

Anatomy lecture number three in the GI system

the lecture today is about the anterior abdominal wall and the rectus sheath .

Abdominal cavity :

boundaries :

Superiorly —> we have the diaphragm which separates the thoracic from the abdominal cavity

Inferiorly —> we have the pelvis and usually the abdominal cavity continues with the pelvis , but we have peritoneum covering the pelvic viscera .

Anteriorly —> we have the anterior abdominal wall .

Posteriorly —> we have the posterior abdominal wall .

note : the umbilicus is located at the midline within linea alba at the level of the intervertebral disc between L3 and L4

if we checked the posterior abdominal wall , we are going to notice that it is formed of :

skin , fascia , vertebral column (the lower five lumbar vertebrae) and last rib - rib number 12 - which is embedded in the abdominal muscles , and finally the muscles

#Muscles of the posterior abdominal wall :

1) Psoas major and minor muscles

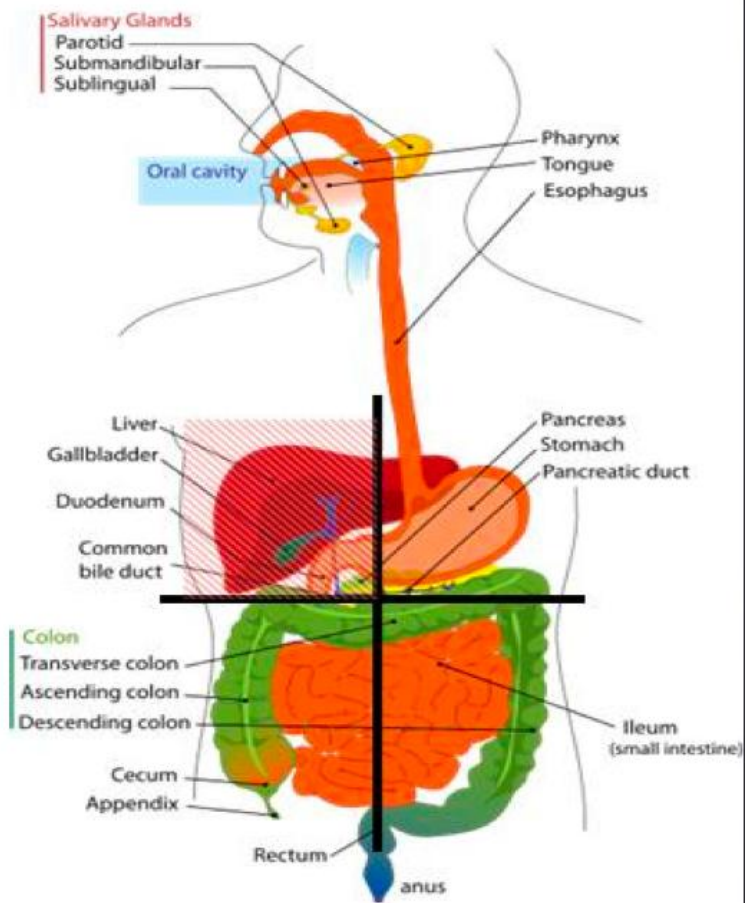
2) quadratus lumborum muscle .

3) transversus abdominis muscle which comes from the back anteriorly .

Anterior abdominal wall :

- starts with the skin and ends with parietal peritoneum that lines the abdominal wall anteriorly and posteriorly (like a balloon in the abdominal cavity)
- superiorly : we have the costal cartilages especially the lower five and xiphoid process .
- inferiorly : we have pubic bone and iliac crest at the level of L4 .

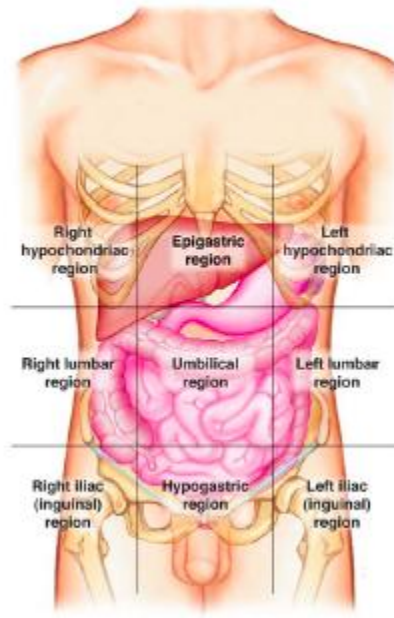
in the past , they used to divide the abdominal surface into four quadrants :



- upper left , upper right , lower left and lower right . And this simplifies the description and terminology between people in medical field , for example :
- if someone has a severe pain in the right upper quadrant , the doctor should think of a problem in liver and gall bladder .
- Another example: if someone has severe pain in the right lower quadrant (right iliac fossa) , the doctor should think about appendicitis or cecum .

Nowadays , the abdominal cavity is divided into nine regions :

- upper three , middle three and lower three .



the cavity is divided into 9 regions by :

*Two Mid clavicular vertical lines (descend from middle of the clavicle)

* Two Horizontal lines:

a- subcostal: plane at the level of L3 vertebra .

b - intertubercular : between iliac tubercle on the iliac crest at level of L5 .

names of the nine abdominal regions :

<< refer to the picture above >>

~ upper three :

a. Epigastric region: means above the stomach.

b. Right Hypochondriac : on the right side of the epigastric .

c. Left Hypochondriac : on the left side of the epigastric .

Hypochondriac : means below the costal cartilage

~ Middle three :

a. umbilical region : surrounds the umbilicus and contains the small intestines .

b. right lumbar region : contains the right kidney and ascending colon .

c. left lumbar region : contains the left kidney and the descending colon .

they are both (right and left lumbar regions) related to lumbar vertebrae . we check them to see if there were any abnormalities in the kidneys.

