metatarsals, pulse of the posterior tibial artery posterior to the medial malleolus, pulse of the dorsalis pedis artery on the dorsum of the foot between the tendons of extensor hallucis longus and extensor digitorum longus; individual muscles on the leg that course to the foot

2. Surface projections: projections of the courses of the femoral, popliteal, anterior tibial, posterior tibial, peroneal, and dorsalis pedis arteries, projections of the courses of the great and small saphenous veins, dermatomes, cutaneous innervation

C. Imaging Anatomy

1. Normal: radiographs (AP, lateral) and MRI selected sequential images of the leg and foot, arteriogram (MRA) of the foot and selected venous phases

2. Pathological: fracture of bones in the foot

IV. A. **Diagnoses**

1. Musculoskeletal: sprains (inversion and eversion sprains), bunions, hallux valgus, pes planus ("flat foot"), calcaneal spur, talipes

2. Infectious/Inflammatory: plantar fasciitis

B. **Preventive Procedures:** support of the ankle in sports

JOINTS OF LOWER EXTREMITY

LEARNING OBJECTIVES Joints of Lower Extremity

I. **Osteology:** bones of the pelvic girdle [pelvic bones (ilium, ischium pubis), sacrum, coccyx] and lower limb (femur, patella, tibia, fibula, tarsals, metatarsals, phalanges), and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment

II. **Arthrology**

A. Hip Joint

1. Articular components: bony components, fibrous capsule, acetabular labrum (transverse acetabular ligament)
2. Ligaments: iliofemoral, ischiofemoral, and pubofemoral ligaments, ligament of the head of the femur; attachments, role in resisting movement at the hip joint

3. Iliopsoas bursa

B. Knee Joint

1. Articular components: bony components, fibrous capsule (quadriceps tendon, patellar ligament, medial and lateral patellar retinacula, arcuate and oblique popliteal ligaments)

2. Ligaments: tibial and fibular collateral and anterior and posterior cruciate ligaments; attachments, role in resisting movement at the knee joint

3. Medial and lateral menisci: shape; attachments; changes in position during movements of the knee; transverse ligament of the knee, coronary ligament

4. Synovial membrane: infrapatellar fat pad, alar fold

5. Bursae: suprapatellar, prepatellar, superficial and deep infrapatellar, anserine, biceps femoris, popliteal, semimembranous, and gastrocnemius bursae

C. Ankle Joint

1. Articular components: bony components, fibrous capsule

2. Ligaments: medial (deltoid) ligament, lateral ligament (anterior and posterior talofibular, calcaneofibular); attachments, role in resisting movement at the ankle joint; relative strength

D. Other Joints of the Lower Limb: proximal and distal tibiofibular subtalar (interosseous talocalcaneal ligament), talocalcaneonavicular

(plantar calcaneonavicular ligament), calcaneocuboid (long and short plantar ligaments), transverse tarsal, tarsometatarsal, metatarsophalangeal, and interphalangeal joints, interosseous membrane

E. Movements: muscles/muscle groups, producing them

F. Innervation

III. Functional, Living, and Imaging Anatomy

A. Functional Anatomy: principles of gait, dynamic anatomy of the joints of the lower limb (range of motion, weight-bearing axes, locking/unlocking mechanism of the knee), functional muscle groups

B. Clinical Anatomy: musculoskeletal: torn ligaments (anterior cruciate ligament tear), "unhappy triad" of the knee, chondromalacia patellae

LEARNING OBJECTIVES**Thorax****I. Thoracic Wall**

A. Osteology: thoracic vertebrae, ribs (true, false, floating), and sternum (manubrium, body, xiphoid process), and their bony landmarks; costal arch, costal margin, superior and inferior thoracic apertures

B. Arthrology: costovertebral, costotransverse, costochondral, sternocostal, interchondral, manubriosternal, and xiphisternal joints; movements

C. Breast

1. Nipple: areola; location (intercostal space) in male

2. Glandular tissue: lobes, lactiferous ducts, lactiferous sinuses; axillary tail

3. Suspensory ligaments

4. Nerves: anterior and lateral cutaneous branches of intercostal nerves; origin (segmental derivation), course

5. Vessels: anterior and posterior intercostal, and lateral thoracic vessels; origin, course

6. Lymphatics: axillary (apical, central, subscapular, pectoral, lateral) and parasternal lymph nodes; pattern of drainage

D. Intercostal Space

1. Muscles: external, internal, and innermost intercostal, subcostal, transversus thoracis; attachments, actions, innervation

2. Fasciae: external and internal intercostal membranes, endothoracic fascia

3. Intercostal nerves: origin, course, structures innervated

4. Vessels: internal thoracic (perforating branches) and anterior and posterior intercostal vessels; origin, course

E. Diaphragm: parts [sternal, costal, lumbar (crura, arcuate ligaments)], central tendon; aortic and esophageal hiatuses, foramen for the inferior vena cava; innervation and blood supply; movements

II. Mediastinum

Divisions: superior mediastinum, inferior mediastinum (anterior, middle, and posterior mediastinum); boundaries

III. Functional, Living, and Imaging Anatomy

A. Living Anatomy

1. Palpable landmarks: clavicle, infraclavicular fossa, manubrium of the sternum, jugular notch, body of the sternum, sternal angle,

xiphisternum, costal arch, costal margin, ribs, intercostal spaces

2. **Surface Projections:** midclavicular, anterior axillary, midaxillary, and posterior axillary lines, projections of the pleural reflections, dermatomes on the skin of the thoracic wall

B. Imaging Anatomy

1. **Normal:** mammogram, radiographs (PA, lateral), and CT and MRI selected sequential images of the thorax

2. **Pathological:** carcinoma of the breast, flail chest, tension pneumothorax, pericardial tamponade, pleural effusion, tuberculosis

IV. Clinical Anatomy

A. Diagnoses

1. **Musculoskeletal:** rib/sternal fractures, flail chest

2. **Vascular:** pleural effusion, thoracic outlet syndrome, hemothorax, chylothorax

3. **Infections/inflammatory:** costochondritis, pleurisy

4. **Neoplastic:** malignant/nonmalignant tumors of the breast

5. **Other:** pneumothorax (tension pneumothorax), pneumomediastinum

B. Diagnostic Procedures: breast examination (palpable mass, orange-peels texture of the skin, dimpling, retraction of the nipple), breast/pleural biopsy, thoracentesis, mediastinoscopy, sternal marrow aspiration

C. Therapeutic Procedures: thoracentesis (intercostal drainage), lumpectomy, mastectomy, intercostal nerve block, thoracostomy, thoracotomy

LUNGS AND MEDIASTINUM

LEARNING OBJECTIVES

Lungs and Mediastinum

I. Lungs

A. Pleural Cavity: visceral pleura, parietal pleura [diaphragmatic, mediastinal, costal, cervical (suprapleural membrane)]; recesses (costodiaphragmatic, costomediastinal); pulmonary ligament; innervation and blood supply

B. External Anatomy of the Lung: surfaces [costal, diaphragmatic (base), mediastinal], apex; impressions on mediastinal surface; hilum, root; borders (inferior, anterior, posterior); fissures [oblique, horizontal (right lung)]; lobes [superior, middle (right lung), inferior]

C. Trachea: cartilaginous "rings"; trachealis muscle; carina

D. Bronchi: principal, lobar, and segmental bronchi

E. Bronchopulmonary Segments

1. Left lung: superior lobe (apicoposterior, anterior, superior and inferior lingular), inferior lobe (superior and medial, lateral, anterior, and posterior basal)

2. Right lung: superior lobe (apical, anterior, posterior), middle lobe (medial, lateral), inferior lobe (superior and medial, lateral, anterior, and posterior basal)

F. Pulmonary Vessels: origin, course (relationship to the bronchial tree)

G. Bronchial Vessels: origin, course

H. Lymphatics: pulmonary, bronchopulmonary, tracheobronchial, and paratracheal lymph nodes, bronchomediastinal lymphatic trunk; pattern of drainage

I. Pulmonary Plexus of Nerves: preganglionic parasympathetic fibers (vagus nerves), postganglionic sympathetic fibers (thoracic pulmonary nerves); postganglionic parasympathetic cell bodies (terminal ganglia); visceral afferent fibers

II. Functional, Living, and Imaging Anatomy

A. Functional Anatomy: mechanics of respiration (changes in thoracic anterior-posterior, transverse, and vertical dimensions)

B. Living Anatomy: projections of the pleural reflections, lobes and bronchopulmonary segments of the lung

C. Imaging Anatomy

1. Normal: bronchogram; radiographs (PA, lateral), and CT and MRI selected sequential images of the thorax

2. Pathological: carcinoma of the lung, pneumonia, tension pneumothorax, tuberculosis

III. Clinical Anatomy

A. Diagnoses

1. Vascular: pulmonary embolism/edema, pleural effusion
2. Infectious/Inflammatory: pneumonia, pleurisy
3. Neoplastic: malignant/nonmalignant tumors of the lung
4. Other: upper respiratory obstruction (aspirated foreign object), ruptured trachea/bronchus

B. Diagnostic Procedures: breath sounds (auscultation), bronchoscopy

C. Therapeutic Procedures: cardiopulmonary resuscitation, lobectomy, segmental resection

LEARNING OBJECTIVES

Heart

I. Heart and Middle Mediastinum

A. Divisions of the Inferior Mediastinum: anterior, middle, and posterior; boundaries

B. Pericardial Sac: fibrous and serous pericardium, pericardial cavity (oblique and transverse pericardial sinuses); innervation and blood supply

C. External Anatomy of the Heart: surfaces (posterior, diaphragmatic, sternocostal), apex; sulci [anterior and posterior interventricular, atrioventricular (coronary)]; borders (right, left, superior, inferior); orientation of the heart in situ

D. Internal Anatomy of the Heart

1. Right atrium: crista terminalis, atrium proper, auricle, pectinate muscles, sinus venarum, interatrial septum, fossa ovalis, limbus ovalis, ostium of the coronary sinus, valve of the coronary sinus, ostium of the inferior vena cava, valve of the inferior vena cava, ostium of the superior vena cava, right atrioventricular orifice, right atrioventricular valve (anterior, posterior, and septal cusps)

2. Right ventricle: trabeculae carneae, septomarginal trabecula, papillary muscles, chordae tendineae, conus arteriosus, pulmonary orifice, pulmonary semilunar valve (anterior, left, and right cusps; valvular sinuses), pulmonary trunk

3. Left atrium: ostia of the pulmonary veins, auricle, pectinate muscles, left atrioventricular orifice, left atrioventricular valve (anterior and posterior cusps)

4. Left ventricle: trabeculae carneae, papillary muscles, chordae tendineae, interventricular septum (membranous and muscular parts), aortic vestibule, aortic orifice, aortic semilunar valve (left, right, and posterior cusps; aortic sinuses), ostia of coronary arteries, ascending aorta

5. Orientation of the heart chambers in situ

E. Coronary Arteries

1. Right coronary artery: sinuatrial nodal, marginal, posterior interventricular (septal branches), and atrioventricular nodal arteries

2. Left coronary artery: anterior interventricular (septal branches) and circumflex arteries

3. Patterns of coronary artery "dominance"

F. Cardiac Veins: great cardiac vein, oblique vein of the left atrium, coronary sinus (middle and small cardiac veins), and anterior and smallest cardiac veins

G. Skeleton of the Heart: anuli fibrosi, fibrous trigones

H. Cardiac Plexuses (superficial, deep): preganglionic parasympathetic fibers (vagus nerves), postganglionic sympathetic fibers (cervical and thoracic cardiac nerves); postganglionic parasympathetic cell bodies (superficial and deep cardiac plexuses, terminal ganglia); visceral afferent fibers

I. Conducting System: sinuatrial and atrioventricular nodes, internodal bundles, atrioventricular bundle, right and left bundle branches

II. **Functional, Living, and Imaging Anatomy**

A. Functional Anatomy: anatomical basis of heart sounds (systole, diastole), mechanism and timing of filling of coronary arteries

B. Living Anatomy

1. Surface projections: projections of the apex beat, cardiac outline, cardiac valves (anatomical and auscultation sites), aortic arch, bifurcation of the pulmonary trunk)

