

2019

Session 3 - Gastrointestinal Packet

SKMC Surface Anatomy
Thomas Jefferson University

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Surface Anatomy Program
Session 3 — Gastrointestinal Packet
Wednesday, March 21 or Wednesday, March 28

Learning Objectives

1. Be able to identify which abdominal organs are located in each of the four quadrants
 2. Be able to identify which pathologies would be associated with pain in the RLQ, RUQ, LLQ, LUQ
 3. Describe the surface anatomy projections of the abdomen
 4. Discuss the differences between direct and indirect inguinal hernias
 5. Describe abdominal pathologies that can be determined from abdominal inspection on physical exam
 6. Identify where pain from abdominal organs will refer to
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Disclaimer — *This is not intended to serve as a primary study guide for Anatomy or Clinical Skills exams. Surface Anatomy is a peer-taught mentoring program overseen by Dr. Spudich; however, the review sessions are primarily designed by MS2 Coordinators. The goal of review sessions is to highlight clinically relevant anatomical landmarks in order to reinforce lecture material. All review topics have been discussed in lecture; no new testable material will be introduced in these sessions.*

MS2 Coordinators

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Planes of the Abdomen

Planes forming QUADRANTS: used to divide the abdomen into four quadrants for physical exam

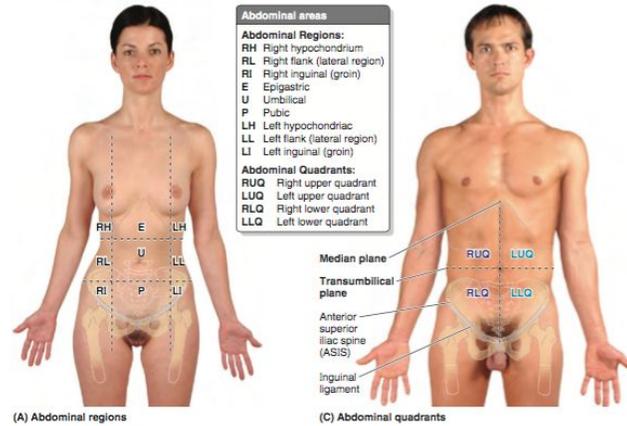
- Vertical Division — the **median plane** defined by the **linea alba**
- Horizontal Division — the **transumbilical plane** found roughly at L3/L4
- Four quadrants — **RUQ, LUQ, RLQ and LLQ**

Discussion Question 1: What anatomical structures are found in each of the four quadrants? Use the following table to outline your answers. (Discussion Answer Key, A)

<u>RUQ</u>	<u>LUQ</u>	<u>RLQ</u>	<u>LLQ</u>

Planes forming REGIONS: used to divide the abdomen into nine quadrants

- **Subcostal Plane** is the horizontal plane through the inferior border of the 10th costal cartilage along a transverse/axial plane
- **Transtubercular Plane** runs through the iliac tubercles and the body of the L5 vertebra along a transverse/axial plane
- **Mid-Clavicular Lines**



Useful Landmark Plane: a good landmark to have with lots of associated structures

Transpyloric Plane — Halfway between the jugular notch and the upper border of the pubic symphysis, roughly at the level of L1, a hand's width below the xiphoid process.

- a. Pancreatic Neck
- b. Gallbladder Fundus — at the intersection between transpyloric plane & right MCL
- c. 9th Costal Cartilage
- d. Renal Hilum of Left Kidney
- e. Superior Pole of Right Kidney
- f. Emergence of SMA over Uncinate Process and Duodenum
- g. Origin of Hepatic Portal Vein
- h. Duodenojejunal Junction

Surface Anatomy Projections

Semilunar Lines — Slightly curved linear impressions in the skin that run parallel to the lateral edges of the rectus sheath. They extend from the inferior costal margin, near the 9th costal cartilage “step”, to the pubic tubercle.