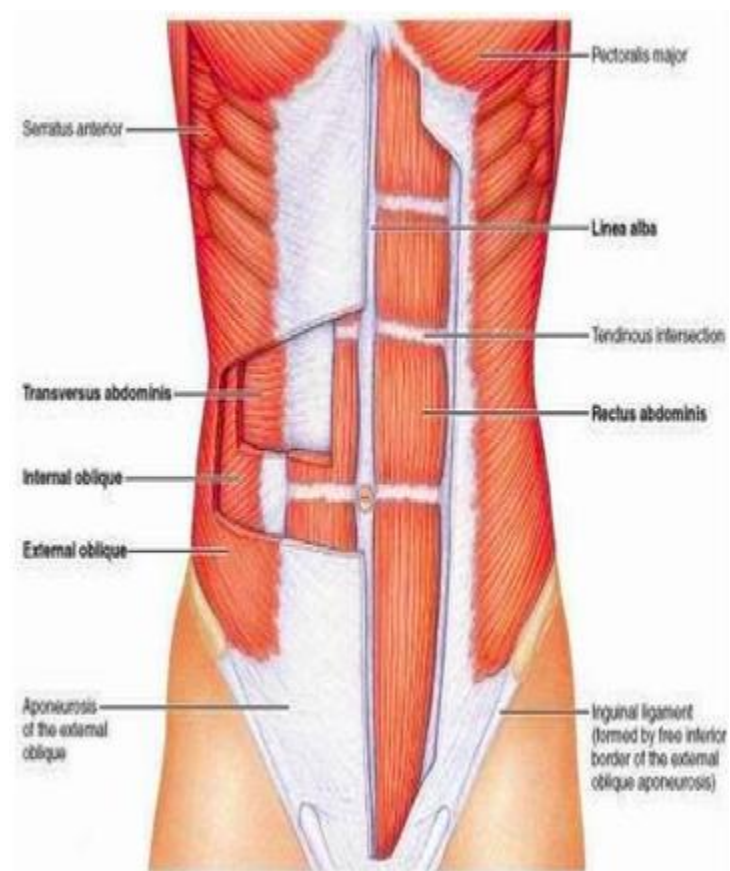
~ lower three :

a. suprapubic (hypogastric) : has urinary bladder (most important) and genitalia .

b. right iliac (inguinal) region : contains the cecum , appendix and right ovary .

c. left iliac (inguinal) region : includes sigmoid colon and left ovary .

Now , we are going to give more details about the anterior abdominal wall :



in the picture above , we can see the line alba which is a fibrous line that extends from the xiphoid process to the symphysis pubis and it is the site of insertion of all abdominal muscles , also it is the site for abdominal incision , when surgeons want to make midline incision they do it in the linea alba .

This has an advantage and disadvantage ;

- advantage: the incision gives them a wide space for working in that area (in cases of large tumors for example).
- disadvantage : as we know it is a fibrous tissue so the healing process will take long time .

getting back to our picture , check the rectus abdominis (we will talk about it in details later in the sheet) , it appears clearly as separated squares in body builder :P , and this appearance is due to the presence of tendinous intersections that come from myotomes in the embryo .

Usually we have three or four tendinous intersections , the first one is at the level of ribs, and the last one at the level of umbilicus .

The line at the midline is called linea alba , and the ones on the lateral sides are called linea semilunaris .

Layers of the abdomen :

1) Skin

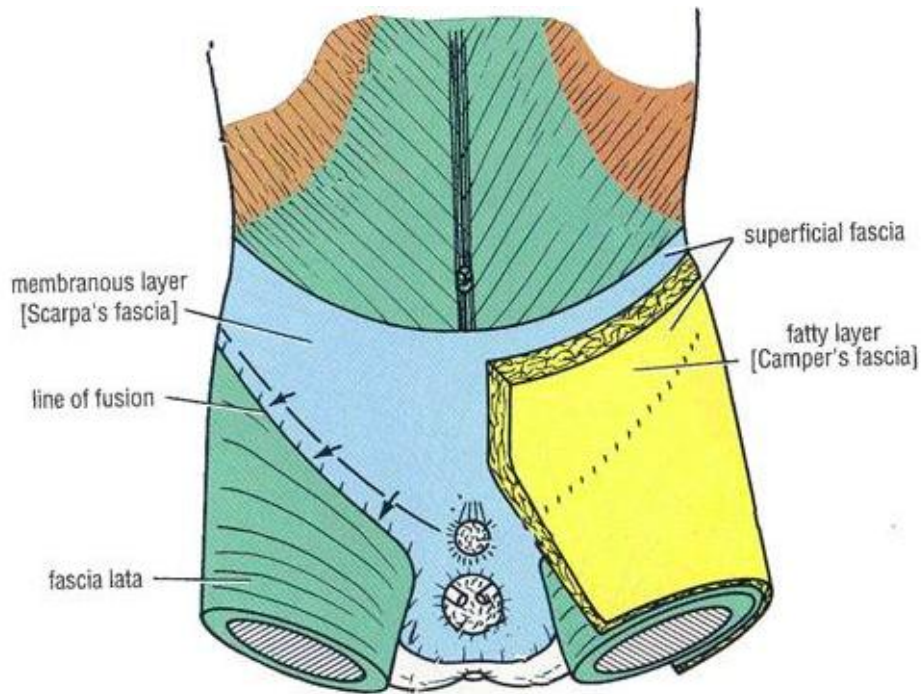
2) Superficial Fascia :

- above the umbilicus : it is one layer
 - below the umbilicus : it is two layers ;
- fatty layer : camper's fascia (superficial)
- membranous layer : scarpa's fascia (deep)

these two layers of the superficial fascia in males continue and reach the scrotum :

* the camper's —> forms the dartos muscle .

* the scarpa's —> forms colles fascia .



the attachment of the membranous fascia (Scarpa's fascia) :

inferiorly : Fascia lata (which descends one inch below the inguinal ligament)

on sides : the arch of pubis on pubic bone .

posteriorly : the perineal body (fibrous body present in the perineum , midway between the anus and the urethra) .

we mentioned the previous information because it has clinical importance ; sometimes we could have rupture of the urethra due to severe trauma and this means extravasation of urine (spreading of the urine in the lower part of the abdomen in the membranous layer , around the scrotum , penis and in the perineum- follows the attachment of the membranous layer) and in the lower part it reaches the fascia lata which extends only one inch below the inguinal ligament as we said before , so the extravasation will not reach the lower limb .

3) Deep Fascia: it is very thin layer to absent and the prof. said that in his opinion it is absent, the evidence for this is the expansion of the abdomen forward during pregnancy and enlargement of the uterus , if there is a deep fascia this will not happen and it will prevent the expansion , but the deep fascia that the books mean here is the connective tissue layer that surrounds the muscles .

4) Muscular layer :

a. Rectus abdominis muscle .

b. external oblique muscle .

c. internal oblique muscle .

d. transversus abdominis muscle .