2. Visual inspection: precordium, apex beat

C. Imaging Anatomy

1. Normal: radiographs of the thorax; aortogram; coronary and pulmonary arteriograms; venous phase studies from selected arterial images

2. Pathological: pericardial tamponade, ventricular hypertrophy

III. **Clinical Anatomy**

A. Diagnoses: vascular: angina pectoris, myocardial infarction, valvular disease (mitral valve prolapse), aortic aneurysm/dissection/rupture, pericardial effusion, pericardial tamponade, coarctation of the aorta

B. Diagnostic Procedures: heart sounds (sites of auscultation), cardiac catheterization (cardiac angiography), pericardiocentesis

C. Therapeutic Procedures: cardiopulmonary resuscitation, balloon angioplasty, insertion of a transvenous cardiac pacemaker, implantation of a cardiac pacemaker, intracardiac injections, coronary bypass surgery, pericardiocentesis, heart transplantation

DORSAL MEDIASTINUM

LEARNING OBJECTIVES

Dorsal Mediastinum

I. **Thoracic Wall: Diaphragm.** Parts [sternal, costal, lumbar (crura, arcuate ligaments)], central tendon; aortic and esophageal hiatuses, foramen for the inferior vena cava; innervation and blood supply; movements

II. **Superior, Posterior, and Anterior Mediastinum**

A. Contents of the Superior Mediastinum: thymus, aortic arch, brachiocephalic trunk, left common carotid artery, left subclavian artery, ligamentum arteriosum; trachea; paratracheal lymph nodes; esophagus; thoracic duct; vagus, left recurrent laryngeal, and phrenic nerves, thoracic sympathetic trunks, sympathetic ganglia, gray and white rami communicantes, thoracic pulmonary and thoracic sympathetic nerves; relationships

B. Contents of the Posterior Mediastinum: esophagus, esophageal plexus; thoracic aorta (posterior intercostal, esophageal, and bronchial arteries); azygous and hemiazygous veins; thoracic duct; thoracic sympathetic trunks, sympathetic ganglia, gray and white rami communicantes, greater, lesser, and least splanchnic nerves (as strictly defined, the thoracic sympathetic trunks and their associated sympathetic ganglia and gray and white rami communicantes do not lie within the boundaries of the posterior mediastinum); relationships

C. Contents of the Anterior Mediastinum: internal thoracic vessels; parasternal lymph nodes; thymus; sternopericardial ligaments; transversus thoracis muscle; relationships

III. **Overview of the Autonomic Nervous System**

A. Sympathetic Nervous System

1. Preganglionic neurons: cell bodies (lateral horn of spinal cord segments T1-L2); efferent fibers (white rami communicantes; greater, lesser, least, lumbar, and sacral splanchnic nerves), course, areas of distribution

2. Postganglionic neurons: cell bodies [sympathetic ganglia, collateral ganglia (celiac; superior and inferior mesenteric, and aorticorenal ganglia, inferior hypogastric plexus)]; efferent fibers (gray rami communicantes, cervical and thoracic cardiac nerves, thoracic pulmonary nerves), course, areas of distribution

B. Parasympathetic Nervous System

1. Preganglionic neurons: cell bodies (brain stem nuclei, lateral horn of spinal cord segments S2-S4); efferent fibers (oculomotor, facial, glossopharyngeal, vagus, and pelvic splanchnic nerves), course, areas of distribution

C. Visceral Afferents

IV. **Functional, Living, and Imaging Anatomy**

A. Functional Anatomy: physiology of the autonomic nervous system (sympathetic vs. parasympathetic, pain vs. reflex visceral afferents, referred vs. direct pleural/pericardial/cardiac pain)

B. Living Anatomy : projections of the brachiocephalic trunk, left common carotid artery, left subclavian artery, right and left brachiocephalic veins, superior vena cava, and bifurcation of the trachea

C. Imaging Anatomy: barium swallow

V. **Clinical Anatomy**

A. Diagnoses

1. Nervous: phrenic nerve palsy
2. Other: ruptured esophagus or diaphragm

B. Diagnostic Procedures: esophagoscopy

C. Therapeutic Procedures: sympathectomy, thymectomy

LEARNING OBJECTIVES

Abdominal Wall

I. Anterolateral Abdominal Wall

A. Fasciae: superficial fascia (fatty and membranous layers), deep fascia

B. Muscles: external and internal abdominal oblique, transversus abdominis, rectus abdominis; aponeuroses; conjoint tendon (falx inguinalis); attachments, actions, innervations, vasculature

C. Folds: median, medial, and lateral umbilical folds

D. Ligaments: inguinal, lacunar, pectineal, median, umbilical, and medial umbilical ligament

E. Rectus Sheath: layers (formation); contents; arcuate line; linea alba

F. Nerves: thoracoabdominal, subcostal, iliohypogastric, and ilioinguinal nerves; origin (segmental derivation), course, structures innervated

G. Vessels: superior and inferior epigastric, deep circumflex iliac, posterior intercostal, and subcostal vessels, thoracoepigastric vein; origin, course

H. Lymphatics: superficial inguinal and axillary lymph nodes; pattern of drainage

I. Inguinal Canal: inguinal rings; contents (spermatic cord/round ligament of uterus)

J. Inguinal Triangle: boundaries

II. Abdominopelvic Cavity

A. Peritoneum: parietal and visceral peritoneum

B. Fasciae: transversalis fascia; extraperitoneal connective tissue

C. Intraperitoneal and retroperitoneal viscera

III. Functional, Living, and Imaging Anatomy

A. Living Anatomy

1. Palpable structures: costal margins, xiphisternum, epigastric fossa, rectus abdominis, linea semilunaris, linea alba, umbilicus, pubic tubercle, inguinal ligament and fold, anterior superior iliac spine, inferior border of liver

2. Surface projections: abdominal quadrants and regions, transpyloric, subcostal, projections of the domes of the diaphragm, dermatomes on the skin of the thoracic/anterolateral abdominal wall

IV. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: ventral, paraumbilical, and incisional hernias
2. Vascular: caput medusae

B. Therapeutic Procedures: abdominal paracentesis, hernia repair, peritoneal dialysis, laparoscopic surgical procedures, laparotomy

INGUINAL CANAL

LEARNING OBJECTIVES

Inguinal Canal

- I. **Anterolateral Abdominal Wall**
 - A. Fasciae: superficial and deep fascia
 - B. Muscles: external and internal abdominal oblique, transversus abdominis, rectus abdominis; aponeuroses; conjoint tendon (falx inguinalis); attachments, actions, innervation, vasculature
 - C. Folds: median, medial, and lateral umbilical folds
 - D. Ligaments: inguinal, lacunar, pectineal, median umbilical, and medical umbilical ligaments
 - E. Rectus Sheath: layers (formation); contents; arcuate line
 - F. Nerves: thoracoabdominal, subcostal, iliohypogastric, and ilioinguinal nerves; origin (segmental derivation), course, structures innervated
 - G. Vessels: superior and inferior epigastric, deep circumflex iliac, posterior intercostal, and subcostal vessels, thoracoepigastric vein; origin, course
 - H. Lymphatics: superficial inguinal and axillary lymph nodes; pattern of drainage
 - I. Inguinal Canal: inguinal rings; contents (spermatic cord/round ligament of uterus)

- II. **Clinical Anatomy**
 - A. Diagnoses: Musculoskeletal: direct and indirect inguinal hernias
 - B. Therapeutic Procedures: hernia repair

ABDOMINAL CAVITY AND DEVELOPMENT

LEARNING OBJECTIVES Abdominal Cavity and Development

I. **Abdominopelvic Cavity**

General Structure

1. Peritoneum: parietal and visceral peritoneum; mesenteries and "ligaments"
2. Greater sac: supracolic space (subphrenic and hepatorenal recesses), infracolic space (paramesenteric and paracolic gutters)
3. Lesser sac (omental bursa): recesses (superior, inferior, splenic); lesser omentum (hepatoesophageal, hepatogastric, and hepatoduodenal ligaments), greater omentum (gastrocolic, gastrosplenic, and splenorenal ligaments); omental foramen
4. Intraperitoneal and retroperitoneal viscera

II. **Clinical Anatomy**

A. Diagnoses

Musculoskeletal: paraumbilical and ventral hernias

- #### B. Therapeutic Procedures: peritoneal dialysis, laparoscopic surgical procedures, laparotomy

ABDOMINAL VASCULATURE

LEARNING OBJECTIVES

Abdominal Vasculature

- I. Abdominopelvic Cavity
 - A. Foregut
 1. Abdominal portion of the esophagus: relationships; innervation and blood supply; lymphatics (pattern of drainage)
 2. Stomach: curvatures (lesser, greater); parts (cardia, fundus, body, pyloric antrum and canal); pylorus; sphincters (cardiac, pyloric); rugae; relationships; innervation and blood supply; lymphatics
 3. Celiac Trunk and its Branches
 - a. Common hepatic artery: proper hepatic artery [right gastric, right hepatic (cystic), left hepatic], gastroduodenal artery [superior pancreaticoduodenal, right gastroepiploic (gastro-omental)]
 - b. Splenic artery: pancreatic branches, left gastroepiploic (gastro-omental) and short gastric arteries
 - c. Left gastric artery: esophageal branches
 - d. Origin, course
 4. Veins
 - a. Portal vein: splenic vein [short gastric, left gastroepiploic, inferior mesenteric (left colic, sigmoid, superior rectal)], superior mesenteric vein (middle colic, right colic, ileocolic, intestinal), right and left gastric, cystic, and paraumbilical veins; portal-systemic anastomoses
 - b. Hepatic veins: left, right, middle; central veins
 - c. Inferior vena cava
 - d. Origin, course
 - B. Midgut and Hingut
 1. Arteries: superior mesenteric artery [inferior pancreaticoduodenal, middle and right colic, ileocolic (appendicular), intestinal], inferior mesenteric artery (left colic, sigmoid, superior rectal), marginal artery; origin, course; arcades, vasa recta
 2. Veins: superior and inferior mesenteric veins; origin, course
 - C. Posterior Abdominal Wall
 1. Arteries
 - a. Abdominal aorta: inferior phrenic arteries, celiac trunk, superior mesenteric, middle suprarenal, renal, testicular/ovarian, lumbar, inferior mesenteric, median sacral, and common iliac arteries; origin (vertebral level), course
 - b. Inferior vena cava: common iliac, lumbar, renal (left renal-let testicular/ovarian, left suprarenal), right testicular/ovarian, and right suprarenal veins; origin, course
 - c. Ascending lumbar veins: origin, course; anastomoses

- II. **Functional, Living, and Imaging Anatomy**
 - A. **Functional Anatomy**: concept of a "portal" vein
 - B. **Living Anatomy**: projection of aortic bifurcation
 - C. **Imaging Anatomy**
 - 1. Normal: celiac, superior mesenteric, inferior mesenteric, and renal arteriograms, aortogram, venous phase studies from selected images
 - 2. Pathological: abdominal aortic aneurysm

- III. **Clinical Anatomy**
 - A. **Diagnoses**: dilation of portal-systemic anastomoses in portal hypertension (esophageal varices, caput medusae, hemorrhoids), aortic aneurysm/dissection/rupture, superior mesenteric artery syndrome
 - B. **Diagnostic Procedures**: auscultation of the abdominal aortic pulse (bruits)
 - C. **Therapeutic Procedures**: portocaval/splenorenal shunt

LIVER, DUODENUM, AND PANCREAS

LEARNING OBJECTIVES Liver, Duodenum, and Pancreas

I. Abdominopelvic Cavity

FOREGUT

1. Stomach: curvatures (lesser, greater); parts (cardia, fundus, body, pyloric antrum and canal); pylorus; sphincters (cardiac, pyloric); rugae; relationships; innervation and blood supply; lymphatics (pattern of drainage)

2. Spleen: surfaces, borders, indentations; relationships; innervation and blood supply; lymphatics

3. Duodenum: parts [superior (duodenal bulb), descending (greater and lesser duodenal papillae), horizontal, ascending]; duodenojejunal flexure; ligament of Treitz; relationships; innervation and blood supply; lymphatics

4. Pancreas: parts [head (uncinate process), inferior border; lobes [anatomical (right, left, quadrate, caudate), functional (surgical)]; bare area; ligaments (falciform, coronary, triangular, hepatorenal, ligamentum teres hepatis, ligamentum venosum); porta hepatis; relationships; innervation and blood supply; lymphatics

