Lecture 5 in Anatomy of GIT By Dr. Mohammad Ahmad Abdulla

Anterior Abdominal Wall

The anterior abdominal wall is made up of skin, superficial fascia, deep fascia, muscles, extraperitoneal fat and parietal peritoneum.

Skin

The skin is loosely attached to the underlying structures except at the umbilicus, where it is tethered to the scar tissue of the umbilicus. The natural lines of cleavage in the skin run downward and forward almost horizontally around the trunk.

The umbilicus is a consolidated scar representing the site of attachment of the umbilical cord in the fetus; it is situated in the linea alba.

Nerve Supply

The cutaneous nerve supply to the anterior abdominal wall is derived from the anterior rami of the lower six thoracic and the first lumbar nerves. The thoracic nerves are the lower five intercostal and the subcostal nerves; the first lumbar nerve is represented by the iliohypogastric and the ilioinguinal nerves.

The dermatome of T7 is located in the epigastrium over the xiphoid process. The dermatome of T10 includes the umbilicus, and that of LI lies just above the inguinal ligament and the symphysis pubis.



Figure 19-1 Dermatomes and distribution of cutaneous nerves on the anterior abdominal

Blood Supply

Arteries: The skin near the midline is supplied by branches of the superior and the inferior epigastric arteries. The skin of the flanks is supplied by branches of the intercostal, lumbar, and deep circumflex iliac arteries. In addition, the skin in the inguinal region is supplied by the superficial epigastric, superficial circumflex iliac, and the superficial external pudendal arteries, which are branches of the femoral artery.

<u>Veins</u>: The venous drainage passes above mainly into the axillary vein via the lateral thoracic vein and below into the femoral vein via the superficial epigastric and the great saphenous veins.



Figure 19-2 On the left, arterial and venous drainage of the anterior abdominal wall. On the right, arterial supply to the anterior abdominal wall.

Lymph Drainage

The cutaneous lymph vessels above the level of the umbilicus drain upward into the anterior axillary lymph nodes. The vessels below this level drain downward into the superficial inguinal nodes.

Superficial Fascia

The superficial fascia is divided into the superficial fatty-layer (fascia of Camper) and the deep membranous layer (Scarpa's fascia).

The fatty layer is continuous with the superficial fascia over the rest of the body. The membranous layer fades out laterally and above. Inferiorly, the membranous layer passes over the inguinal ligament to fuse with the deep fascia of the thigh (fascia lata) approximately one fingerbreadth below the inguinal ligament. In the midline, the membranous layer is not attached to the pubis but, instead, forms a tubular sheath for the penis (clitoris). In the perineum, it is attached on each side to the margins of the pubic arch and is known as **Colles' fascia**. Posteriorly, it fuses with the perineal body and the posterior margin of the perineal membrane.

Deep Fascia

In the anterior abdominal wall, the deep fascia is a thin layer of areolar tissue covering the muscles.





Muscles of the Anterior Abdominal Wall

The muscles of the anterior abdominal wall consist mainly of three broad, thin sheets that are aponeurotic in front.

From exterior to interior, these sheets are the external oblique, the internal oblique, and the transversus. In addition, on either side of the midline anteriorly, there is a wide, strap-like, vertical muscle called the rectus abdominis. As the aponeuroses of the three sheets pass forward, they enclose the rectus abdominis to form the rectus sheath.

In the lower part of the rectus sheath, there may be a small muscle called the pyramidalis.

The **cremaster muscle** forms part of the covering of the spermatic cord and is derived from the lower fibers of the internal oblique; it passes inferiorly and enters the scrotum.