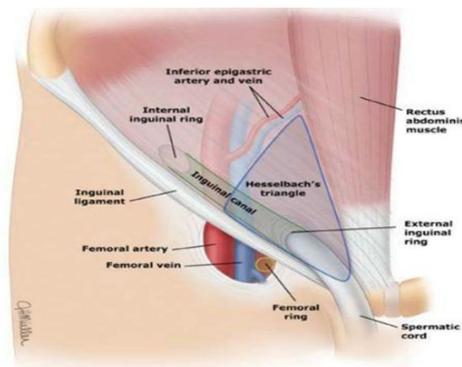
Spleen — associated posteriorly with the 9th through 11th ribs

Inguinal Ligament — Attached to the ASIS and pubic tubercle

Superficial Inguinal Ring — Palpable superolateral to the pubic tubercle by invaginating the skin of the upper scrotum with the index finger.

- a. Ilioinguinal Nerve
- b. Genital branch of Genitofemoral Nerve
- c. Spermatic Cord
- d. Round Ligament of the Uterus
- e. Blood Vessels
- f. Lymphatic Vessels

Triangle of Hesselbach — Known as the “inguinal triangle”. Borders are formed by the lateral border of rectus abdominis (semilunar line), inferior epigastric vessels, and inguinal ligament; location of direct inguinal hernias.



Deep Inguinal Ring — Non-Palpable. The entrance to the inguinal canal; found superior to the middle of the inguinal ligament, and lateral to the inferior epigastric vessels.

Discussion Question 2: The deep inguinal ring is an evagination of which fascial layer? (Discussion Answer Key, B)

Hernias — A hernia occurs when an organ or fatty tissue squeezes through a weak spot in the surrounding muscle or connective tissue called fascia.

- A. Inguinal Hernia
- B. Incisional Hernia
- C. Femoral Hernia
- D. Umbilical Hernia
- E. Hiatal Hernia

Discussion Question 3: What differentiates an indirect inguinal hernia from a direct inguinal hernia? Which type of hernia is more common in infancy? In adulthood? Is a hernia that extends into the scrotum more likely to be indirect or direct? (Discussion Answer Key, C)

Blood Vessels, Pulses and Lymphatics

Origin of **Celiac Trunk** — T12

Origin of **Superior Mesenteric Artery** — L1

Origin of **Inferior Mesenteric Artery** — IV Disc L2/L3

Bifurcation of the **Aorta** — L4

Abdominal Aorta Pulse — In children and lean adults the pulsations of the aorta may be seen when the wall is relaxed.

- Often found to the left of the umbilicus
- Palpate by pressing firmly and deeply over the umbilicus when the abdomen is relaxed
- Palpation can detect an abdominal aortic aneurysm. **Remember** when the patient is supine, a vertical pulsation of the aorta is *normal*, however clinical suspicion should be raised when you palpate a lateral expansion of the aorta.

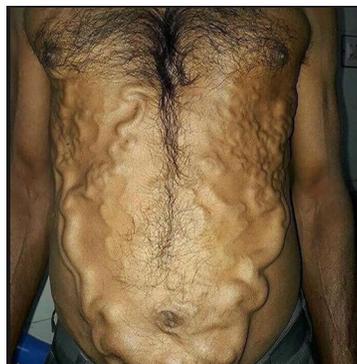
Discussion Question 4: When palpating the aorta at the level of the umbilicus, what vertebral body are you compressing the aorta against? (Answer Key, D)

Portal Hypertension — Liver and biliary pathology (i.e. advanced hepatitis, cholecystitis, malignancies) can lead to constricted hepatic microcirculation.

- In response to constricted hepatic circulation, the splanchnic vessels dilate and blood pools here. This dilation effectively reduces the arterial blood volume stimulating the RAAS system to constrict renal vasculature in order to preserve renal function (**Hepatorenal Syndrome**)
- Progressive portal hypertension leads to recruitment of portosystemic venous collaterals. These esophageal and gastric varices are thin-walled and under high pressure and can rupture causing significant hemorrhage.
- **Caput Medusae** refers to the appearance of distended and engorged superficial epigastric veins, which are seen radiating from the umbilicus across the abdomen, a physical exam finding in portal hypertension.