5) Transversalis Fascia : it's extension forms the posterior wall of the femoral sheath .

6) Extra peritoneal fascia (or fat) : located before peritoneum .

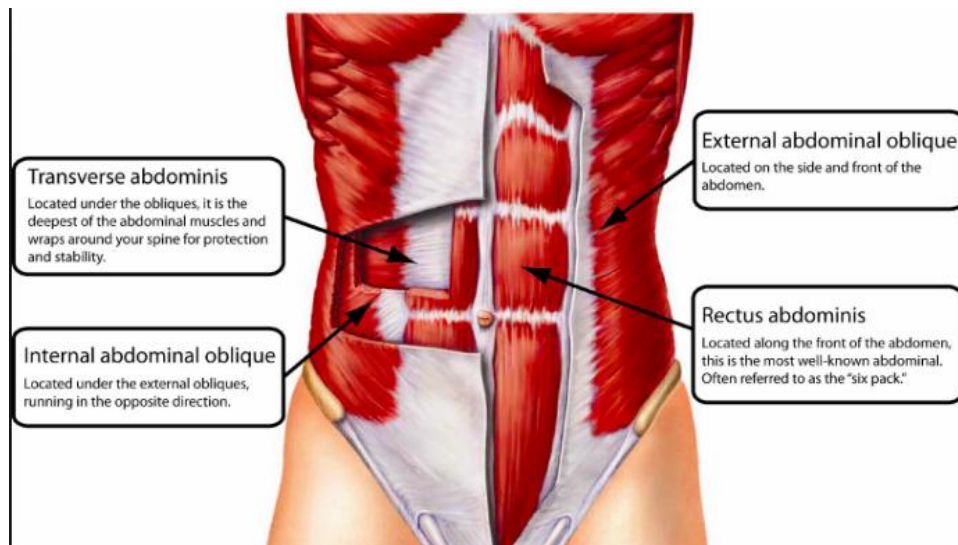
7) Parietal peritoneum :

- the peritoneum is two layers :
 - a. Parietal : lining the abdominal wall (this is what we are talking about)
 - b. Visceral : surrounding the abdominal viscera .

to reach the abdominal viscera you have to open the parietal one .

****NOTE:** we still did NOT reach the minute 18th in the lecture ,don't get bored ,there are still a lot to read :D!

Abdominal Muscles :



as mentioned above :

a. Rectus abdominis muscle .

b. external oblique muscle .

c. internal oblique muscle .

d. transversus abdominis muscle .

- we noticed that abdominal muscles end as aponeurosis (fibrous tissue) at the area close to the linea alba , and their origin is fleshy (muscular fibers)

- the aponeurosis will make ligaments at the lower abdomen such as the inguinal ligament , lacunar ligament and the pectineal ligament , all of them are made by the aponeurosis of external oblique muscle .

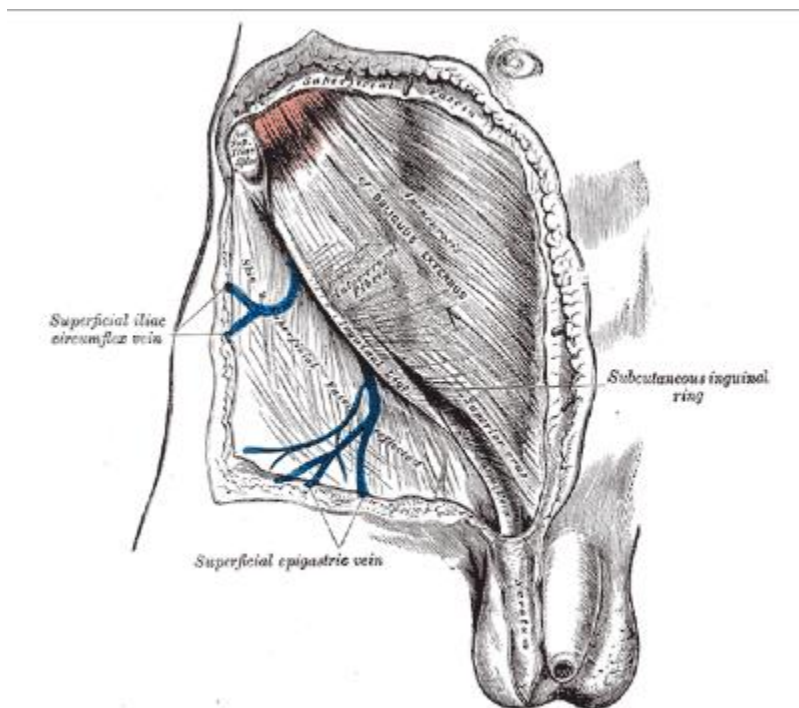
* External Oblique muscle :

- origin : the outer surface of the lower eight ribs .
- the fibers are directed downwards , forwards and medially towards the linea alba .
- insertion : in the linea alba (which extends from the xiphoid process) to pubic tubercle and crest ending in the iliac crest (this is the insertion of the external oblique)
- nerve supply : lower six thoracic (intercostal) nerves .

>> check the picture above for the whole abdominal muscles <<

Note : Thoracic nerve are 12 in number and the last one is called subcostal , the lower six descend to the abdomen and supply it's muscles , also we can see them in the rectus sheath (among its contents) .

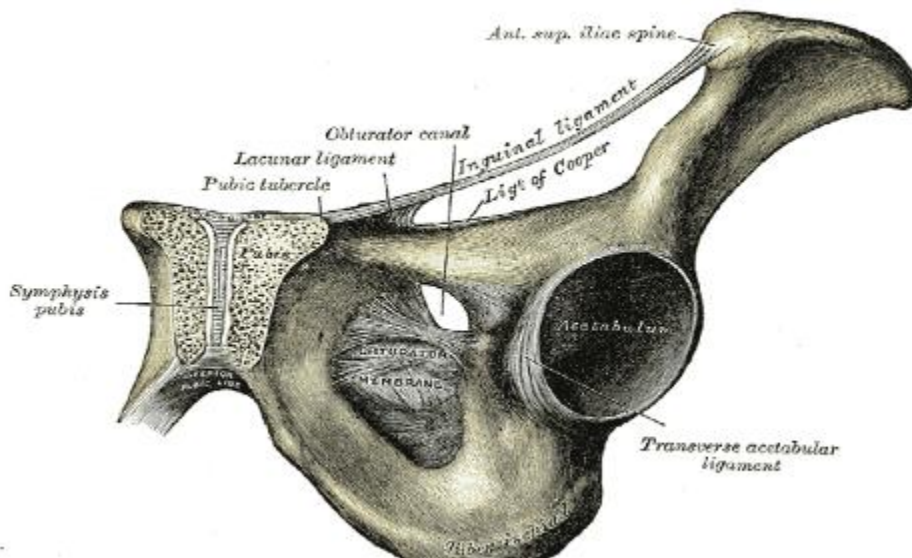
~ the inguinal ligament : it is a folding of the aponeurosis of external oblique muscle upon itself , attached to anterior superior iliac spine superiorly , and pubic tubercle inferiorly .