5. Gall bladder: parts (fundus, body, neck); relationships; innervation and blood supply; lymphatics

6. Bile ducts: intrahepatic, extrahepatic (right, left, and common hepatic, cystic, common bile; relationships); hepatopancreatic ampulla and sphincter; innervation

7. Lymphatics: celiac [and posterior mediastinal (liver)] lymph nodes, intestinal trunk, cisterna chyli; pattern of drainage

II. Functional, Living, and Imaging Anatomy

A. Living Anatomy

1. Palpable structures: inferior border of liver

2. Surface projections: projections of the gall bladder, liver, spleen, duodenum, root of the mesentery, head of the pancreas

B. Imaging Anatomy

1. Normal: radiographs (AP) and CT (especially for imaging of the pancreas) and MRI selected sequential images of the abdomen

2. Pathological: liver abscess, pancreatic pseudocyst,

III. **Clinical Anatomy**

A. Diagnoses

1. Infectious/Inflammatory: cholecystitis, pancreatitis
2. Neoplastic: carcinoma of the stomach/pancreas, metastatic cancer to the liver
3. Other: obstructive jaundice

B. Diagnostic Procedures: rebound tenderness, liver biopsy, esophagogastroduodenoscopy

C. Therapeutic Procedures: gastric aspiration and lavage, cholecystectomy, hepatic resection, liver transplantation

KIDNEY, SUPRARENALS, AND ABDOMINAL AUTONOMICS

LEARNING OBJECTIVES

Kidneys, Suprarenals, and Abdominal Autonomics

I. Abdominopelvic Cavity

A. Foregut

1. Celiac Plexus: preganglionic parasympathetic fibers (vagal trunks), preganglionic sympathetic fibers (greater splanchnic nerves); postganglionic parasympathetic cell bodies (terminal ganglia), postganglionic sympathetic cell bodies (celiac ganglia); visceral afferent fibers

2. Lymphatics: celiac [and posterior mediastinal (liver)] lymph nodes, intestinal trunk, cisterna chyli; pattern of drainage

B. Midgut and Hindgut

1. Appendix: external and internal anatomy of the appendix and cecum; mesoappendix

2. Superior and Inferior Mesenteric Plexuses: preganglionic parasympathetic fibers (vagal trunks, pelvic splanchnic nerves), preganglionic sympathetic fibers (greater, less, and lumbar splanchnic nerves); postganglionic parasympathetic cell bodies (terminal ganglia), postganglionic sympathetic cell bodies (superior and inferior mesenteric ganglia); visceral afferent fibers; intermesenteric plexus [preganglionic sympathetic fibers (greater, lesser, least, and lumbar splanchnic nerves)]

3. Lymphatics: superior and inferior mesenteric lymph nodes, intestinal and lumbar lymph nodes, intestinal and lumbar trunks, cisterna chyli; pattern of drainage

II. Posterior Abdominal Wall

A. Muscles: quadratus lumborum, psoas major and minor, iliacus; attachments, actions, innervation

B. Diaphragm: parts [sternal, costal, lumbar (crura, arcuate ligaments)], central tendon; aortic and esophageal hiatuses, foramen for the inferior vena cava; innervation and blood supply; movements

C. Lumbar Plexus: iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral and obturator nerves, lumbosacral trunk; origin (segmental derivations), course, structures innervated

D. Vessels

1. Abdominal Aorta: inferior phrenic arteries, celiac trunk, superior mesenteric, middle suprarenal, renal, testicular/ovarian, lumbar, inferior mesenteric, median sacral, and common iliac arteries; origin (vertebral level), course

2. Inferior Vena Cava: common iliac, lumbar, renal (left renal-left testicular/ovarian, left suprarenal), right testicular/ovarian, and right suprarenal veins; origin, course

3. Ascending Lumbar Veins: origin, course; anastomoses

4. Lymphatics: lumbar lymph nodes, lumbar lymphatic trunks, cisterna chyli; pattern of drainage

E. Lumbar Sympathetic Trunks: sympathetic ganglia, white and gray rami communicantes, lumbar splanchnic nerves

F. Kidney: parenchyma (cortex, medulla); hilum; renal sinus; minor and major calyces, renal pelvis, ureter (course, innervation); perirenal and pararenal fat; renal fascia; relationships; innervation and blood supply; lymphatics (pattern of drainage)

G. Suprarenal Gland: parenchyma (cortex, medulla); relationships; innervation and blood supply; lymphatics (pattern of drainage)

III. Functional, Living, and Imaging Anatomy

A. Functional Anatomy: pain vs. reflex visceral afferents, referred vs. direct peritoneal pain

B. Living Anatomy

1. Palpable structures: abdominal aorta

2. Surface projections: abdominal quadrants and regions, transpyloric, subcostal, supracristal, and transtuberular planes (vertebral levels), projections of the domes of the diaphragm, kidneys, aortic bifurcation, projections of the kidneys on the skin of the posterior abdominal wall, McBurney's point

C. Imaging Anatomy

1. Normal: radiographs (AP) and CT (especially for imaging of the kidney) and MRI selected sequential images of the abdomen, abdominal ultrasound, barium swallow/enema, celiac, superior mesenteric, inferior mesenteric, and renal arteriograms, aortogram, intravenous pyelogram, cholangiogram, cholecystogram, lymphangiogram

2. Pathological: diverticulosis, cholelithiasis, hydronephrosis, ureteral calculus, abdominal aortic aneurysm, colon cancer, bowel obstruction, liver abscess, pancreatic pseudocyst

IV. Clinical Anatomy

A. Diagnoses

1. Neoplastic: renal cell carcinoma

2. Other: renal ptosis, hydronephrosis

B. Diagnostic Procedures: rebound tenderness, referred rebound tenderness, guarding, psoas sign, pyelogram, renal biopsy

C. Therapeutic Procedures: appendectomy, nephrectomy, lithotripsy, kidney transplantation, sympathectomy, vagotomy, ganglionectomy, celiac plexus blockade

TOPOGRAPHY OF PELVIC VISCERA

LEARNING OBJECTIVES Topography of Pelvic Viscera

I. Pelvis

A. Osteology: pelvic bone (ilium, ischium, pubis), sacrum, coccyx, and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment

B. Arthrology: pubic symphysis, sacroiliac joints; sacroiliac, sacrotuberous, and sacrospinous ligaments (attachments, role in resisting movement at the sacroiliac joint), obturator membrane

C. Viscera

1. Urinary bladder: parts (body, neck, apex); peritoneal relations [vesicouterine (female) and rectovesical (male) pouches]; puboprostatic (male), pubovesical (female), and median umbilical ligaments; innervation and blood supply; lymphatics (pattern of drainage)

2. Ovary: mesovarium, suspensory ligament of the ovary, ligament of the ovary; relationships; blood supply; lymphatics (pattern of drainage)

3. Uterine tube: parts [infundibulum (fimbriae), ampulla, isthmus, intramural part]; mesosalpinx; blood supply

4. Uterus: parts (fundus, body, cervix); relationships; peritoneal relations (vesicouterine and rectouterine pouches); orientation (anteflexion, anteversion); ligaments [broad, round, transverse cervical (cardinal), uterosacral]; innervation and blood supply; lymphatics (pattern of drainage)

5. Vagina: walls, fornices; relationships; innervation and blood supply; lymphatics (pattern of drainage)

D. Vessels

1. Internal iliac artery: anterior trunk [umbilical, superior and inferior vesical, middle rectal, uterine (female; relationship to ureter), vaginal (female), internal pudendal inferior gluteal, and obturator arteries], posterior trunk (superior gluteal, iliolumbar, and lateral sacral arteries); origin, course; anastomoses

2. Internal iliac vein: middle, rectal, uterine (female), vaginal (female), internal pudendal, inferior and superior gluteal, obturator, and lateral and median sacral veins, prostatic (male), vesical, and rectal venous plexuses; origin, course; relationship to internal iliac artery

E. Lymphatics: sacral lymph nodes, internal, external, and common iliac lymph nodes; pattern of drainage

II. Functional, Living, and Imaging Anatomy

A. Functional Anatomy: mechanisms of urinary and fecal incontinence, support of pelvic viscera (active and passive mechanisms)

B. Living Anatomy: palpable structures: iliac crest, tubercle of the iliac crest, posterior superior iliac spine, pubic tubercle, inguinal ligament and fold, spermatic cord, ductus deferens; sacrospinous and sacrotuberous ligaments; urinary bladder, vaginal fimbriae, cervix, body of uterus, oviducts, ovaries, rectum, and canal, ischial tuberosity, ischial spine

C. Imaging Anatomy

1. Normal radiographs (AP, lateral) and CT and MRI selected sequential images of the pelvis, cystourethrogram, hysterosalpingogram, aortogram, internal iliac arteriogram, venous phase studies, ultrasound of non-gravid uterus, gravid uterus, ureters, and bladder

2. Pathological: carcinoma of the cervix/ovary, pelvic fracture, ectopic pregnancy, ovarian cyst, pelvic/perineal abscess, varicocele

III. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: pelvic fractures
2. Nervous: impotence, urinary and fecal incontinence; vaginismus
3. Vascular: intrapelvic hemorrhage, common/external/internal iliac aneurysm
4. Infectious/Inflammatory: cystitis
5. Neoplastic: endometriosis
6. Other: prolapse of the urinary bladder, vagina, uterus, and rectum, and fissure fistula, ectopic pregnancy (rupture), infertility, emergency delivery, membranous urethra in the male (extravasation of urine)

B. Diagnostic Procedures: rectal and vaginal examinations, Pap smear, culdoscopy, iliac bone marrow biopsy

C. Therapeutic Procedures: intrauterine contraceptive device - removal, hysterectomy

D. Preventive Procedures: intrauterine contraceptive device insertion

PERINEUM

LEARNING OBJECTIVES PERINEUM

Perineum

A. Boundaries and Divisions

B. Anal Triangle

1. Anal canal: internal anatomy; anal sphincters; innervation and blood supply (submucosal venous plexus); lymphatics (inferior mesenteric and superficial inguinal lymph nodes; pattern of drainage)

2. Ischicanal fossae: walls; recesses; content

C. Urogenital Triangle

1. Deep perineal pouch (urogenital diaphragm); superior fascia of the urogenital diaphragm, inferior fascia of the urogenital diaphragm (perineal membrane); sphincter urethrae and deep transverse perineal muscles (attachments, actions, innervation); membranous urethra; vagina (female); bulbourethral glands (male)

2. Superficial perineal pouch: inferior fascia of the urogenital diaphragm (perineal membrane), deep perineal fascia; superficial transverse perineal, ischiocavernosus, and bulbospongiosus muscles (attachments, actions, innervation); crus of the clitoris, bulbs of the vestibule, greater vestibular glands, vagina, and urethra (female); crura and bulb of the penis (male)

3. Potential space: deep and superficial perineal fasciae

4. Perineal body: composition, muscular insertions

5. Female external genitalia; mons pubis, labia majora, pudendal cleft, labia minora, vestibule of the vagina (external urethra and vaginal orifices, orifices of the ducts of the greater vestibular glands); clitoris (body, glans, prepuce, frenulum)

6. Male external genitalia: penis [root, body, glans, prepuce; corpora cavernosa, corpora spongiosum (bulb of the penis); tunica albuginea, superficial and deep penile fascia, suspensory and fundiform ligaments, innervation and blood supply]; scrotum (fascia; dartos muscle; innervation and blood supply); spermatic cord [fasciae (external spermatic, cremasteric, internal spermatic); cremaster muscle (action, innervation); ductus (vas) deferens; nerves (ilioinguinal nerve, genital branch of genitofemoral nerve); vessels (testicular artery, pampiniform plexus, cremaster artery, artery of the ductus deferens)]; testis [tunica vaginalis; tunica albuginea; seminiferous tubules; innervation and blood supply; lymphatics (pattern of drainage)]; epididymis

7. Nerves: pudendal nerve [perineal nerve (posterior scrotal/labial nerves), dorsal nerve of the penis/clitoris], perineal branch of the posterior femoral cutaneous nerve, genital branch of the genitofemoral nerve, and ilioinguinal nerve; origin (segmental derivation), course, structures innervated; innervation of perineal viscera - preganglionic sympathetic fibers (hypogastric and sacral splanchnic nerves); postganglionic parasympathetic cell bodies (terminal ganglia), postganglionic sympathetic cell bodies (inferior hypogastric plexus); visceral afferent fibers