Caput Medusa



Collaterals for SVC or IVC

Collateral Pathways for Obstruction of SVC or IVC — The thoraco-epigastric veins provide collateral pathways by which an obstruction can be bypassed and blood can be returned to the heart.

- Collaterals can form in your superior, inferior and superficial epigastrics.

Left Supraclavicular Lymph Nodes — Presence of a lymph node in the left supraclavicular fossa.

1. **Trosier** — Single lymph node located behind the clavicular head of the SCM. Reflects metastatic involvement of the ipsilateral lung or breast and esophageal tumor.
2. **Virchow Node** — Located in the same area and reflects metastatic gastric carcinoma, to palpate have the patient sit upright with their head forward and their arms down
3. **Sister Mary Joseph Nodule** — Non-tender irregular protuberance that either completely replaces the umbilicus or can be palpated through the umbilicus. Indicates metastatic involvement of an intra-abdominal malignancy (specificity: stomach > ovary > colon > rectum > pancreas).

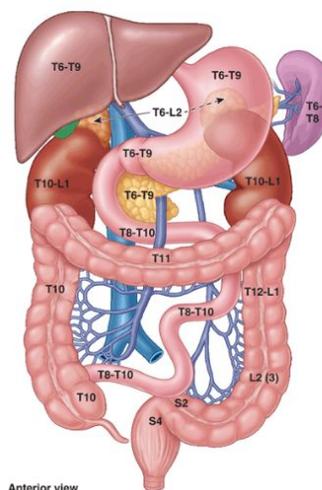
Dermatomes and Referred Pain

Liver and Gallbladder — Trouble with the liver or gallbladder can also cause pain in the neck or upper shoulder areas, as well as the right side of the body, just below the nipple. Referred to the shoulder and scapula due to innervation by the **phrenic nerve** which arises from cervical spinal cord segments **C3-C5**.

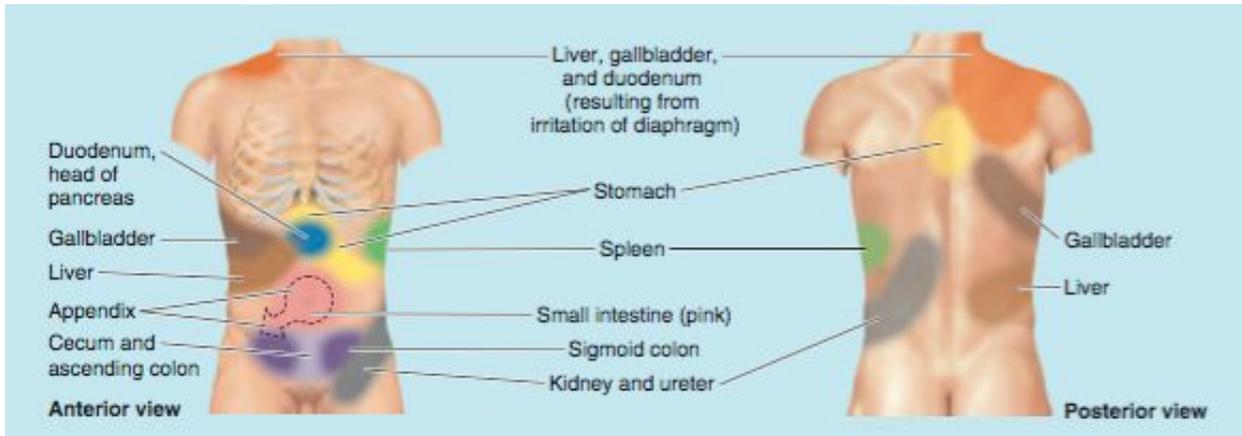
Stomach — The stomach often refers pain to the skin of the *epigastric region* because stomach is supplied by afferent pain fibers from **T7-T8**.

Pain of appendicitis — Usually begins as a vague pain in the **periumbilical region** because afferent pain fibers that innervate the appendix originate from the **T10** spinal cord level; severe pain in the right lower quadrant results from irritation of the parietal peritoneum.