- in the picture above , we can see the superficial inguinal ring , which is a defect in the external oblique

aponeurosis, lies above and medial to the pubic tubercle , acting as a passage way for the spermatic cord (which passes in the inguinal canal through the superficial inguinal ring) in males , and the round ligament of the uterus in females which is attached to labia majora .

~ the lacunar ligament : it is an extension of external oblique aponeurosis , lies on the medial side of the femoral ring .



the picture above shows the lacunar ligament .

~ Pectinial ligament: is also an extension of the external oblique aponeurosis (actually a continuation of the lacunar ligament) attached to the pectinial line of the pubic bone , thickens and blends with the periosteum of the pubic bone .

* Internal oblique :



- Origin : lumbar fascia , anterior two thirds of iliac crest and lateral two third of inguinal ligament .
- Direction of fibers : upwards , forwards and medially
- Insertion: lower three ribs and costal cartilage, xiphoid process, linea alba and symphysis pubis.
- nerve supply : lower six thoracic nerves and L1 spinal nerve which divides in the abdomen to ilioinguinal (one of the inguinal canal contents) and iliohypogastric and both innervate the lower abdomen .

~ internal oblique makes an important tendon that is the conjoint tendon which is :

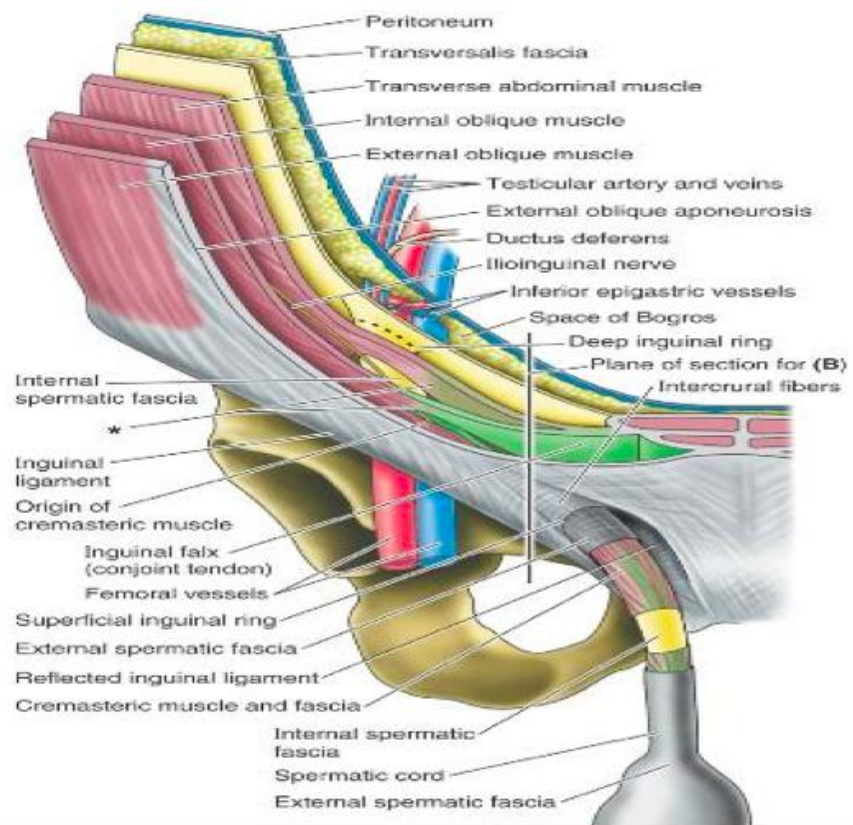
- fibers from internal oblique and transversus abdominis .
- lies posterior to the inguinal canal .
- supports the superficial inguinal ring .
- medially attached to linea alba and pubic bone .

Cremasteric fascia and cremasteric muscle :

- they are extensions form the deep ring from the internal oblique muscle and it surrounds the spermatic cord .
- Layers surrounding the spermatic cord (form abdominal muscles) :
 - a. External spermatic fascia .
 - b. internal spermatic fascia .

c. cremasteric muscle and fascia (between the external and internal spermatic fascia).

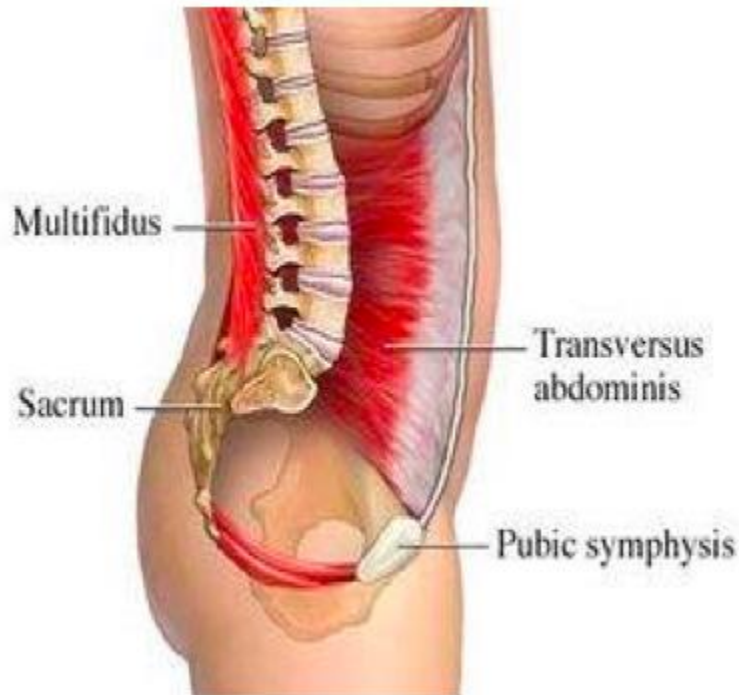
the picture below shows the whole layers of the abdomen :



~ Deep inguinal ring : is a defect in transversalis fascia found 1 Cm above the midinguinal point .