8. Vessels: internal pudendal artery (perineal artery, artery of the bulb, deep artery of the penis/clitoris, dorsal artery of the penis/clitoris) deep dorsal vein of the penis/clitoris; origin, course

9. Lymphatics: internal iliac, lumbar, and superficial inguinal lymph nodes; pattern of drainage

PELVIC MUSCULATURE AND FASCIA

LEARNING OBJECTIVES Pelvic Musculature and Fascia

I. Pelvis

A. Osteology: pelvic bone (ilium, ischium, pubis), sacrum, coccyx, and their bony landmarks, including articular surfaces and areas of muscular/tendinous attachment; pelvic inlet and outlet; major and minor pelvis

B. Arthrology: pubic symphysis, sacroiliac joints; sacroiliac, sacrotuberous, and sacrospinous ligaments (attachments, role in resisting movement at the sacroiliac joint), obturator membrane

C. Muscles

1. Pelvic wall: piriformis, obturator internus (obturator fascia); attachments, actions, innervation

2. Pelvic diaphragm: levator ani (puborectalis, pubococcygeus, iliococcygeus), coccygeus; attachments, actions, innervation

D. Viscera

1. Urinary bladder: parts (body, neck, apex); detrusor muscle; internal anatomy (trigone, ureteral and internal urethral orifices); peritoneal relations [vesicouterine (female) and rectovesical (male) pouches]; puboprostatic (male), pubovesical (female), and median umbilical ligaments; innervation and blood supply lymphatics (pattern of drainage)

2. Male urethra: prostatic (urethral crest, colliculus seminalis, orifices of the prostatic utricle and ejaculatory ducts, prostatic sinuses), membranous and penile (navicular fossa) urethrae; internal and external urethral orifices

3. Prostate gland, ductus (vas) deferens, seminal vesicle, ejaculatory duct; relationships; innervation and blood supply; lymphatics (pattern of drainage)

4. Ovary: mesovarium, suspensory ligament of the ovary, ligament of the ovary; relationships; blood supply; lymphatics (pattern of drainage)

5. Uterine tube: parts [infundibulum (fimbriae), ampulla, isthmus, intramural part]; mesosalpinx; blood supply

6. Uterus: parts (fundus, body, cervix); relationships; peritoneal relations (vesicouterine and rectouterine pouches); orientation (anteflexion, anteversion); ligaments [broad, round, transverse cervical (cardinal), uterosacral]; innervation and blood supply; lymphatics (pattern of drainage)

7. Vagina: walls, fornices; relationships; innervation and blood supply; lymphatics (pattern of drainage)
8. Female urethra: orientation; relationships; internal and external orifices
9. Rectum: external and internal anatomy; relationships; peritoneal relations; innervation and bloody supply; lymphatics (pattern of drainage)

E. Vessels

1. Internal iliac artery: anterior trunk [umbilical, superior and inferior vesical, middle rectal, uterine (female; relationship to ureter), vaginal (female), internal pudendal, inferior gluteal, and obturator arteries], posterior trunk (superior gluteal, iliolumbar, and lateral sacral arteries); origin, course, anastomoses

2. Internal iliac vein: middle rectal, uterine (female), vaginal (female), internal pudendal, inferior and superior gluteal, obturator, and lateral and median sacral veins, prostatic (male), vesical, and rectal venous plexuses; origin, course; relationship to internal iliac artery

F. Lymphatics: sacral lymph nodes, internal, external, and common iliac lymph nodes; pattern of drainage

II. Functional, Living, and Imaging Anatomy

A. Living Anatomy

1. Palpable structures: iliac crest, tubercle of the iliac crest, posterior superior iliac spine, ischial tuberosity, anterior superior iliac spine, pubic tubercle, inguinal ligament and fold, spermatic cord, ductus deferens; per rectum-intersphincteric groove, anorectal ring, coccyx, sacrum, ischial tuberosity, ischial spine, sacrospinous and sacrotuberous ligaments, prostate (male), seminal vesicle (male), ductus deferens (male), cervix (female), per vaginam-urethra, urinary bladder, vaginal fornices, cervix, body of uterus, oviducts, ovaries, rectum, anal canal, ischial tuberosity, ischial spine, sacrospinous and sacrotuberous ligaments

2. Surface projections: projection of the dermatomes on the skin of the perineum

B. Imaging Anatomy

1. Normal: radiographs (AP, lateral) and CT and MRI selected sequential images of the pelvis, cystourethrogram, hysterosalpingogram, aortogram, internal iliac arteriogram, internal iliac arteriogram, venous phase studies from selected arterial images, ultrasound of testis, non-gravid uterus, gravid uterus, ovary, ureters, and bladder

2. Pathological: carcinoma of the cervix/prostate/testis/ovary, pelvic fracture, ectopic pregnancy, ovarian cyst, pelvic/perianal abscess, varicocele

III. Clinical Anatomy

A. Diagnoses

1. Musculoskeletal: pelvic fractures
2. Nervous: impotence, urinal and fecal incontinence, vaginismus
3. Vascular: hemorrhoids, varicocele, intrapelvic hemorrhage, common/external/internal iliac aneurysm, priapism
4. Infections/Inflammatory: cystitis, epididymitis, prostatitis, perianal, ischioanal, pelvic (suprlevator), and greater vestibular gland abscesses
5. Neoplastic: benign prostatic hyperplasia, carcinoma of the prostate/cervix/rectum/ovary/testis, endometriosis
6. Other: prolapse of the urinary bladder, vagina, uterus, and rectum, anal fissure, , fistula, ectopic pregnancy (rupture), infertility, emergency delivery, hydrocele, testicular torsion, phimosis, fracture of the penis, straddling injury and rupture of the membranous urethra in the male (extravasation of urine)

B. Diagnositc Procedures: rectal, vaginal, and testicular examinations, urethral catheterization, Pap smear, pelvimetry, culdoscopy, proctoscopy, sigmoidoscopy, urethrocytscopy, hysteroscopy, iliac bone marrow biopsy

C. Therapeutic Procedures: urethral catheterization, episotomy, hemorrhoidectomy, cirumcision, dilation and curettage, epidural and sacral anesthesia, cesarean section, intrauterine contraceptive device removal, hysterectomy, prostatectomy (transurethral, radical), pudendal/penile block, resection of the rectum, orchidectomy, penile implant, aspiration of a hydrocele

D. Preventive Procedures: intrauterine contraceptive device insertion, vasectomy

PELVIC NERVES AND VESSELS

LEARNING OBJECTIVES Pelvic Nerves and Vessels

I. Perineum

A. Nerves: pudendal nerve [perineal nerve (posterior scrotal/labial nerves), dorsal nerve of the penis/clitoris], perineal branch of the posterior femoral cutaneous nerve, genital branch of the genitofemoral nerve, and ilioinguinal nerve; origin (segmental derivation), course, structures innervated; innervation of perineal viscera - preganglionic parasympathetic fibers (pelvic splanchnic nerves), preganglionic sympathetic fibers (hypogastric and sacral splanchnic nerves); postganglionic parasympathetic cell bodies (terminal ganglia), postganglionic sympathetic cell bodies (inferior hypogastric plexus); visceral afferent fibers

B. Vessels: internal pudendal artery (perineal artery, artery of the bulb, deep artery of the penis/clitoris, dorsal artery of the penis/clitoris), deep dorsal vein of the penis/clitoris; origin, course

C. Lymphatics: internal iliac, lumbar, and superficial inguinal lymph nodes; pattern of drainage

II. Pelvis

A. Vessels

1. 1. Internal iliac artery: anterior trunk [umbilical, superior and inferior vesical, middle rectal, uterine (female; relationship to ureter), vaginal (female), internal pudendal, inferior gluteal, and obturator arteries], posterior trunk (superior gluteal, iliolumbar, and lateral sacral arteries); origin, course, anastomoses

2. Internal iliac vein: middle rectal, uterine (female), vaginal (female), internal pudendal, inferior and superior gluteal, obturator, and lateral and median sacral veins, prostatic (male), vesical, and rectal venous plexuses; origin, course; relationship to internal iliac artery

B. Lymphatics: sacral lymph nodes, internal, external, and common iliac lymph nodes; pattern of drainage

C. Nerves

1. Somatic nerves (branches of the sacral plexus): sciatic, pudendal, superior and inferior gluteal, and posterior femoral cutaneous nerves, nerves to the piriformis, levator ani, coccygeus, obturator internus, and quadratus femoris; origin (segmental derivation), course, structures innervated

2. Autonomic nerves: sacral sympathetic trunks, sympathetic ganglia, gray rami communicantes, visceral afferent fibers; innervation of pelvic viscera - preganglionic parasympathetic fibers (pelvic splanchnic nerves), preganglionic sympathetic fibers (superior hypogastric plexus, hypogastric and sacral splanchnic nerves), postganglionic parasympathetic cell bodies (terminal ganglia), postganglionic sympathetic cell bodies (inferior hypogastric plexus); visceral afferent fibers

III. Clinical Anatomy

Diagnoses

1. Nervous: impotence, urinary and fecal incontinence, vaginismus
2. Vascular: hemorrhoids, varicocele, intrapelvic hemorrhage, common/external/internal iliac aneurysm, priapism

Learning Objectives: Axilla and Brachial Plexus

I. Axilla: contents and relations

- A. Boundaries: walls, base, apex, relations
- B. Muscles: serratus anterior, subscapularis, latissimus dorsi, teres major, long head triceps, deltoid, pectoralis major and minor, coracobrachialis, short head biceps
- C. Vessels: axillary artery (superior thoracic; thoracoacromial, lateral thoracic, subscapular, circumflex scapular, thoracodorsal, anterior and posterior circumflex humeral), axillary vein; origin and course
- D. Lymphatics: apical, central, subscapular, pectoral, and lateral lymph nodes, subclavian lymphatic trunk; pattern of drainage
- E. Nerves: brachial plexus, intercostalbrachial (referred pain)

II. Brachial Plexus: pattern of formation, relations

- A. Roots: origin; long thoracic and dorsal scapular nerves; course and innervations
- B. Trunks: nerve to subclavius, suprascapular nerve; course and innervations
- C. Divisions: anterior, posterior; origin, pattern of formation, course
- D. Cords and branches: lateral cord (lateral pectoral nerve, lateral root of the median nerve, musculocutaneous nerve), medial cord (medial pectoral nerve, medial brachial and antebrachial cutaneous nerves, medial root of the median nerve, ulnar nerve), posterior cord (upper and lower subscapular, thoracodorsal, axillary, and radial nerves); origin, pattern of formation, course, structures innervated
- E. Axillary sheath: fascial continuity

III. Imaging Anatomy

- A. Imaging: bilateral MRI sequential images of the brachial plexus (coronal, transverse, sagittal, oblique transverse)

IV. Clinical Anatomy

- A. Diagnosis and treatment
 - 1. Nervous: Klumpke's paralysis, Erb's paralysis, accessory nerve palsy, winging of the scapula, predict all deficits following lesion of each nerve derived from the brachial plexus

Learning Objectives: Scapular and Shoulder Regions

I. Scapular Region

- A. Osteology: pectoral girdle (clavicle, scapula), scapular fossae and attachments
- B. Joints: scapulothoracic "joint," acromioclavicular
- C. Ligaments: transverse scapular, coracoacromial (subacromial bursa), coracoclavicular
- D. Muscles: trapezius, latissimus dorsi, levator scapulae, rhomboid major and minor, deltoid, teres major, serratus anterior, rotator cuff muscles (subscapularis, supraspinatus, infraspinatus, teres minor), deltoid; attachments, actions, innervation
- E. Nerves: accessory, axillary, dorsal scapular, suprascapular, and thoracodorsal nerves; origin, course, structures innervated
- F. Vessels: posterior circumflex humeral, transverse cervical, suprascapular, and circumflex scapular vessels; origin, course arterial anastomoses around the scapula
- G. Spaces: quadrangular and triangular spaces, boundaries and contents
- H. Movements: Scapulohumeral movement, related innervations, muscle groups