Rectus Sheath

The rectus sheath is a long fibrous sheath that encloses the rectus abdominis muscle and pyramidalis muscle (if present) and contains the anterior rami of the lower six thoracic nerves and the superior and inferior epigastric vessels and lymph vessels. It is formed by the aponeuroses of the three lateral abdominal muscles. The internal oblique aponeurosis splits at the lateral edge of the rectus abdominis to form two laminae; one passes anteriorly and one passes posteriorly to the rectus. The aponeurosis of the external oblique fuses with the anterior lamina, and the transversus aponeurosis fuses with the posterior lamina. At the level of the anterior superior iliac spines, all three aponeuroses pass anteriorly to the rectus muscle, leaving the sheath deficient posteriorly below this level. The lower, crescentshaped edge of the posterior wall of the sheath is called the arcuate line. All three aponeuroses fuse with each other and with their fellows of the opposite side in the midline between the right and the left recti muscles to form a fibrous band called the linea alba, which extends from the xiphoid process above to the pubic symphysis below.

The posterior wall of the sheath is not attached to the rectus muscle. The transverse tendinous intersections, which divide the rectus abdominis muscle into segments, are usually three in number: One at the level of the xiphoid process, one at the level of the umbilicus, and one between these two. These intersections are strongly attached to the anterior wall of the rectus sheath.



Linea Semilunaris

The linea semilunaris is the lateral edge of the rectus abdominis muscle. It crosses the costal margin at the tip of the ninth costal cartilage.

Conjoint Tendon

The internal oblique muscle has a lower, free border that arches over the spermatic cord (or the round ligament of the uterus) and then descends behind and attaches to the pubic crest and the pectineal line. Near their insertion, the lowest tendinous fibers are joined by similar fibers from the transversus abdominis to form the conjoint tendon, which strengthens the medial half of the posterior wall of the inguinal canal.

Table 4-1 Muscles of the Anterior Abdominal Wall				
Name of Muscle	Origin	Insertion	Nerve Supply	Action
External oblique	Lower eight ribs	Xiphoid process, linea alba, pubic crest, pubic tubercle, iliac crest	Lower six thoracic nerves and iliohypogastric and ilioinguinal nerves (L1)	Supports abdominal contents; compresses abdominal contents; assists in flexing and rotation of trunk; assists in forced expiration, micturition, defecation, parturition, and vomiting
Internal oblique	Lumbar fascia, iliac crest, lateral two- thirds of inguinal ligament	Lower three ribs and costal cartilages, xiphoid process, linea alba, symphysis pubis	Lower six thoracic nerves and ilio- hypogastric and ilioinguinal nerves (L1)	As above
Transversus	Lower six costal cartilages, lumbar fascia, iliac crest, lateral third of inguinal ligament	Xiphoid process linea alba, symphysis pubis	Lower six thoracic nerves and ilio- hypogastric and ilioinguinal nerves (L1)	Compresses abdominal contents
Rectus abdominis	Symphysis pubis and pubic crest	Fifth, sixth, and seventh costal cartilages and xiphoid process	Lower six thoracic nerves	Compresses abdominal contents and flexes vertebral column; accessory muscle of expiration
Pyramidalis (if present)	Anterior surface of pubis	Linea alba	Twelfth thoracic nerve	Tenses the linea alba



Figure 4-8 Rectus sheath in anterior view (A) and in sagittal section (B). Note arrangement of the aponeuroses forming the rectus sheath.



Figure 4-9 Anterior view of the pelvis showing attachment of the conjoint tendon to the public crest and the adjoining part of the pectineal line.

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Inguinal Ligament

The inguinal ligament connects the anterior superior iliac spine with the pubic tubercle. This ligament is formed by the lower border of the aponeurosis of the external oblique, which is folded back on itself. From the medial end of the ligament, the lacunar ligament extends backward and upward to the pectineal line of the superior ramus of the pubis, where it becomes continuous with the pectineal ligament (a thickening of the periosteum). The lower border of the inguinal ligament is attached to the deep fascia of the thigh (the fascia lata).

Fascia Transversalis

The fascia transversalis is a thin layer of fascia that lines the transversus muscle and is continuous with a similar layer lining the diaphragm and the iliacus muscle. The femoral sheath of the femoral vessels is formed from the fascia transversalis and the fascia iliaca.