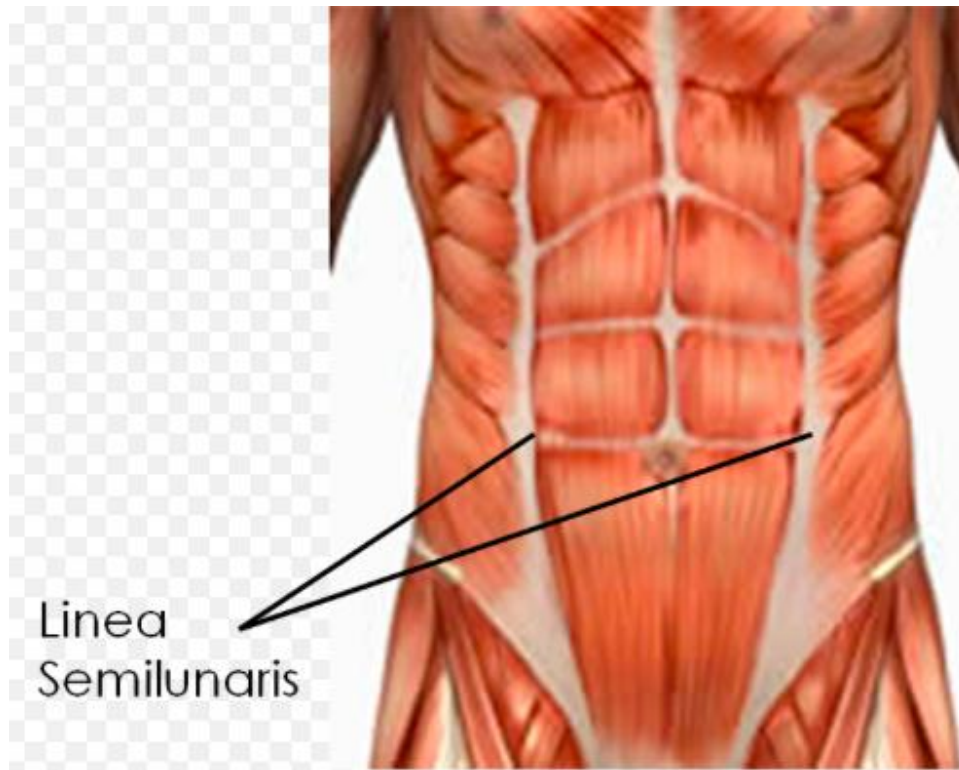
~ The inguinal canal: the canal between the deep and superficial inguinal rings, the most important content of it is the spermatic cord in males and the round ligament of uterus in females.

* Transversus abdominis :



- transverse fibers
- origin : inner surface of lower six costal cartilage , lumbar fascia , anterior two thirds of iliac crest and lateral third of inguinal ligament .
- insertion : xiphoid process , linea alba and symphysis pubis .
- the lower fibers fuse with internal oblique to form the conjoint tendon which is attached to pubic crest and pectineal line .
- nerve supply : lower six thoracic and L1 spinal nerve .
- it also assists in the formation of the rectus sheath .

* Rectus abdominis :

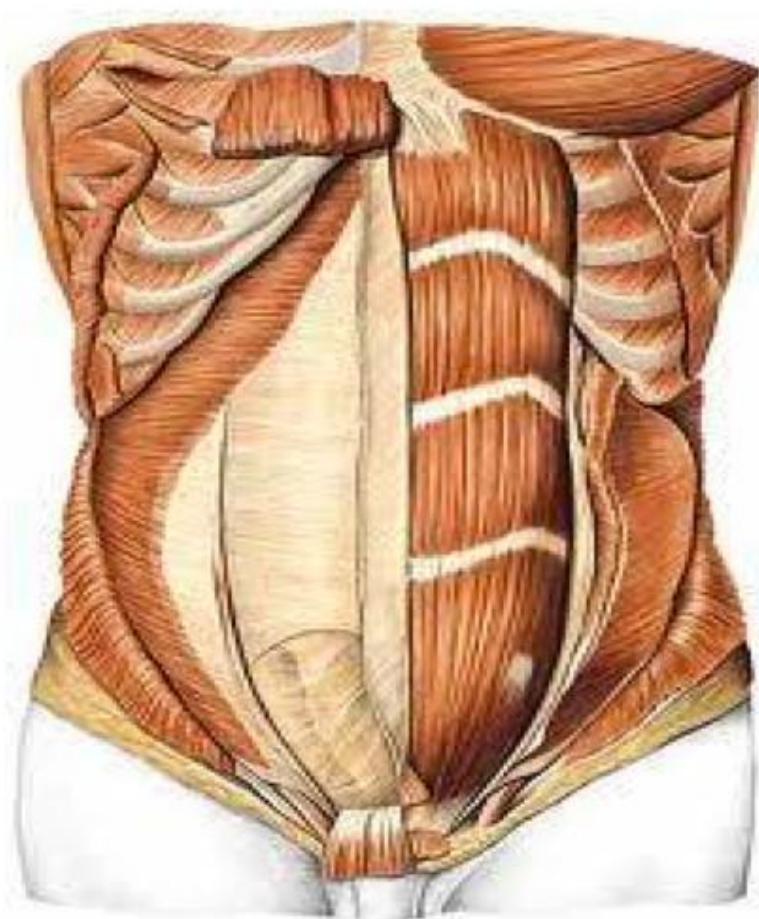


- long strap muscle
- extends along the whole length of the anterior abdominal wall
- inside the rectus sheath
- origin : symphysis pubis and pubic crest .
- insertion : 5th , 6th and 7th costal cartilages and xiphoid process .
- nerve supply : lower six thoracic nerve (L1 is not included here)
- action : bending of the trunk forward .

~ tendinous intersection : firmly adherent to anterior abdominal wall of the rectus sheath but separated from the posterior .

* Pyramidalis muscle :

- sometimes it is absent and sometimes present inside the rectus sheath anterior to rectus abdominis muscle at the lower part .