Pain of Pyelonephritis — Associated with distension of the renal capsule or



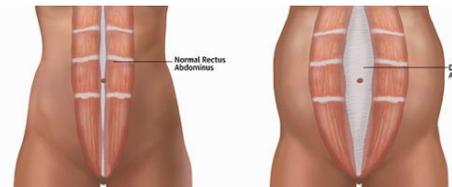
pelvis. Visceral afferents refer pain to spinal cord segments **T11-L2**.



Physical Exam

1. **Inspection** — Consists of visual examination of the abdomen with note made of the shape of the abdomen, skin abnormalities, abdominal masses, and the movement of the abdominal wall with respiration. Abnormalities detected on inspection provide clues to intra-abdominal pathology; these are further investigated with auscultation and palpation.

Diastasis Recti — Benign midline separation between the two sides of the rectus abdominis muscle. This is most commonly seen in newborns and pregnant women.

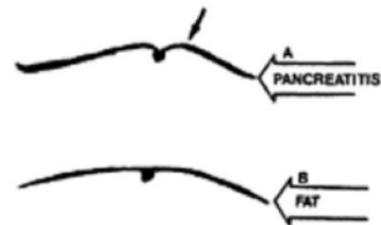


Gray-Turner's Sign — Bilateral flank reddish/purple discoloration.

Cullen's Sign — Purplish discoloration of the umbilicus.

Cupid Bow — Dimple of the abdominal contour.

- Pancreatitis
- Fat
- Bladder Distension



Discussion Question 5: What are striae? Name one disease state that frequently manifests with abdominal striae. (Discussion Answer Key: E)

2. **Auscultation** — Performed for detection of altered bowel sounds, rubs, or vascular bruits. Normal peristalsis creates bowel sounds that may be altered or absent by disease.

- Irritation of serosal surfaces may produce a sound (rub) as an organ moves against the serosal

surface.

- Atherosclerosis may alter arterial blood flow so that a bruit is produced

3. **Palpation** — Examination of the abdomen for crepitus of the abdominal wall, for any abdominal tenderness, or for abdominal masses. The liver and kidneys may be palpable in normal individuals, but any other masses are abnormal.

Palpating Spleen — In the majority of normal, healthy adults the spleen is not palpable; an enlarged spleen can descend as far as the lower right quadrant.

Palpating Liver — Place left hand behind right 11th and 12th rib; use right hand to palpate below right costal margin lateral to rectus abdominis; on inspiration pull left hand anteriorly and palpate with right.

Murphy's Sign — Palpate at the step of right 9th costal cartilage or under the costal margin where the semilunar line intersects with the costal margin; tenderness with a sudden pause in inspiration is a *positive Murphy's sign*; a sign of possible gallbladder inflammation (cholecystitis).

McBurney's Point — 1/3 distance from right ASIS to umbilicus; tenderness indicates possible appendicitis

Iliopsoas Test — Person is asked to lie on unaffected side, **extend** the thigh on the affected side against resistance; if the person feels pain then it is a *positive psoas sign*.

Discussion Question 6: What are some causes of a positive psoas sign? (Discussion Answer Key F)

Discussion Question 7: What are rebound tenderness and guarding? What pathology do they suggest? (Discussion Answer Key: G)

4. **Percussion** — Percuss to identify the presence of fluid (ascites, urinary bladder).

Ascites — Pathological accumulation of excess fluid in the peritoneal cavity. Cirrhosis is the most common cause of ascites in the US. On physical exam one can test for ascites using the fluid wave test and the shifting dullness test.