II. Shoulder Region

- A. Muscles: deltoid, pectoralis major and minor, rotator cuff, trapezius, triceps, coracobrachialis, biceps
- B. Vessels: branches of axillary a. (thoracoacromial trunk), ascending br. from brachial, cephalic v.,
- C. nerves: brachial plexus
- D. Shoulder joint
 1. Articular components: bony components, fibrous capsule glenoid labrum
 2. Ligaments: glenohumeral, coracohumeral, coracoacromial lig., attachments, role in maintaining the integrity of the shoulder joint
 3. Subscapular and subacromial bursae
 4. Movements: muscle groups and innervations, intrinsic vs. extrinsic

III. Pectoral Region

- A. Fascia: cutaneous nerves; origin, area of distribution, clavipectoral fascia
- B. Muscles: pectoralis major and minor, subclavius; attachments, actions, innervation
- C. Nerves: medial and lateral pectoral nerves, nerve to the subclavius; origin, course, structures innervated.
- D. Vessels: superior thoracic, thoracoacromial trunk, lateral thoracic vessels, cephalic vein; origin, course

IV. Functional, Living, and Imaging Anatomy

- A. Function anatomy: dynamic anatomy of shoulder joint, functional muscle groups, scapulohumeral rhythm, rotator cuff mechanism, rotator cuff and shoulder joint stability

- B. Living anatomy: palpate clavicle, infraclavicular fossa, coracoid process, acromion, acromial angle, superior and inferior angles of the scapula, medial and lateral borders of the scapula, spine of the scapula; surface projections of brachial plexus, and axillary artery and branches
- C. Imaging anatomy: radiographs and MRI; sagittal, oblique sagittal, synovial cavity, bursa

V. Clinical Anatomy

- A. Diagnosis: strains, sprains, acromioclavicular separation, rotator cuff tears, frozen shoulder, shoulder dislocation
- B. Nervous: shoulder dislocation and upper lateral cutaneous nerve

Learning Objectives: Arm and Elbow

- I. Osteology: humerus, radius, ulna; bony landmarks and attachments
- II. Ligaments: radial and ulnar collateral, annular ligament; attachments, role in maintaining the integrity of the elbow joint
- III. Superficial fascia
 - A. Cutaneous nerves: intercostobrachial, upper lateral brachial (axillary), medial brachial and antebrachial cutaneous, superior and inferior lateral brachial cutaneous, and posterior brachial cutaneous nerves; origin, area of distribution
 - B. Superficial veins: cephalic and basilic veins; course and origin
- IV. Deep fascia: medial and lateral intermuscular septa, fascial compartments
- V. Muscles
 - A. Anterior compartment: coracobrachialis, biceps brachii, brachialis
 - B. Posterior compartment: triceps brachii, anconeus
 - C. Attachments, actions, innervation
- VI. Nerves: musculocutaneous, ulnar, median, and radial nerves; course, structures innervated
- VII. Vessels: brachial, profunda brachii (middle and radial collateral), and superior and inferior ulnar collateral vessels; origin, course, contributions to elbow anastomosis
- VIII. Cubital fossa: boundaries, contents, relations
- IX. Functional, Living, and Imaging Anatomy
 - A. Functional anatomy: dynamic anatomy of the joints of the upper limb, functional muscle groups
 - B. Palpable landmarks: head of the humerus, tendon of the long head of the biceps brachii in the intertubercular sulcus, coracoacromial ligament, anterior axillary fold, posterior axillary fold (latissimus dorsi, teres major), medial and lateral epicondyles and medial and lateral supracondylar crests of the humerus, ulnar nerve in the ulnar groove, basilic, cephalic, and median cubital veins, tendon of the insertion of the biceps brachii, bicipital aponeurosis, olecranon, subcutaneous border of the ulna, head of radius
 - C. Surface projections: projections of the courses of the musculocutaneous, ulnar, median, axillary, and radial nerves, projections of the courses of the axillary and brachial arteries and branches, projections to parts of axillary artery and relevance to stab wounds in respect to anastomotic vessels
 - D. Imaging: arteriograms, dislocated elbow, ulnar groove
- X. Clinical Anatomy
 - A. Musculoskeletal: dislocation of the humeral and radial heads, attrition of the supraspinatus tendon, dislocation/rupture of the tendon of the long head the biceps brachii, fracture of the surgical neck of the humerus

- B. Nervous: entrapment neuropathies, ulnar nerve at intermuscular septum and at ulnar groove, median nerve palsy due to supracondylar fracture of the humerus, axillary nerve palsy due to glenohumeral dislocation or fracture of humerus, radial nerve palsy due to fracture of humeral shaft (are triceps affected?)**
- C. Diagnostics: brachial pulse and blood pressure, tendon reflex, pressure within fascial compartments**

Learning Objectives: Forearm

- I. **Osteology: humerus, radius, ulna, bony landmarks and attachments**
- II. **Ligaments: radial and ulnar collateral, annular ligaments, interosseous membrane, radioulnar lig.; attachments, role in maintaining the stability of the radioulnar joint**
- III. **Superficial fascia**
 - A. **Cutaneous nerves: medial, lateral, and posterior antebrachial cutaneous; origin, area of distribution**
 - B. **Superficial veins: cephalic, basilic, and median cubital veins; course and origin**
- IV. **Deep fascia: medial, lateral, and intermediate intermuscular septa, fascial compartments; common flexor and common extensor tendons, insertion of biceps brachii on radial tuberosity**
- V. **Muscles**
 - A. **Anterior compartment: superficial muscles (pronator teres, flexor carpi radialis, palmaris longus, flexor carpi ulnaris, flexor digitorum superficialis), deep muscles (flexor pollicis longus, flexor digitorum profundus, pronator quadratus)**
 - B. **Posterior compartment: superficial muscles (brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi, extensor carpi ulnaris), deep muscles (supinator, abductor pollicis longus, extensor pollicis brevis and longus, extensor pollicis brevis and longus, extensor indicis; anatomical snuff box)**
 - C. **Attachments, actions, innervation**
- VI. **Nerves:**
 - A. **Radial nerve: superficial and deep branches, posterior interosseous nerve**
 - B. **Median nerve: anterior interosseous nerve**
 - C. **Ulnar nerve: branches to forearm muscles**
- VII. **Vessels:**
 - A. **Ulnar vessels: anterior and posterior ulnar recurrent, common interosseous, interosseous recurrent; elbow anastomosis,**
 - B. **Radial vessels: radial recurrent vessels**
 - C. **Origin, course, and structures innervated**
- VIII. **Functional, Living, and Imaging Anatomy**
 - A. **Functional anatomy: dynamic anatomy of the joints of the upper limb, functional muscle groups**
 - B. **Palpable landmarks: subcutaneous border of the ulna, head of the radius, tendons of flexor carpi ulnaris, palmaris longus, flexor carpi radialis, brachioradialis, abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus at the wrist, anatomical snuff box, styloid process of the radius, dorsal radial tubercle, head and styloid process of the ulna, pulse of ulnar artery lateral to the tendon of flexor carpi ulnaris at the wrist,**

pulse of the radial artery between the tendons of flexor carpi radialis and brachioradialis at the wrist

- C. Surface projections: projections of the courses of the musculocutaneous, ulnar, median, axillary, and radial nerves, projections of the courses of the radial and ulnar arteries and branches,
- D. Imaging: arteriograms, dislocated elbow, ulnar groove, wrist, Colles' fracture, fractured scaphoid (blood supply), dislocation of the lunate (nerve compression)

IX. Clinical Anatomy

- A. Musculoskeletal: dislocation of the humeral and radial heads, avascular necrosis of the scaphoid,
- B. Nervous: nerve palsies; ulnar nerve lesion at the wrist (claw hand), median nerve compression in carpal tunnel (carpal tunnel release), superficial and deep radial nerve
- C. Diagnostics: ulnar and radial pulse at the wrist, radial pulse in the anatomical snuff box, pressure within fascial compartments

Learning Objectives: Hand

I. Osteology: radius, ulna, carpals, metacarpals, phalanges; bony landmarks and attachments

II. Arthrology

A. Wrist joint

1. articular components: bony and fibrocartilaginous components, fibrous capsule
2. Ligaments: radial and ulnar collateral ligaments; attachments, role in resisting movement at the wrist

B. Distal to wrist: intercarpal, carpometacarpal, metacarpophalangeal, and interphalangeal joints

III. Superficial fascia

A. Palm of hand: cutaneous nerves (palmar and digital branches of the median and ulnar nerves); origin, area of distribution; palmaris brevis

B. Dorsum of hand: cutaneous nerves (superficial branch of the radial nerve, dorsal branch of the ulnar nerve, digital branches of the median and ulnar nerves); origin, area of distribution; dorsal venous network

IV. Deep fascia

A. Palm of hand: flexor retinaculum (carpal tunnel – boundaries, contents), palmar aponeurosis, fibrous tendon sheaths, thenar and hypothenar fasciae

B. Dorsum of the hand: extensor retinaculum

V. Muscles

A. Thenar: abductor and flexor pollicis brevis, opponens pollicis

B. Hypothenar: abductor digiti minimi, flexor digiti minimi brevis, opponens digiti minimi

C. Other intrinsic: adductor pollicis, lumbricals, palmar and dorsal interossei

D. Attachments, actions, innervation

E. Extensor expansions: composition, muscular insertions, actions

F. Flexor tendon pattern of insertion and action, mesotendons

VI. Nerves:

A. Recurrent branch of the median nerve

B. Superficial and deep branches of the ulnar nerve

C. Origin, course, structures innervated

D. Median vs. ulnar nerve dominance

VII. Vessels:

A. Ulnar vessels: superficial palmar arch (common and proper palmar digital arteries), deep palmar branch

- B. Radial vessels: superficial palmar branch, deep palmar arch, princeps pollicis artery, radialis indicis artery
- C. Venae comitantes
- D. Origin, course, and structures innervated

VIII. Functional, Living, and Imaging Anatomy

- A. Functional anatomy: dynamic anatomy of the joints of the upper limb, functional muscle groups, functional anatomy of the hand and hand placement,
- B. Palpable landmarks: tubercle of the scaphoid, pisiform, hook of the hamate, metacarpals, phalanges, pulse of the tendons of flexor carpi ulnaris, palmaris longus, flexor carpi radialis, brachioradialis, abductor pollicis longus, extensor pollicis brevis, and extensor pollicis longus at the wrist, anatomical snuff box, styloid process of the radius, dorsal radial tubercle, head and styloid process of the ulna, pulse of ulnar artery lateral to the tendon of flexor carpi ulnaris at the wrist, pulse of the radial artery between the tendons of flexor carpi radialis and brachioradialis at the wrist
- C. Surface projections: projections of the courses of the ulnar, median, and radial nerves, projections of the courses of the radial and ulnar arteries and branches, tendons of the extensor digitorum on the dorsum of the hand
- D. Imaging: dislocation of the lunate (nerve compression), arteriograms

IX. Clinical Anatomy

- A. Musculoskeletal: avascular necrosis of the scaphoid,
- B. Nervous: nerve palsies; ulnar nerve lesion at the wrist (claw hand), median nerve compression in carpal tunnel (carpal tunnel release), recurrent median nerve injury
- C. Diagnostics: ulnar and radial pulse at the wrist, radial pulse in the anatomical snuff box, pressure within fascial compartments, tendon sheath infection and spread

Learning Objectives: Joints of the Upper Extremity

I. Shoulder joint

- A. Articular components: bony components (glenoid fossa and head of humerus), fibrous capsule, glenoid labrum
- B. Ligaments: glenohumeral, coracohumeral, coracoacromial ligs., attachments, role in maintaining the integrity of the shoulder joint
- C. Subscapular and subacromial bursae
- D. Movements: muscle groups and innervations, intrinsic vs. extrinsic

II. Elbow joint (humeroulnar, humeroradial, and proximal radioulnar joints)

- A. Articular components: bony components (trochlea, olecranon fossa, capitulum, head of radius, coronoid process), fibrous capsule
- B. Ligaments: radial and ulnar collateral and annular ligaments; attachments, role in stabilizing the elbow joint
- C. Olecranon bursae
- D. Carrying angle
- E. Elbow arterial anastomosis