- pyramidal in shape
- origin : anterior surface of the pubis
- insertion : linea alba
- action : tensing of linea alba .
- nerve supply : only the 12th thoracic nerve (subcostal nerve)

Now the function of the abdominal muscles (together) :

- increasing the intra abdominal pressure during vomiting , sneezing , coughing , defecation , micturition and labor .
- also they protect and keep the viscera fixed in it's place by forming a net (since their fibers have different directions)

Rectus sheath :

it is a long fibrous sheath formed mainly by the aponeurosis of the three lateral abdominal muscles, it has an anterior wall, posterior wall, and contains rectus abdominis inside it, it extends from linea semilunaris to linea alba.

* contents :

a. rectus abdominis muscle

b. pyramidalis muscle (if present)

c. anterior rami of the lower six thoracic nerves without L1

d. superior epigastric vessels (from the internal thoracic which is a branch from the subclavian artery)

e. inferior epigastric vessels (from the external iliac artery)

>> Both groups of vessels are located in front of the posterior wall of the sheath (included in its contents) <<

~ in order to describe the rectus sheath , we will discuss ant. And post. walls at many levels ;

- First level at xiphoid process
- Second level , midway between (xiphoid process and umbilicus) and (umbilicus and symphysis pubis)
- third level , below the level of the superior anterior iliac spine .

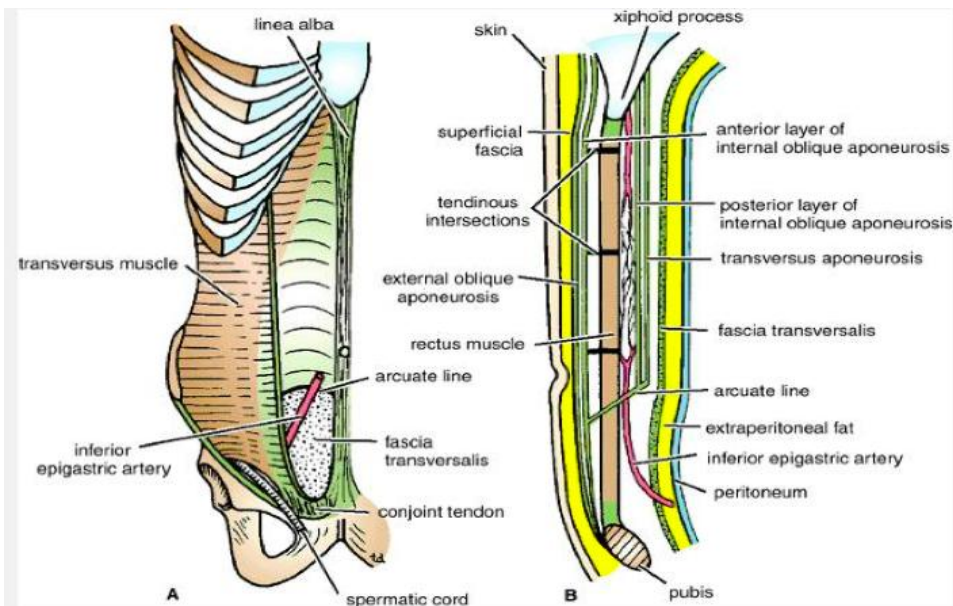


Figure 4-10 Rectus sheath in anterior view (A) and in sagittal section (B). Note the arrangement of the aponeuroses forming the rectus sheath.

- the doctor pointed at the area around the inferior epigastric artery (in the posterior wall of the rectus sheath):

this area is covered only with fascia transversalis so it is a weak area .

- then pointed at the inguinal triangle which is a triangle located medial to inferior epigastric artery covered posteriorly by transversalis fascia and considered as weak area because it is fascia only , In old age , there may be a bulge of small intestine or omentum causing DIRECT inguinal hernia .

- Deep inguinal ring is located lateral to the inferior epigastric artery and it is the start of the inguinal canal that is also considered as weak point where the INDIRECT inguinal hernia can occur .

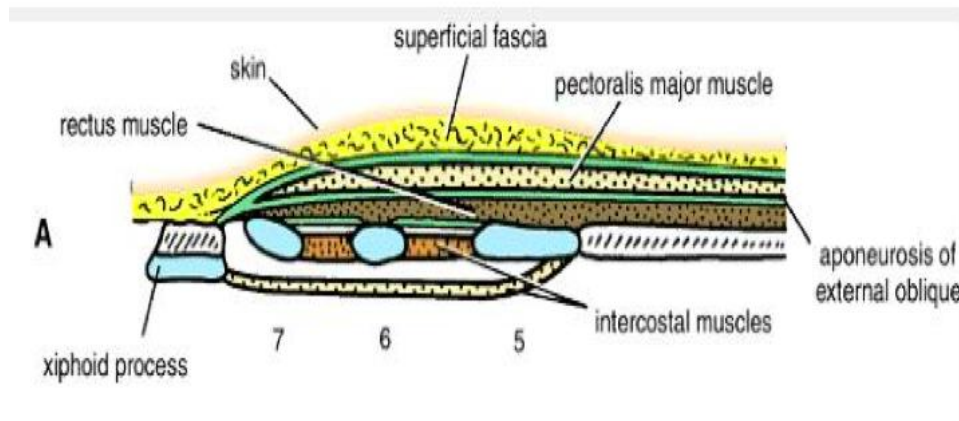
- there is a difference between the direct and the indirect inguinal hernia which are separated by inferior epigastric artery .

**** Note :** we are almost done :D , only more 10 minutes and you are free to go !

the first section at the level of xiphoid process (costal margin) :

- the anterior wall is formed by the external oblique muscle aponeurosis

- the posterior wall is formed by the costal cartilage number 5 , 6 and 7 .