Extraperitoneal Fat

The extraperitoneal fat is a thin layer of connective tissue that contains a variable amount of fat and lies between the fascia transversalis and the parietal peritoneum.

Parietal Peritoneum

The walls of the abdomen are lined with parietal peritoneum. This is a thin serous membrane and is continuous below with the parietal peritoneum lining the pelvis.

Nerves of the Anterior Abdominal Wall

The nerves of the anterior abdominal wall are the anterior rami of the lower six thoracic and the first lumbar nerves. These nerves run downward and forward between the internal oblique and the transversus muscles. They supply the skin, the muscles, and the parietal peritoneum of the anterior abdominal wall. The lower six thoracic nerves pierce the posterior wall of the rectus sheath. The first lumbar nerve is represented by the iliohypogastric and the ilioinguinal nerves, which do not enter the rectus sheath. Instead, the iliohypogastric nerve pierces the external oblique aponeurosis above the superficial inguinal ring, and the ilioinguinal nerve passes through the inguinal canal to emerge through the ring.

Blood Supply of the Anterior Abdominal Wall

<u>Arteries:</u> These include the superior and inferior epigastric arteries, the deep circumflex iliac artery, the lower two posterior intercostal arteries, and the four lumbar arteries. The superficial epigastric artery, the superficial circumflex iliac artery, and the superficial external pudendal artery also supply the lower part of the anterior abdominal wall.

<u>Veins</u>: The veins have the same names as the arteries and follow them to drain into the internal thoracic and the external iliac veins, the azygos veins, and the inferior vena cava.

The superficial epigastric, the superficial circumflex iliac, and the superficial external pudendal veins drain into the great saphenous vein and, from there, into the femoral vein. The thoraco-epigastric vein is the name given to the anastomoses between the lateral thoracic vein, a tributary of the axillary vein, and the superficial epigastric vein, a tributary of the great saphenous vein. This vein provides an alternative path for the venous blood should the superior or inferior vena cava become obstructed.

Peritoneum and Peritoneal Cavity

The peritoneum is the serous membrane that lines the abdominal and the pelvic cavities and that clothes the viscera. The peritoneum can be regarded as a balloon against which organs are pressed from the outside. The <u>parietal layer</u> lines the walls of the abdominal and the pelvic cavities, and the <u>visceral layer</u> covers the organs. The potential space between the parietal and the visceral layer is called the <u>peritoneal cavity</u>. In males, this is a closed cavity, but in females, there is communication with the exterior through the uterine tubes, the uterus, and the vagina.

The peritoneal cavity is divided into two parts: the greater sac and the lesser sac. The <u>greater sac</u> is the main compartment and extends from the diaphragm down into the pelvis. The <u>lesser sac</u> is smaller and lies behind the stomach. The greater and the lesser sacs are in free communication with one another through the <u>epiploic foramen</u>. The peritoneum secretes a small amount of serous fluid that lubricates the peritoneal surfaces and facilitates free movement between the viscera.



Figure 5-5 Sagittal section of the female abdomen showing the arrangement of the peritoneum.

Peritoneal Ligaments, Omenta, and Mesenteries

The peritoneal ligaments, omenta, and mesenteries permit blood, lymph vessels, and nerves to reach the viscera.

Peritoneal Ligaments:

Peritoneal ligaments are two-layered folds of peritoneum that connect solid viscera with the abdominal walls. The liver, for example, is connected to the diaphragm by the falciform ligament, the coronary ligament, and the right and the left triangular ligaments.

Omenta:

Omenta are two-layered folds of peritoneum that connect the stomach with another viscus. The greater omentum connects the greater curvature of the stomach with the transverse colon. It hangs down like an apron in front of the coils of the small intestine and is folded back on itself. The lesser omentum suspends the lesser curvature of the stomach to the fissure for the ligamentum venosum and the porta hepatis of the liver. The gastrosplenic omentum (ligament) connects the stomach to the hilus of the spleen.