III. Wrist Joint

- A. Articular components: bony and fibrocartilaginous (articular disc) components, fibrous capsule
- B. Ligaments: radial and ulnar collateral; attachments, role in limiting movement of the wrist joint

IV. Common learning objectives for each joint

- A. Movements: muscles/muscle groups producing them
- B. Innervation: to the joint proper
- C. Blood supply and associated anastomoses

V. The above learning objectives are integral to the objectives for the upper limb in general

Learning Objectives: Vertebral Column and Muscles of Back

I. Vertebral Column

- A. **Osteology:** cervical, thoracic, and lumbar vertebrae and sacrum and coccyx, and their bony landmarks including articular surfaces
- B. **Ligaments:** posterior and anterior longitudinal, flavum, interspinous, supraspinous
- C. **Arthrology:**
 - 1. **Synovial joints:** atlantooccipital, medial and lateral atlantoaxial, zygapophyseal joints, innervations, possible mechanisms of pain
 - 2. **Fibrocartilagenous joints:** intervertebral disc anatomy and relations to intervertebral foramen
- D. **Normal Curvatures:** primary and secondary

II. Muscles: deep and superficial (intrinsic and extrinsic)

- A. **Fascia:** superficial, deep (thoracolumbar)
- B. **Superficial muscles:** trapezius, latissimus dorsi, levator scapulae, rhomboids
- C. **Intermediate muscles:** serratus posterior superior and inferior
- D. **Deep muscles:** splenius et cervicis, splenius et capitis, erector spinae (iliocostalis, longissimus, spinalis), transversospinalis
- E. **Nerves:** dorsal and ventral rami, plexuses, pure sensory, segmental, pattern of distribution and relation to origins

III. Functional Anatomy

- A. **mobility and range of motion, center of gravity, shock absorption, posture, stabilization by abdominal pressure**

IV. Living Anatomy

- A. **Palpable landmarks:** external occipital protuberance, spinous processes (C7), iliac crest, anterior and posterior superior iliac spines, sacrum, sacral hiatus, coccyx, erector spinae
- B. **Surface projections:** spinal cord ending, dural sac, lumbar puncture, posterior superior iliac spines, iliac crests

V. Imaging

- A. **Normal:** vertebral anatomy, intervertebral foramina, intervertebral space, spinal cord and nerve relations to canal and foramina
- B. **Pathological:** excessive curvatures (kyphosis, lordosis, scoliosis), herniated disc and spinal cord or root compression, osteoporosis, fractures, osteophytes, spondylolisthesis

VI. Clinical Anatomy

- A. **Diagnosis and treatment**
 - 1. **Musculoskeletal:** muscle strains/spasms, curvatures, displacements, osteophytes, whiplash injury, herniated intervertebral disc, osteoporosis, dislocations and fractures, spondylosis, spondylolisthesis, coccydynia, spinal stenosis
 - 2. **Nervous:** sciatica, radiculopathies, cord and nerve compression, neoplastic injury
- B. **Procedures:** lumbar puncture, laminectomy, epidural, spinal, and caudal anesthesia

Learning Objectives: Lumbar Spine and Spinal Canal

I. Lumbar Vertebra and associated structures

- A. **Osteology:** cervical, thoracic, and lumbar vertebrae and sacrum and coccyx, and their bony landmarks including articular surfaces
- B. **Ligaments:** posterior and anterior longitudinal, flavum, interspinous, supraspinous
- C. **Arthrology:**
 - 1. Synovial joints: zygapophyseal joints, innervations and possible mechanisms of pain
 - 2. Fibrocartilaginous joints: intervertebral disc anatomy and relations to intervertebral foramen
- D. **Muscles:** Transversospinalis (intrinsic)
- E. **Nerves:** dorsal rami
- F. **Functional Anatomy**
 - 1. mobility and range of motion, center of gravity, shock absorption, posture, stabilization by abdominal pressure
- G. **Living Anatomy**
 - 1. Palpable landmarks: iliac crest, sacrum, sacral hiatus, coccyx, erector spinae
 - 2. Surface projections: spinal cord ending, dural sac, lumbar puncture, posterior superior iliac spines, iliac crests
- H. **Imaging**
 - 1. Normal: disks, ivf, conus medullaris,
 - 2. Pathological: herniated disks, narrowing of ivf, pedicle fractures, spurs, cord compression

II. Spinal Canal, Spinal Cord, and Meninges

- A. **Meninges**
 - 1. Dura mater: epidural space, internal and external vertebral venous plexuses
 - 2. Arachnoid: arachnoid trabeculae, subarachnoid space, lumbar cistern, cerebrospinal fluid
 - 3. Pia mater: denticulate ligaments, filum terminale
- B. **Spinal Cord**
 - 1. Spinal nerves: dorsal and ventral rootlets and roots, spinal ganglia, dorsal and ventral rami; cauda equina; intervertebral foramina and boundaries
 - 2. Regions: cervical and lumbar enlargements, conus medullaris
 - 3. Internal organization: gray matter, white matter
 - 4. Spinal vessels: anterior and posterior spinal, segmental, and radicular vessels; origin, course
 - 5. Surface projections: inferior extents of the spinal cord and dural sac, site of lumbar puncture, projections of vertebral levels in relation to spinal segments
- C. **Clinical Anatomy**
 - 1. Nervous: sciatica, radiculopathies, compression of a spinal nerve, compression of the spinal cord/cauda equina, spinal cord transections
 - 2. Vascular: metastasis via the vertebral venous plexuses
 - 3. Procedures: lumbar puncture, laminectomy, discectomy, vertebral fusion

Learning Objectives: Cervical Spine and Suboccipital Region

I. Cervical Spine

A. Osteology

1. cervical vertebrae and their bony landmarks, including articular surfaces

B. Ligaments

1. posterior and anterior longitudinal, flavum, interspinous, supraspinous (nuchal)

C. Arthrology

1. Synovial joints: atlanto-occipital, median and lateral atlantoaxial, and zygapophyseal joints; articular components; innervation
2. Fibrocartilaginous joints: intervertebral discs (anulus fibrosus, nucleus pulposus) and

D. Deep muscles

1. trapezius, spenius capitis et cervicis, transversospinalis (rotatores, multifidus)

E. Meninges

1. Dura mater: epidural space, internal and external vertebral venous plexuses
2. Arachnoid: arachnoid trabeculae, subarachnoid space, lumbar cistern cerebrospinal fluid
3. Pia mater: denticulate ligaments, filum terminale

F. Spinal Cord

1. Spinal nerves: dorsal and ventral rootlets and roots, spinal ganglia, dorsal and ventral rami; cauda equina; intervertebral foramina and boundaries
2. Regions: cervical and lumbar enlargements, conus medullaris
3. Internal organization: gray matter, white matter
4. Spinal vessels: anterior and posterior spinal, segmental, and radicular vessels; origin, course
5. Surface projections: dural sac, projections of vertebral levels in relation to spinal segments

G. Clinical Anatomy

1. Nervous: sciatica, radiculopathies, compression of a spinal nerve, compression of the spinal cord/cauda equina, spinal cord transections
2. Vascular: metastasis via the vertebral venous plexuses
3. Procedures: cervical puncture, laminectomy, discectomy, vertebral fusion
4. Nervous: sciatica, radiculopathies, cord and nerve compression, neoplastic injury

II. Suboccipital Region

A. Osteology: nuchal lines, posterior tubercle of atlas, transverse foramina and processes,

1. Palpable landmarks: external occipital protuberance, spinous process of C2

B. Boundaries and contents

1. Muscles: obliquus capitis superior and inferior, rectus capitis posterior major and minor; attachments, innervations and actions
2. nerves: suboccipital nerve, greater occipital nerve, course and structures innervated
3. Vessels: vertebral artery and relations to atlas
4. Posterior atlantooccipital membrane and foramen magnum

Learning Objectives: Functional Components of CNS, Skull, Scalp, Face

I. Functional Components

- A. Know each component for each cranial nn and each branch**
- B. Clinical Anatomy: Knowledge of functional deficits unique to each nerve branch**

II. Skull

- A. Parietal, temporal, frontal, ethmoid, sphenoid, occipital, maxilla, mandible, zygomatic, nasal, lacrimal, inferior nasal concha, vomer, and palatine bones, and bony landmarks, including foramina and structures traversing, and areas of muscular/tendinous attachment**
- B. Sutures: sagittal, lambdoid, squamosal, and coronal sutures**
- C. Fetal skull: fontanelles, metopic suture**

III. Face

A. Superficial fascia

- 1. Cutaneous nerves: ophthalmic branches (supraorbital, supratrochlear, infratrochlear, lacrimal), maxillary branches (intraorbital, zygomaticofacial, zygomaticotemporal), mandibular branches (mental, buccal, auriculotemporal); course, area of distribution
- 2. Muscles of facial expression: key functions and innervation (VII)

B. Facial nerve: temporal, zygomatic, buccal, marginal, mandibular, and cervical branches; course, muscles innervated

C. Vessels: facial artery (inferior and superior labial, later nasal), ophthalmic artery (supraorbital, supratrochlear, dorsal nasal, medial and lateral palpebral), maxillary artery (infraorbital, mental), superficial temporal artery (transverse facial), facial vein (superior ophthalmic, deep facial, superior and inferior labial); origin, course

D. Lymphatics: submental, submandibular, parotid, superficial cervical, and deep cervical lymph nodes: pattern of drainage

E. Clinical Anatomy: venous drainage and spread of infection – cavernous sinus

IV. Scalp

A. Layers: skin, connective tissue, aponeurosis (galea aponeurotica), loose connective tissue, paricranium; innervation and blood supply

B. Clinical Anatomy: venous drainage and spread of infection, profuse bleeding

Learning Objectives: Cranial Nerves, Cranial Fossae, Meninges

I. Cranial Meninges, Dural Venous Sinuses, and Emissary Veins

A. Cranial meninges

1. Dura mater: dural septa (falx cerebri, tentorium cerebelli, falx cerebelli, diaphragma sellae); epidural space, subdural space
2. Addition layers: arachnoid, pia
3. Nerves: meningeal branches of the ophthalmic, maxillary, mandibular, vagus, and cervical spinal nerves
4. Vessels: middle, accessory, anterior, and posterior meningeal arteries, meningeal veins; origin, course

B. Dural venous sinuses: superior sagittal, inferior sagittal, straight, transverse, sigmoid, cavernous (traversing structures – ophthalmic, maxillary, oculomotor, trochlear, abducens, greater superficial petrosal, deep petrosal, sympathetic root to ciliary ganglion, internal carotid plexus; internal carotid artery), occipital, superior and inferior petrosal, and sphenoparietal sinuses, basilar venous plexus, confluence of the sinuses

C. Emissary veins: mastoid, parietal, and condylar emissary veins; diploic veins

D. Clinical Anatomy: Cavernous sinus infection, radical neck dissection and intracranial drainages; epidural hematoma and herniation

II. Cranial Fossae

A. Anterior, middle, and posterior cranial fossae: bony landmarks, foramina and contents

B. Clinical anatomy: acoustic neuroma and surgical approaches

Learning Objectives: Orbit

I. Eyelids

- A. palpebral conjunctiva, tarsi, tarsal glands, superior and inferior tarsal muscles, orbital septum

II. Lacrimal apparatus

- A. lacrimal gland and papilla, nasolacrimal duct (opening into nasal cavity), lacrimal lake, punctum, canaliculus, and sac; pattern of flow of lacrimal fluid; parasympathetic innervation of the lacrimal gland – pterygopalatine ganglion (facial, greater superficial petrosal, nerve of the pterygoid canal, maxillary, zygomatic, zygomaticotemporal, communicating, lacrimal)

III. Bones of the orbit

- A. roof, floor, lateral and medial walls; shape and orientation of the bony orbit; foramina and fissures

IV. Muscles

- A. levator palpebrae superioris; superior and inferior oblique; lateral superior, medial, and inferior rectus; attachments, actions, innervation; common annular tendon and contents

V. Fasciae

- A. periorbita, intermuscular membrane, fascial sheaths, bulbar sheath, trochlear sling

VI. Nerves

- A. frontal (supraorbital, supratrochlear), lacrimal, trochlear, oculomotor (superior and inferior divisions), abducens, nasociliary (long ciliary, ciliary root of ciliary ganglion, posterior and anterior ethmoidal, infratrochlear), optic (meningeal coverings, subarachnoid space), infraorbital, and zygomatic nerves; origin, course, structures innervated; innervation of the ciliary and sphincter pupillae muscles, ciliary ganglion (preganglionic and postganglionic pathways)