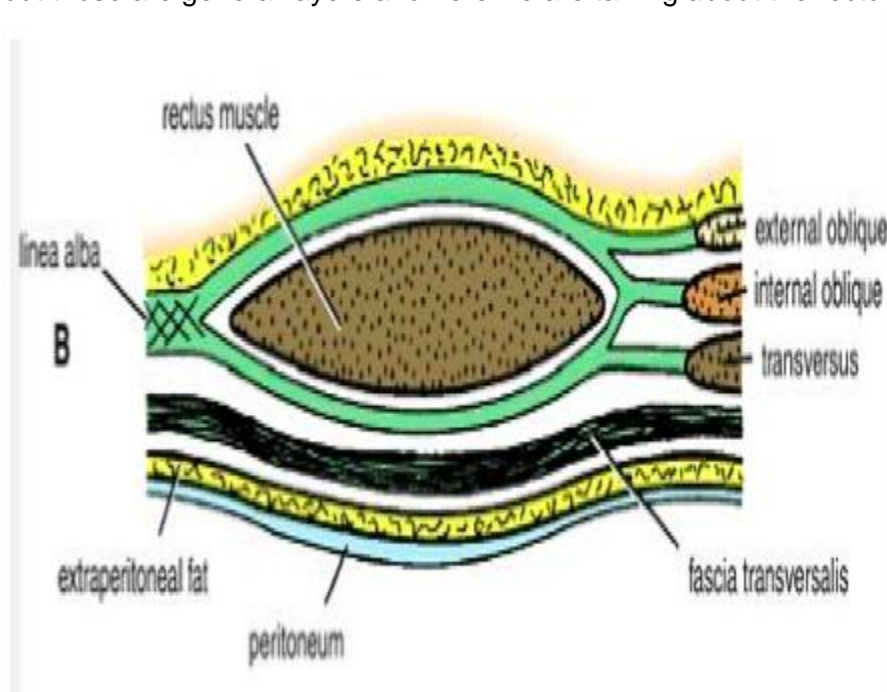
ABOVE THE COSTAL MARGIN,

- ANTERIOR WALL # APONEUROSIS OF THE EXTERNAL OBLIQUE.
- POSTERIOR WALL # THORACIC WALL THAT IS, THE FIFTH, SIXTH, AND SEVENTH COSTAL CARTILAGES AND THE INTERCOSTAL SPACES.

the second level (midway)

- anterior wall is formed by external oblique aponeurosis plus one layer of internal oblique aponeurosis .
- posterior wall is formed by the posterior layer of the internal oblique aponeurosis plus the transversus abdominis aponeurosis .

note: in the picture below; you can also see the fascia transversalis, extraperitoneal fat and peritoneum, but those are general layers and here we are talking about the rectus sheath.



- the internal oblique aponeurosis splits into two layers ; one for anterior and one for posterior .

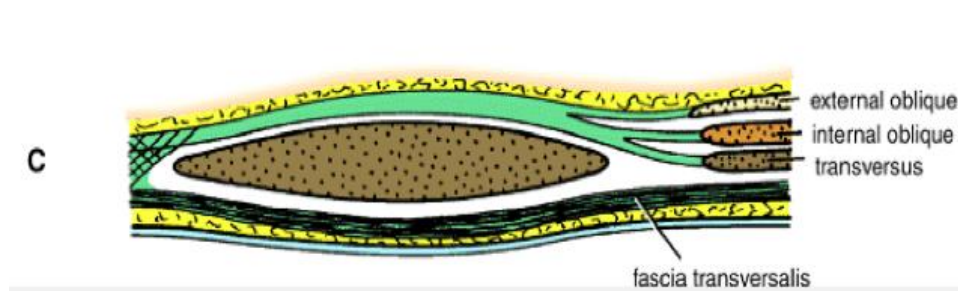
the third level below the level of anterior superior iliac spine :

- the anterior wall is formed by all aponeurosis of abdominal muscles (external , internal , and transversus) .
- the posterior wall is formed by the transversalis fascia (which is weak area below the level of anterior superior iliac spine) .

Between the level of the anterosuperior iliac spine and the pubis

the anterior wall : the aponeurosis of all three muscles form.

The posterior wall is absent, and the rectus muscle lies in contact with the fascia transversalis.



~ there is something called arcuate line : which is a line present at the level of anterior superior iliac spine and it is a land mark that indicates that the posterior wall of the rectus sheath at that level is formed only by fascia transversalis (which is weak and site for direct inguinal hernia) .

>> Lumbar triangle is NOT required from us <<

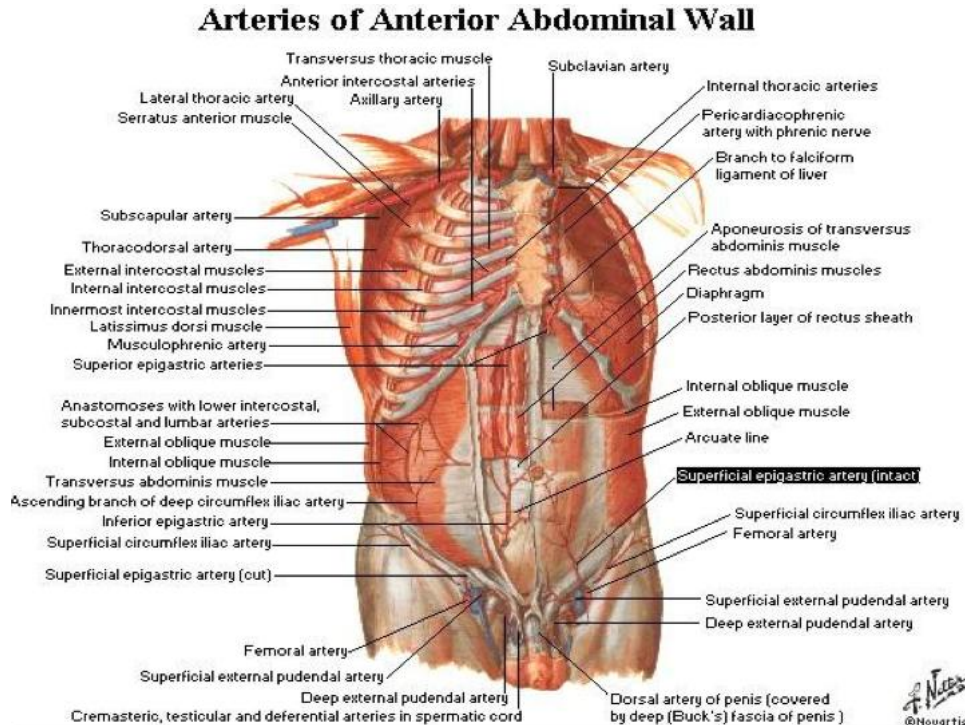
- but the doctor said that it is located at the posterior wall of the abdomen and it is a site for hernia also, because it is a weak point.

Blood supply of the anterior abdominal wall :

- superior epigastric artery.
- inferior epigastric artery .