Mesenteries:

Mesenteries are two-layered folds of peritoneum connecting parts of the intestines with the posterior abdominal wall (e.g., the mesentery of the small intestine, the transverse mesocolon, and the sigmoid mesocolon).

The extent of the peritoneum and the peritoneal cavity should be studied in the transverse and sagittal sections of the abdomen seen in Figures 19-21 and 19-22.



Figure 5-4 Transverse sections of the abdomen showing the arrangement of the peritoneum. The *arrow* in the lower diagram indicates the position of the opening of the lesser sac. These sections are viewed from below.

Lesser Sac:

The lesser sac lies behind the stomach and the lesser omentum. It extends upward as far as the diaphragm and downward between the layers of the greater omentum. The left margin of the sac is formed by the spleen, the gastrosplenic omentum, and the splenicorenal ligament. The right margin opens into the greater sac (the main part of the peritoneal cavity) through the epiploic foramen.

Boundaries of the Epiploic Foramen:

<u>Anteriorly:</u> Free border of the lesser omentum, the bile duct, the hepatic artery, and the portal vein.

<u>Posteriorly:</u> Inferior vena cava.

Superiorly: Caudate process of the caudate lobe of the liver.

Inferiorly: First part of the duodenum.



Peritoneal Recesses, Spaces, and Gutters

Duodenal Recesses

Close to the duodenojejunal junction, there may be four small pouches of peritoneum called the superior duodenal recess, the inferior duodenal recess, the paraduodenal recess, and the retroduodenal recess.



Figure 5-8 Peritoneal recesses that may be present in the region of the duodenojejunal junction. Note the presence of the inferior mesenteric vein in the peritoneal fold, forming the paraduodenal recess.

Cecal Recesses

Folds of peritoneum close to the cecum produce three peritoneal recesses called the superior ileocecal recess, the inferior ileocecal recess, and the retrocecal recess.

Intersigmoid Recess

The intersigmoid recess is situated at the apex of the inverted, V-shaped root of the sigmoid mesocolon. Its mouth opens downward and lies in front of the left ureter.



Subphrenic Spaces

The right and left anterior subphrenic spaces lie between the diaphragm and the liver on each side of the falciform ligament. The right posterior subphrenic space lies between the right lobe of the liver, the right kidney, and the right colic flexure. The right extraperitoneal space lies between the layers of the coronary ligament and is, therefore, situated between the liver and the diaphragm.

Paracolic Gutters

The paracolic gutters lie on the lateral and medial sides of the ascending and descending colons, respectively.

The subphrenic spaces and the paracolic gutters are clinically important because they may be sites for the collection and movement of infected peritoneal fluid.



Nerve Supply of the Peritoneum

The <u>parietal peritoneum</u> is supplied for the sensations of pain, temperature, touch, and pressure by the lower six thoracic and first lumbar nerves. The parietal peritoneum in the pelvis is mainly supplied by the obturator nerve.

The <u>visceral peritoneum</u> is supplied for the sensation of stretch only by autonomic nerves that supply the viscera or that are traveling in the mesenteries

Retroperitoneal Space

The retroperitoneal space lies on the posterior abdominal wall behind the parietal peritoneum. It extends from the twelfth thoracic vertebra and the twelfth rib to the sacrum and the iliac crests below.

The floor or posterior wall of the space is formed from medial to lateral by the psoas and quadratus lumborum muscles and the origin of the transversus abdominis muscle. Each of these muscles is covered on the anterior surface by a definite layer of fascia. In front of the fascial layers is a variable amount of fatty connective tissue that forms a bed for the suprarenal glands, the kidneys, the ascending and descending parts of the colon, and the duodenum. The retroperitoneal space also contains the ureters and the renal and gonadal blood vessels.