VII. Clinical Anatomy: Horners syndrome, facial nerve palsy, mechanical lesions

Learning Objectives: Posterior Triangle, Cervical Fascia, Cervical Plexus

I. Cervical Fascia

A. Superficial fascia

1. Cutaneous nerves: lesser occipital, great auricular, transverse cervical, and supraclavicular nerves; origin, course, area of distribution
2. Superficial veins: anterior and external jugular veins; origin, course

B. Deep fascia

1. investing, prevertebral, and pretracheal fasciae, carotid sheaths; structures invested; superior and inferior continuations

C. Clinical Anatomy: Pretracheal, retrovisceral, and "danger" spaces; spread of infection

II. Posterior Triangle

A. subdivisions: (occipital and subclavian triangles); boundaries, contents

B. Boundaries: trapezius, sternocleidomastoid, occipital bone, clavical

C. Muscles

1. Sternocleidomastoid, platysma, splenius, levator scapular, omohyoid
2. Deep neck: scalenus anterior, medius and posterior,
3. Attachments, actions, innervation, relations

D. Nerves

1. Accessory nerve
2. Phrenic nerve
3. Brachial plexus: divisions, cords
4. dorsal scapular, long thoracic, suprascapular,
5. cervical plexus: great auricular, lesser occipital, transverse cervical, supraclavicular
6. Origin, course, structures innervated

E. Vessels

1. transverse cervical, suprascapular, dorsal scapular

F. Lymphatics

1. Pericervical: occipital, retroauricular, parotid, submandibular, and submental lymph nodes
2. Superficial and deep cervical lymph nodes
3. Pattern of drainage

G. Clinical Anatomy: torticollis

Learning Objectives: Anterior Triangle, Autonomic Innervation of Head and Neck

I. Anterior triangle

A. Subdivisions: (submandibular, carotid, muscular, and submental triangles); boundaries, contents

1. Boundaries: medial to sternocleidomastoid, inferior to mandible, superior to sternum and clavical

B. Muscles

1. Sternocleidomastoid, platysma
2. infrahyoid: sternohyoid, omohyoid, sternothyroid, thyrohyoid
3. Suprahyoid: stylohyoid, digastric, mylohyoid, geniohyoid
4. Deep neck: scalenus anterior, medius and posterior, longus capitis and colli, rectus capitis anterior and lateralis
5. Attachments, actions, innervation, relations

C. Nerves

1. Vagus nerve: pharyngeal branches; superior laryngeal nerve (internal and external laryngeal); nerves to the carotid body; recurrent laryngeal nerve
2. Accessory nerve: short course in anterior triangle
3. hypoglossal nerve
4. Phrenic nerve
5. Ansa cervicalis: superior and inferior roots
6. Brachial plexus: roots, trunks, divisions (involves posterior triangle)
7. Sympathetic trunk: superior, middle, and inferior cervical ganglia; cervical cardiac nerves, gray rami communicantes, internal and external carotid plexuses, ansa subclavia
8. Origin, course, structures innervated

D. Lymphatics

1. Pericervical: occipital, retroauricular, parotid, submandibular, and submental lymph nodes
2. Superficial and deep cervical lymph nodes
3. Pattern of drainage

E. Thyroid gland

1. Lobes, isthmus, and capsule
2. Vessels: superior and inferior thyroid arteries, superior, middle, and inferior thyroid veins; origin, course
3. Lymphatics: paratracheal and deep cervical nodes; pattern of drainage
4. Surfaces and relations
5. Parathyroid glands: size; relationships
6. Trachea and esophagus: relationships, innervation and blood supply

II. Autonomic Supply to the Head

A. Sympathetic system: cervical sympathetic trunk, superior cervical sympathetic trunk ganglion, internal and external carotid plexuses; course and innervations

B. Parasympathetic system

1. Ciliary ganglion: preganglionic fibers, postganglionic fibers; origin (cell bodies), structures innervated
2. Pterygopalatine ganglion: preganglionic fibers, postganglionic fibers; origin (cell bodies), structures innervated
3. Otic ganglion: preganglionic fibers, postganglionic fibers; origin (cell bodies), structures innervated
4. Submandibular ganglion: preganglionic fibers, postganglionic fibers; origin (cell bodies), structures innervated

C. Clinical Anatomy: Bell's palsy, Horner's syndrome

Learning Objectives: TMJ Joint, Muscles of Mastication, Parotid Region

I. Parotid and temporal region

A. Parotid gland: parotid fascia; lobes, isthmus; parotid duct; intraparotid nerve plexus; vessels (external carotid artery, retromandibular vein; origin, course); parasympathetic innervation (IX, tympanic br. and plexus, lesser superficial petrosal, otic ganglion, auriculotemporal, communicating, facial)

B. Masseter and temporalis muscles: attachments, actions, innervation

C. Temporomandibular joint

1. Articular components (bony components, fibrous capsule, articular disc)
2. Ligaments: sphenomandibular, lateral temporomandibular
3. Movements: elevation, depression, retraction, protraction, abduction
4. Associated muscles and innervations

II. Muscles of Mastication: masseter, medial and lateral pterygoids, temporalis

A. actions, attachments, innervations

Learning Objectives: Infratemporal Region

I. Infratemporal fossa

A. Boundaries

B. Muscles: medial and lateral pterygoids; attachments, actions, innervation

C. Nerves: mandibular nerve (auriculotemporal, buccal, lingual, inferior alveolar (nerve to the mylohyoid), nerve to the medial pterygoid, nerve to the lateral pterygoid, masseteric, deep temporal, chorda tympani nerve, posterior superior alveolar nerve; origin, course, structures innervated

D. Vessels: maxillary artery (inferior alveolar, middle meningeal, buccal, posterior superior alveolar, infraorbital, sphenopalatine, descending palatine, deep auricular, anterior tympanic, pterygoid, masseteric, accessory meningeal, and anterior and posterior deep temporal, maxillary vein (pterygoid venous plexus); origin, course

II. Pterygopalatine fossa

A. Boundaries

B. Contents

C. Bony communications and traversing structures

Learning Objectives: Larynx, Craniovertebral Joints, Prevertebral Region

I. Prevertebral Region

A. Muscles

1. Deep neck: scalenus anterior, medius and posterior, longus capitis and colli, rectus capitis anterior and lateralis
2. Attachments, actions, innervation, relations

B. Nerves

1. Vagus nerve: pharyngeal branches; superior laryngeal nerve (internal and external laryngeal); nerves to the carotid body; recurrent laryngeal nerve
2. Accessory nerve: short course in anterior triangle
3. hypoglossal nerve
4. Phrenic nerve
5. Ansa cervicalis: superior and inferior roots
6. Brachial plexus: roots, trunks, divisions (involves posterior triangle)
7. Sympathetic trunk: superior, middle, and inferior cervical ganglia; cervical cardiac nerves, gray rami communicantes, internal and external carotid plexuses, ansa subclavia
8. Origin, course, structures innervated

II. Craniovertebral Joints

- A. Atlanto-occipital and median and lateral atlantoaxial joints: movements and muscles producing them; articular components (bony components, fibrous capsule), anterior and posterior atlanto-occipital membranes; innervation
- B. Fibrous joints between the axis and occipital: membrana tectoria, cruciform ligaments to the atlas, alar ligaments, apical ligament of the dens

III. Larynx

- A. Skeleton: thyroid cartilage, cricoid cartilage, arytenoid cartilage, epiglottis; cricothyroid and cricoarytenoid articulations; thyrohyoid membrane, medial cricothyroid ligament
- B. Regions and associated structures
 1. Vestibule: laryngeal aditus, quadrangular membrane
 2. Ventricles: vestibular folds
- C. Muscles: cricothyroid, posterior and lateral cricoarytenoid, arytenoideus, aryepiglotticus, thyroarytenoideus, thyroepiglotticus; attachments, actions, innervation
- D. Nerves: superior laryngeal and recurrent laryngeal nerves; origin, course
- E. Lymphatics: retropharyngeal lymph nodes; pattern of drainage

IV. Ear and Temporal Bone

- A. External ear: parts
- B. Middle ear
 1. Tympanic membrane
 2. Tympanic cavity: boundaries, ossicles

3. **Muscles:** tensor tympani stapedius; attachments actions, innervation
 4. **Nerves:** facial nerve; branches, courses, innervations
- C. Inner ear**
1. **Bony labyrinth:** components
- D. Facial canal:** course and contents
- E. Clinical Anatomy:** Bell's palsy

Learning Objectives: Temporal Bone and Ear, Palate, Pharynx, Mouth, Tongue, Pterygopalatine fossa

I. Pharynx

A. Layers: mucosa, submucosa (pharyngobasilar fascia), muscularis, buccopharyngeal fascia

B. Regions and associated structures

1. Nasopharynx: pharyngeal tonsils, pharyngeal ostium of the auditory tube, torus tubarius, pharyngeal recess, torus levatorius
2. Oropharynx: faucial isthmus (palatine tonsils, palatopharyngeal and palatoglossal arches)
3. Laryngopharynx: piriform recess

C. Muscles

1. external muscles (superior, middle, and inferior constrictors), palatopharyngeus, salpingopharyngeus, stylopharyngeus; attachments, actions, innervation; gap between the superior and middle pharyngeal constrictors (glossopharyngeal nerve, stylopharyngeus muscle), gap between the middle and inferior pharyngeal constrictors (internal laryngeal nerve, superior laryngeal artery)

D. Nerves

1. Glossopharyngeal nerve: pharyngeal branches (pharyngeal plexus)
2. Vagus nerve: pharyngeal branch, superior laryngeal, and recurrent laryngeal nerves
3. Maxillary nerve: pharyngeal branch
4. Course, structures innervated

E. Vessels: ascending pharyngeal artery, pharyngeal plexus of veins; origin course

F. Lymphatics: retropharyngeal lymph nodes; pattern of drainage

G. Retropharyngeal and lateral pharyngeal spaces: boundaries

II. Nose, Nasal Cavity, and Paranasal Sinuses

A. Nose: bony and cartilaginous components

B. Nasal cavity

1. Regions: vestibule, respiratory and olfactory regions
2. Boundaries: roof, floor, medial wall, lateral wall, anterior orifice, posterior orifice
3. Nerves: olfactory, ophthalmic (anterior ethmoidal, and maxillary (posterior superior lateral and medial nasal, posterior inferior lateral nasal, infraorbital) nerves; course, structures innervated; parasympathetic innervation of the nasal glands – GSPN, Vidian, PTG, maxillary nerve branches
4. Vessels: sphenopalatine, anterior and posterior ethmoidal, superior labial, greater palatine, and lateral nasal vessels; origin, course; anastomoses
5. Lymphatics: retropharyngeal lymph nodes; pattern of drainage

C. Paranasal sinuses: frontal, ethmoidal, sphenoidal, and maxillary sinuses; openings into nasal cavity; innervation and blood supply

III. Oral Cavity

A. Floor of mouth: sublingual fold, sublingual and submandibular glands and ducts, lingual and hypoglossal nerves

B. Parasympathetic innervation to glands

C. Tongue

1. Parts: root, dorsum, associated glands and surface anatomy

2. Muscles: extrinsic, intrinsic

3. Nerves: lingual, chorda tympani, hypoglossal, glossopharyngeal, internal laryngeal nerves; origin, course

4. Lymphatics: submental, submandibular, and deep cervical lymph nodes; pattern of drainage

D. Palate

1. Parts: hard and soft palates

2. Muscles: levator and tensor veli palatini, musculus uvulae, palatoglossus, palatopharyngeus; attachments, actions, innervation

3. Nerves: greater and lesser palatine and nasopalatine nerves; origin, course, structures innervated; parasympathetic innervation of the palatine glands

4. Vessels: descending, greater, lesser, and ascending palatine vessels; origin course

IV. Functional Anatomy

A. Deglutition, vocalization, mastication, air pressure equalization of pressure between middle ear and external environment

RADIOLOGY

LEARNING OBJECTIVES

Basic Radiology

I. INTRODUCTION

- A. Role of radiology relative to H & P
- B. Cost effective imaging
 - 1. definition
 - 2. examples
- C. Diagnostic Radiology
 - 1. 5 major areas