1. **Fluid wave test** — With the patient lying supine, have an assistant or patient press the ulnar surface of his/her hand downwards into the patient's mid-abdomen. The examiner should sharply tap the patient's right flank, while having his/her left hand on the patient's left flank. The test is positive if the examiner's left pulse receives an impulse.
 2. **Shifting Dullness Test** — With the patient lying supine, percuss from mid-abdomen to flank area and note change from tympany to dullness. Mark dullness line with a pen. With the patient on his/her flank, facing away from the examiner, again percuss from mid-abdomen to flank area, and re-mark the line of dullness. Test is positive when the area of dullness shifts to the dependent site, implying presence of ascites.
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USMLE Case

Adapted from Gastrointestinal Case 4 from *First Aid Cases for the USMLE Step 1*

A 25-year-old woman presents to her physician complaining with a 3-day history of crampy abdominal pain that started in the epigastrium. She also reports nausea, low-grade fever, and loss of appetite. She denies changes in frequency of urination, dysuria, or recent contact with a sick person. Her last menstrual period was 2 weeks ago. Relevant laboratory findings are as follows:

WBC count: 13,000/mm³ (Normal range: 4,500 to 11,000/mm³)
B-Human chorionic gonadotropin: negative
Urinalysis: negative for blood, WBCs, leukocyte esterase, and protein

1. What is your differential diagnosis?

On physical exam, you note that the patient has deep tenderness when you press on the right side of her abdomen as well as pain in her epigastrium.

2. What term describes the location of this pain?
3. What is the most likely diagnosis?
4. What is the pathophysiology of this condition?
5. Which antibiotics are used to cover against enteric organisms?
6. What is the most appropriate treatment for this condition?

Multiple Choice Questions

1. What vertebral level is the transpyloric plane?
 - a. T12
 - b. L1
 - c. L2
 - d. L3
2. What planes and/or lines divide the abdomen into 9 sections?
 - a. Transpyloric, median, transumbilical
 - b. Transtubercular, mid-clavicular, subcostal
 - c. Transtubercular, transpyloric, subcostal
 - d. Transumbilical, midclavicular, subcostal
3. What structure is NOT at the level of the transpyloric plane?
 - a. Pancreatic Neck
 - b. Duodenojejunal junction
 - c. 9th costal cartilage "step"
 - d. Superior pole of the Left kidney
4. Diaphragm pain due to friction with the spleen is referred where?
 - a. Right shoulder
 - b. Left shoulder
 - c. Abdomen
 - d. Back
5. The Diaphragm is innervated by which nerves?
 - a. T3-T5
 - b. C2-C4
 - c. C3-C5
 - d. C4-C7
6. The pancreatic head is located in which quadrant?
 - a. Right upper
 - b. Right lower
 - c. Left upper
 - d. Left lower
7. A 60-year old man comes to the emergency department because of a 2-week history of abdominal pain, nausea, and vomiting. The patient has had weight loss and weakness over the past month. Physical examination shows a radiographic image is taken in the transverse plane through the xiphoid process. Which of the following structures would be predominantly observed in this image?
 - A) Inferior vena cava

- B) Liver
- C) Kidneys
- D) Spleen
- E) Stomach

8. A 36-year-old man is brought to the emergency department because of severe lower abdominal pain that began about 6 hours ago. The pain was a vague periumbilical discomfort but, in the past hour, has localized as a sharp pain in the right iliac fossa, which worsens on walking and coughing. The patient has lost his appetite and has vomited 3 times. Physical examination shows discomfort when the hip is flexed and laterally rotated. A diagnosis of appendicitis is made. Which of the following spinal dermatomes is most likely responsible for the initial presentation of the patient's pain?

- A) T6
- B) T8
- C) T10
- D) T12
- E) L1

9. Pain due to diverticular disease is most commonly located in which abdominal area?

- A) Epigastric
- B) Lower right
- C) Upper right
- D) Lower left
- E) Upper left

ANSWER KEY

Discussion Question Answers

A. Discussion Question 1: What anatomical structures are found in each of the four quadrants?

Right upper quadrant: right lobe of liver, gallbladder, pylorus of stomach, parts 1-3 of duodenum, head of pancreas, right suprarenal gland, right kidney, right colic (hepatic) flexure, superior part of ascending colon, right half of transverse colon

Left upper quadrant: left lobe of liver, spleen, stomach, jejunum and proximal ileum, body and tail of pancreas, left kidney, left suprarenal gland, left colic (splenic) flexure, left half of transverse colon, superior part of descending colon