Surface Landmarks of the Abdominal Wall

Xiphoid Process

The xiphoid process is the thin cartilaginous lower part of the sternum. It is easily palpated in the depression where the costal margins meet in the upper part of the anterior abdominal wall. The xiphisternal junction is identified by feeling the lower edge of the body of the sternum, and it lies opposite the body of the ninth thoracic vertebra.

Costal Margin

The costal margin is the curved lower margin of the thoracic wall and is formed in front by the cartilages of the seventh, eighth, ninth, and tenth ribs and behind by the cartilages of the eleventh and twelfth ribs. The costal margin reaches its lowest level at the tenth costal cartilage, which lies opposite the body of the third lumbar vertebra. The twelfth rib may be short and difficult to palpate.

Iliac Crest

The iliac crest can be felt along its entire length and ends in front at the anterior superior iliac spine and behind at the posterior superior iliac spine. Its highest point lies opposite the body of the fourth lumbar vertebra.

About 2 in. (5 cm) posterior to the anterior superior iliac spine, the outer margin of the iliac crest projects to form the tubercle of the crest. The tubercle lies at the level of the body of the fifth lumbar vertebra.

Pubic Tubercle

The pubic tubercle is an important surface landmark. It may be identified as a small protuberance along the superior surface of the pubis.



Figure 19-79 Anterior abdominal wall of a 27-year-old man.

Symphysis Pubis

The symphysis pubis is the cartilaginous joint that lies in the midline between the bodies of the pubic bones. It is felt as a solid structure beneath the skin in the midline at the lower extremity of the anterior abdominal wall. The pubic crest is the name given to the ridge on the superior surface of the pubic bones medial to the pubic tubercle (Fig. 19-10).

Inguinal Ligament

The inguinal ligament lies beneath a skin crease in the groin. It is the rolled-under inferior margin of the aponeurosis of the external oblique muscle. It is attached laterally to the anterior superior iliac spine and curves downward and medially, to be attached to the public tubercle.

Linea Alba

The linea alba is a vertically running fibrous band that extends from the symphysis pubis to the xiphoid process and lies in the midline. It is formed by the fusion of the aponeuroses of the muscles of the anterior abdominal wall and is represented on the surface by a slight median groove.

Umbilicus

The umbilicus lies in the linea alba and is inconstant in position. It is a puckered scar and is the site of attachment of the umbilical cord in the fetus.

Rectus Abdominis

The rectus abdominis muscles lie on either side of the linea alba and run vertically in the abdominal wall; they can be made prominent by asking the patient to raise the shoulders while in the supine position without using the arms.

Tendinous Intersections of the Rectus Abdominis

The tendinous intersections are three in number and run across the rectus abdominis muscle. In muscular individuals, they can be palpated as transverse depressions at the level of the tip of the xiphoid process, at the umbilicus, and halfway between the two.

Linea Semilunaris

The linea semilunaris is the lateral edge of the rectus abdominis muscle and crosses the costal margin at the tip of the ninth costal cartilage. To accentuate the semilunar lines, the patient is asked to lie on the back and raise the shoulders off the couch without using the arms. To accomplish this, the patient contracts the rectus abdominis muscles so that their lateral edges stand out.

Abdominal Lines and Planes

Vertical lines and horizontal planes are commonly used to facilitate the description of the location of diseased structures or the performing of abdominal procedures.

Vertical Lines

Each vertical line (right and left) passes through the midpoint between the anterior superior iliac spine and the symphysis publis.

Transpyloric Plane

The horizontal transpyloric plane passes through the tips of the ninth costal cartilages on the two sides—that is, the point where the lateral margin of the rectus abdominis (linea semilunaris) crosses the costal margin. It lies at the level of the body of the first lumbar vertebra. This plane passes through the pylorus of the stomach, the duodenojejunal junction, the neck of the pancreas, and the hila of the kidneys.

Subcostal Plane

The horizontal subcostal plane joins the lowest point of the costal margin on each side that is, the tenth costal cartilage. This plane lies at the level of the third lumbar vertebra.