II. RADIOGRAPHY

- A. X-Ray
 - 1. definition & properties
 - 2. schematic of x-ray to production of radiograph
- B. Terminology
 - 1. how studies are named (e.g. PA Chest)
- C. Radiographic Density
 - 1. composition
 - 2. thickness
 - 3. basic densities (gas, fat, water, tissue, calcium, metal)
 - 4. interface/silhouette
 - 5. magnification
 - 6. tomography
- D. Mammography
 - 1. effectiveness in screening
 - 2. sensitivity/specificity
- E. Contrast Radiography
 - 1. Barium
 - 2. Iodine
- F. Angiography
 - 1. example of technique
 - 2. complications

III. NUCLEAR MEDICINE

- A. How image produced
- B. Utilization/advantages
- C. Lexicon
 - 1. photopenic, hot spot

IV. ULTRASOUND

- A. How image produced
- B. Utilization/advantages
 - 1. no ionizing radiation
 - 2. independent of function
- C. Lexicon
 - 1. anechoic
 - 2. echogenic
 - 3. hyperechoic
 - 4. shadowing
- D. Limitations

V. COMPUTED TOMOGRAPHY

- A. Basic principles
- B. Advantages
 - 1. superior density resolution
- C. Lexicon
 - 1. attenuation

VI. MAGNETIC RESONANCE IMAGING

- A. Basic principles
- B. Advantages
 - 1. no radiation
 - 2. image in any plane
 - 3. detect flowing blood without contrast
- C. Lexicon
 - 1. signal
- D. Contraindications

EMBRYOLOGY

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Gametogenesis & Fertilization

By the conclusion of this section the student will be able to describe the origin of genetic diversity and the mechanism and consequences of chromosome abnormalities that occur during meiosis. In addition, the student should be able to explain when male and female gametes are generated and describe the process of cytodifferentiation for each. By the conclusion of this section the student also will be able to describe the events and endocrine regulation of ovulation and fertilization.

- I. Origin of Genetic Diversity
- II. Chromosome abnormalities
 - A. Nondisjunction
 - B. Translocations
- III/IV. Spermatogenesis/Oogenesis
 - A. Timing and stages of generating haploid gametes
 - B. Cytodifferentiation
- V. Ovulation
 - A. Structural Events
 - B. Completion of Meiosis
- VI. Hormonal Regulation of Gametogenesis and Ovulation
 - A. Hormonal Cascade
 - B. Ovarian and Testicular Hormones
 - C. Female Reproductive Cycle
- VII. Fertilization
 - A. Stages of fertilization
 - B. Consequences of fertilization
- VIII. Clinical Correlates
 - A. Prevention of Pregnancy
 - B. Infertility

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES

Implantation and Formation of the Bilaminar Germ Disc

By the conclusion of this section the student will be able to discuss early cleavage and principles of differentiation. In addition, the student should be able to describe the time course and process of implantation and identify the structural components that comprise the bilaminar germ disc.

I. Pre-Implantation Development

- A. Early Cleavage Stages
- B. Blastocyst Formation

II. Principles of the Developmental Process

- A. Restriction
- B. Determination
- C. Differentiation
- D. Genetic Regulation of Development

III. Implantation

- A. Histology of Uterus
- B. Trophoblast Invasion/Early Placental Development
- C. Clinical Correlation

IV. The Bilaminar Embryo

- A. Embryonic Structures
- B. Extraembryonic Structures
- C. Embryo Development - Week 2

V. Clinical Correlates

- A. Multiple Embryos
- B. Embryo Malformations

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Gastrulation and the Trilaminar Embryo

By the conclusion of this section the student will be able to identify the forming germ layers during gastrulation and discuss the biological basis of inductive processes during mesoderm formation and the initiation of the nervous system.

I. Gastrulation

- A. The Primitive Streak
- B. Formation Of The Germ Layers
- C. Formation Of Axial Structures
- D. Formation And Migration Of Germ Cells
- E. Genetic Control Of Gastrulation

II. Primary Neural Induction

- A. Mesoderm Induction
- B. Neural Induction
- C. Genetic Control of Neural Induction

III. Clinical Correlations

- A. Embryonic Teratomas
- B. Caudal Dysgenesis
- C. Detection of Pregnancy

IV. Embryonic Period Overview: Weeks 3-8

- A. Gastrulation
- B. Formation of Embryonic Body Plan
- C. Establishment of External Body Structures
- D. Organogenesis

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Embryonic Period

By the conclusion of this section the student will be able to outline the events that occur to establish the basic body form, identify the destinies of the three embryonic germ layers and identify the origin of all basic organ systems.

- I. Derivatives of the Germ Layers
 - A. Ectodermal Derivatives
 - B. Mesodermal Derivatives
 - C. Endodermal Derivatives
 - D. Formation Of Rudimentary Organs

- II. Formation of the Embryonic Body Plan
 - A. Neurulation
 - B. Segmentation
 - C. Cephalocaudal and Transverse Folding: Formation of Gut and Body Cavities

- III. Establishment of the Uteroplacental Circulation
 - A. Placental Circulatory System
 - B. Embryonic Circulation
 - C. Establishment of Functional Circulation

- IV. Embryonic Period: Chronological Overview
 - A. The 28 Day Embryo
 - B. Initiation of Organogenesis
 - C. Clinical Correlations

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES

Respiratory System

By the conclusion of this section the student will be able to describe formation of the larynx, trachea, bronchi and lungs and identify the major defects associated with formation of the respiratory system.

I. Early Lung Development

- A. Lung Bud
- B. Partitioning of Larynx and Esophagus
- C. Tracheoesophageal Malformations

II. Larynx Development

- A. Pharyngeal Arches
- B. Innervation
- C. Laryngeal Cartilages

III. Lung Morphogenesis

- A. Branching
- B. Developmental Stages

IV. Diaphragm Development

- A. Septum Transversum
- B. Pleuroperitoneal Folds
- C. Body Wall
- D. Definitive Diaphragm
- E. Innervation
- F. Diaphragmatic Hernia

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Cardiovascular System

At the conclusion of this lecture, the student should have (1) an understanding of how the cardiac tube folds, twists, and partitions to form the multichambered mature heart, (2) knowledge about the origin and formation of the major components of the arterial and venous systems, and (3) knowledge about major defects associated with cardiovascular development.

- I. Formation of the Mature Heart
 - A. Rotation of the Heart Tube
 - B. Septation of the Ventricles
 - C. Septation of the Atria
 - D. Formation of Valves
 - E. Septation of the Input and Output Vessels
- II. Development of the Arterial System
 - A. Aortic Arches
 - B. Dorsal Aorta
 - C. Vitelline and Umbilical Arteries
- III. Development of the Venous System
 - A. Vitelline Veins
 - B. Umbilical Veins
 - C. Cardinal Veins
- IV. Changes Required for Normal Circulation from the Fetus to Breathing Infant
- V. Defects of the Heart and Vessel Formation - e.g., truncus arteriosus, tetralogy of Fallot, septal defects, transposition of great vessels.
- VI. Factors Influencing Normal Cardiovascular Development
 - A. Genetics
 - B. Mechanical Influences
 - C. Growth Factors

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Urogenital System

By the conclusion of this section the student will be able to describe the origin and formation of the fetal and neonatal (adult) urinary systems as well as the formation of the male and female reproductive systems with reference to commonalities and differences in structures and origins.

I. Urinary Tract

- A. Kidney and Ureter Development
- B. Pronephroi
- C. Mesonephroi
- D. Metanephroi
- E. Development of the Nephron
- F. Development of the Collecting System
- G. Development of the Bladder
- H. Development of the Urethra
- I. Renal Blood Vessels and Ascent of the Kidneys
- J. Kidney Function and Post-Natal Development

II. Genital System

- A. Indifferent Stage
 - 1. Gonadal development
 - 2. Ductal development
 - 3. External genitalia
- B. Male Genital System
 - 1. Testicular development
 - 2. Male genital duct and gland development
 - 3. Male external genitalia
 - 4. Formation of the inguinal canals and testicular descent
- C. Female Genital System
 - 1. Ovarian development
 - 2. Female genital ducts and glands
 - 3. Female external genitalia

III. Adrenal (Suprarenal Glands)

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES

Musculoskeletal System and Limb Formation

By the conclusion of this section the student will be able to describe the embryonic origins and differentiation of the skeletal and muscular systems. In addition, the student will be able to outline the formation of the vertebral column and limbs and will be able to discuss the mechanisms of ossification.

I. Skeletal System

- A. Origins
- B. Differentiation of the Somites
- C. Formation of the Vertebral Column
- D. Malformations of the Vertebral Column
- E. Ribs and Sternum
- F. Limb Formation
- G. Clinical Correlations: Limb Malformations
- H. Skull
- I. Ossification

II. Muscular system

- A. Origins and Muscle Types
- B. Trunk Musculature
- C. Head and Neck Musculature
- D. Limb Musculature
- E. Muscle Differentiation
- F. Clinical Correlations: Malformations and Diseases

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Head and Neck

By the conclusion of this section the student will be able to describe the formation of the head and discuss the contributions of the pharyngeal arches, pouches, and clefts to tissues in the head and neck. In addition the student should be able to detail the structures and processes involved in facial formation.

I. Head and Neck

- A. Origin and Overview
- B. Derivatives of Pharyngeal Arches, Clefts and Pouches
- C. Pharyngeal Arches and Clefts
- D. Pharyngeal Pouches
- E. Clinical Correlations

II. Facial Formation

- A. Facial Prominences
- B. Merging of the Facial Prominences
- C. Palate formation
- D. Biological Correlations
- E. Clinical Relevance

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Concepts Of Neural Development

By the conclusion of this section the student will be able to describe the formation of the peripheral and central nervous systems. In addition, the student will be able to discuss mechanisms of establishing connections during development of the nervous system.

- I. Overview: Concepts of Neural Development
 - A. Formation
 - B. Structure
- II. Early Development of the Nervous System
 - A. CNS vs. PNS
 - B. Neurulation
 - C. Segmentation
 - D. Congenital Malformations of Early Neural Development
- III. Formation of Peripheral Nervous System
- IV. Development of Spinal Cord
 - A. Formation of Neuroepithelium
 - B. Alar and Basal Plates
 - C. Development of Spinal Nerves
- V. Development of the Brain
 - A. Brainstem Regions
 - B. Cranial Nerves
 - C. Myelencephalon
 - D. Metencephalon
 - E. Mesencephalon
 - F. Diencephalon
 - G. Telencephalon
- VI. Connectivity
 - A. Axonal Growth
 - B. Synapse Formation
 - C. Stabilization and Fine-Tuning
 - D. Plasticity

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Fetal Membranes and Placenta

By the conclusion of this section the student will be able to describe the development of the placenta, identify the origins of the fetal membranes and discuss the relationship of these membranes to multiple embryos.

- I. **Placental Development**
 - A. Placental Invasion
 - B. Development of Definitive Placenta

- II. **The Mature Placenta**
 - A. Mature Placental Structure
 - B. Placental Function

- III. **Amnion and Umbilical Cord**
 - A. Amnion
 - B. Primitive Umbilical Ring
 - C. Definitive Umbilical Cord

- IV. **Placenta and Fetal Membranes in Multiple Embryos**
 - A. Dizygotic Twins
 - B. Monozygotic Twins

- V. **Clinical Correlations**
 - A. Placental Defects
 - B. Amniotic Defects

Medical Embryology: Learning Objectives

LEARNING OBJECTIVES Fetal Period

By the conclusion of this section the student will be able to discuss factors that control and disturb normal fetal growth. In addition, the student should be able to describe the origin of major fetal abnormalities and to list the methods available for prenatal diagnosis.

I. Fetal Period

- A. General Overview and Determination of Size
- B. Major Hallmarks of Fetal Period

II. Fetal Growth/Birthweight

- A. Factors Controlling Normal Fetal Growth
- B. Intrauterine Growth Retardation (IUGR)

III. Causes of other Fetal Malformations

- A. General Principles
- B. Known Teratogens
- C. Maternal Diabetes

IV. Prenatal Diagnostic Techniques

- A. Ultrasound
- B. Amniocentesis
- C. Chorionic Villus Sampling