Right lower quadrant: cecum, appendix, most of ileum, inferior part of ascending colon, right ovary, right uterine tube, abdominal part of right ureter, abdominal part of right spermatic cord, uterus (if enlarged) urinary bladder (if very full)

Left lower quadrant: sigmoid colon, inferior part of descending colon, left ovary, left uterine tube, abdominal part of left ureter, abdominal part of left spermatic cord, uterus (if enlarged), urinary bladder (if very full)

- B. Discussion Question 2: The deep inguinal ring is an evagination of which fascial layer?** The deep inguinal ring is an evagination of transversalis fascia.
- C. Discussion Question 3: What differentiates an indirect inguinal hernia from a direct inguinal hernia? Which type of hernia is more common in infancy? In adulthood? Is a hernia that extends into the scrotum more likely to be indirect or direct?** Indirect inguinal hernias occur through a patent processus vaginalis and can extend out of the superficial inguinal ring. Direct hernias are usually caused when the wall of the abdominal muscles becomes weak, allowing a portion of the intestine to push through the abdominal wall. They are less common and can extend from the inguinal triangle to outside of the superficial inguinal ring. Indirect inguinal hernias are more common in infancy, while direct inguinal hernias are more common in adulthood. A hernia that extends into the scrotum is more likely to be indirect.
- D. Discussion Question 4: When palpating the aorta at the level of the umbilicus, what vertebral body are you compressing the aorta against?** You are compressing the aorta against L4.
- E. Discussion Question 5: What are striae? Name one disease state that frequently manifests with abdominal striae.** Striae is the medical term for stretch marks. They appear as wide, reddish-purple streaks and are usually benign. Striae are commonly seen in obese individuals because the increasingly thin skin cannot hide the color of venous blood in the underlying dermis. Cushing's syndrome, a hormonal disorder of excess glucocorticoid exposure, is a disease state that often presents with central adiposity and abdominal striae.
- F. Discussion Question 5: What are some causes of a positive psoas sign?** A positive psoas sign can be due to appendicitis, intervertebral/sacroiliac joint disease, and adenocarcinoma of the pancreas.
- G. Discussion Question 6: What are rebound tenderness and guarding? What pathology do they suggest?** Rebound tenderness is the presence of pain upon removal of, rather than application of, pressure; it is indicative of peritonitis. Guarding is a voluntary contraction of the abdominal wall musculature in response to external pressure; it serves to prevent pain by "guarding" inflamed abdominal organs.

USMLE Case Answers

- Genitourinary:** Ruptured Graafian follicle, ectopic pregnancy, pelvic inflammatory disease, ovarian torsion.
Gastrointestinal: Crohn's disease, Meckel's diverticulitis, perforated bowel, Yersinia enterocolitica infection, intussusception
Renal: Urinary tract infection, renal colic
Lymphatics: Mesenteric lymphadenitis
- McBurney's point is one-third the distance from the right anterior superior iliac spine to the umbilicus, and is where the pain from acute appendicitis classically localizes. Aaron's sign is a referred pain felt in the epigastrium upon continuous pressure over McBurney's point. It is also indicative of appendicitis.
- Appendicitis
- Appendicitis results from **obstruction or infection**. The appendiceal lumen may become obstructed by mucosal secretions or a fecolith (hard stony mass of feces), resulting in a distended appendix. Alternatively, bacteria may attack the wall of the appendix, blocking the venous system, creating increased intraluminal pressure and subsequent arterial insufficiency.

5. *Ampicillin and sulbactam are empirically used to treat Escherichia coli and Bacteroides fragilis infections. Gentamicin, clindamycin, imipenem, , second-generation cephalosporins, and piperacillin/tazobactam are also effective.*
6. *The most likely cause of the appendicitis in this patient is obstruction, as her presentation is typical and her laboratory results are not indicative of infection. Surgery is the preferred treatment, along with supportive intravenous fluids and empiric antibiotics (in case of rupture).The gold standard for diagnosis is CT of the abdomen with contrast.*

Practice Question Answers

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|------|------|------|------|------|
| 1. B | 3. D | 5. C | 7. B | 9. D |
| 2. B | 4. B | 6. A | 8. C | |