Intercristal Plane

The intercristal plane passes across the highest points on the iliac crests and lies on the level of the body of the fourth lumbar vertebra. This is commonly used as a surface landmark when performing a lumbar spinal tap.

Intertubercular Plane

The horizontal intertubercular plane joins the tubercles on the iliac crests (Fig. 19-80) and lies at the level of the fifth lumbar vertebra.



Abdominal Quadrants

It is common practice to divide the abdomen into quadrants by using a vertical and a horizontal line that intersect at the umbilicus. The quadrants are the upper right, upper left, lower right, and lower left. The terms epigastrium and periumbilical are loosely used to indicate the area below the xiphoid process and above the umbilicus and the area around the umbilicus, respectively.



Surface Landmarks of the Abdominal Viscera

It must be emphasized that the positions of most of the abdominal viscera show individual variations as well as variations in the same person at different times. Posture and respiration have a profound influence on the position of viscera.

The following organs are more or less fixed, and their surface markings are of clinical value:-

Liver

The liver lies under cover of the lower ribs, and most of its bulk lies on the right side. In infants, until about the end of the 3rd year, the lower margin of the liver extends one or two fingerbreadths below the costal margin. In the adult who is obese or has a well-developed right rectus abdominis muscle, the liver is not palpable. In a thin adult, the lower edge of the liver may be felt a fingerbreadth below the costal margin. It is most easily felt when the patient inspires deeply and the diaphragm contracts and pushes down the liver.

Gallbladder

The fundus of the gallbladder lies opposite the tip of the right ninth costal cartilage — that is, where the lateral edge of the right rectus abdominis muscle crosses the costal margin.

Spleen

The spleen is situated in the left upper quadrant and lies under cover of the ninth, tenth, and eleventh ribs (Fig. 19-81). Its long axis corresponds to that of the tenth rib, and in the adult, it does not normally project forward in front of the midaxillary line. In infants, the lower pole of the spleen may just be felt.



Figure 19-81 Surface markings of the fundus of the gallbladder, spleen, and liver. In a young child, the lower margin of the normal liver and the lower pole of the normal spleen can be palpated. In a thin adult, the lower margin of the normal liver may just be felt at the end of deep inspiration.

Pancreas

The pancreas lies across the transpyloric plane. The head lies below and to the right, the neck lies on the plane, and the body and tail lie above and to the left.

Stomach

The cardioesophageal junction lies about three finger-breadths below and to the left of the xiphisternal junction (the esophagus pierces the diaphragm at the level of the tenth thoracic vertebra).

The pylorus lies on the transpyloric plane just to the right of the midline. The lesser curvature lies on a curved line joining the cardioesophageal junction and the pylorus. The greater curvature has an extremely variable position in the umbilical region or below.

Duodenum (First Part)

The duodenum lies on the transpyloric plane about four fingerbreadths to the right of the midline.

Cecum

The cecum is situated in the right lower quadrant. It is often distended with gas and gives a resonant sound when percussed. It can be palpated through the anterior abdominal wall.

Appendix

The appendix lies in the right lower quadrant. The base of the appendix is situated one third of the way up the line, joining the anterior superior iliac spine to the umbilicus (McBurney's point). The position of the free end of the appendix is variable.

Ascending Colon

The ascending colon extends upward from the cecum on the lateral side of the right vertical line and disappears under the right costal margin. It can be palpated through the anterior abdominal wall.

Transverse Colon

The transverse colon extends across the abdomen, occupying the umbilical region. It arches downward with its concavity directed upward. Because it has a mesentery, its position is variable.

Descending Colon

The descending colon extends downward from the left costal margin on the lateral side of the left vertical line. In the left lower quadrant, it curves medially and downward to become continuous with the sigmoid colon. The descending colon has a smaller diameter than the ascending colon and can be palpated through the anterior abdominal wall.