>> and both of them are within the rectus sheath

- intercostal arteries : branches from the descending thoracic aorta .
- lumbar arteries : branches from the abdominal aorta (four to the right and four to the left) .
- Deep circumflex iliac artery from external iliac artery.

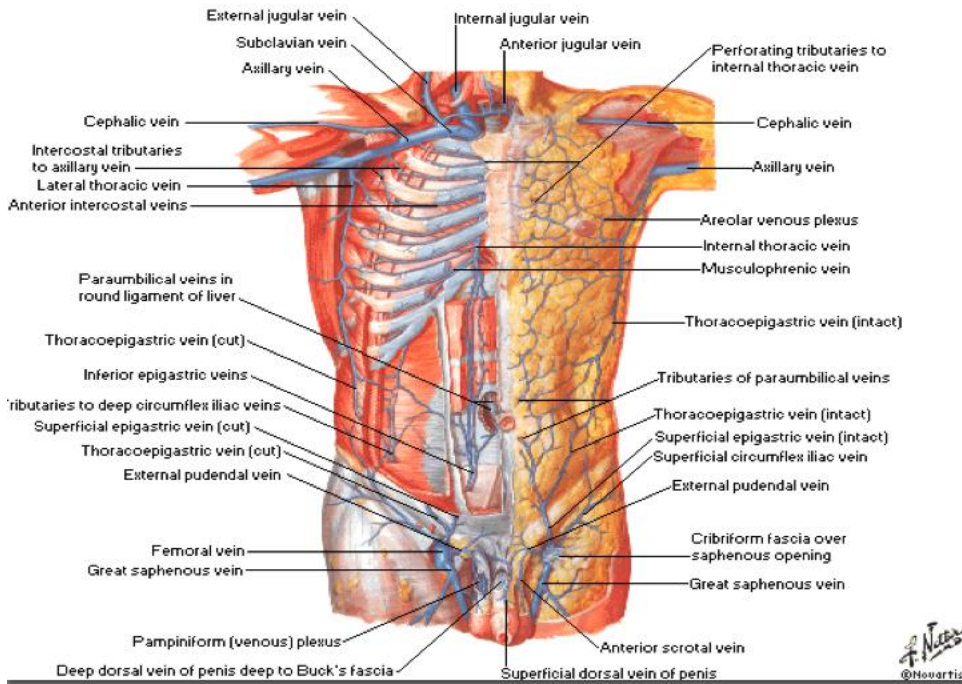


Venous drainage :

- above the umbilicus —> lateral thoracic vein ends in the axillary vein
- below the umbilicus —> inferior epigastric to femoral vein and finally to external iliac vein .

* Paraumbilical vein : surrounds the umbilicus and ends through ligamentum teres to the portal vein (important in portosystemic anastomosis: sometimes an engorgement of blood around the umbilicus happens causing caput medusae which will be discussed in portosystemic anastomosis) .

Veins of Anterior Abdominal Wall



~ nerve supply to the anterior abdominal wall :

Lower six thoracic nerves + L1 (with it's two branches ; ilioinguinal and iliohypogastric)

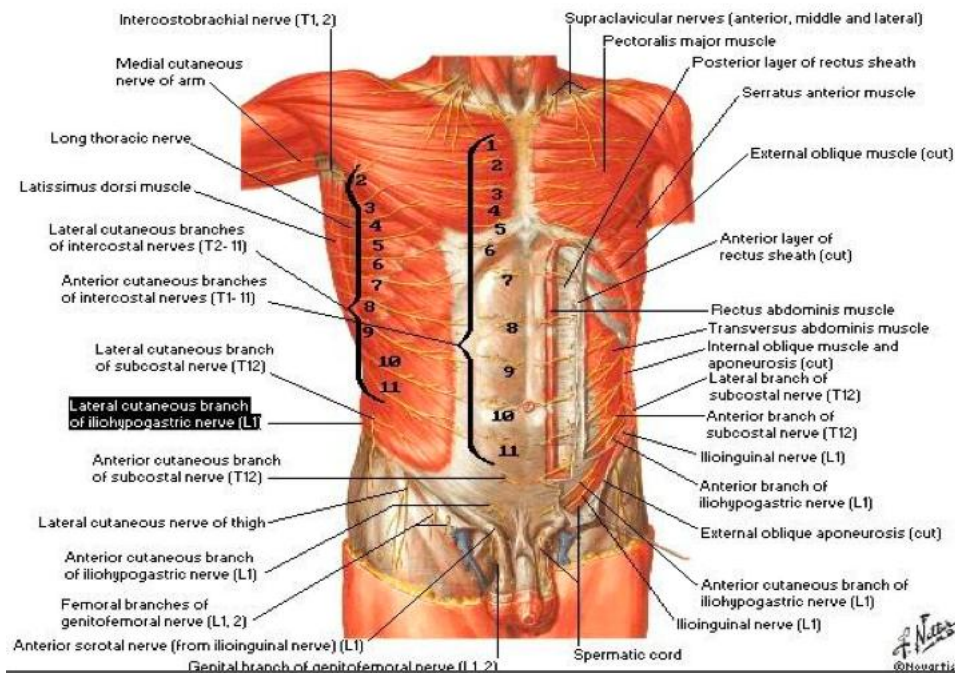
~ Dermatomes :

- Skin below xiphoid process —> T7

- around the umbilicus —> T10 (that's why pain for appendicitis starts at the level of the umbilicus)

- above the symphysis pubis —> L1

Nerves of Anterior Abdominal Wall



the lower six thoracic nerves are inside the rectus sheath but L1 IS NOT !

- During midline or paramedian incision, the rectus abdominis is pulled laterally not medially, because if it was pulled medially you may cut the nerves, because they extend from lateral to medial.

Lymphatic drainage :

- Above the umbilicus → anterior axillary lymph nodes (same lymph nodes draining lateral side of the breast).
- Below the umbilicus → superficial inguinal lymph nodes .
- Above the iliac crest → posterior axillary lymph nodes. (also called sub scapular lymph nodes)
- Below the iliac crest → superficial inguinal lymph nodes .

Clinical notes :

Abdominal stab wounds >> طعن

- we have to know the relation of the wound to the rectus sheath -most important- (in the midline (linea alba) , lateral or anterior to the rectus sheath)

* Surgical incision :

- there are many types for example :

- for the appendix : McBurney's incision .
- for gall bladder : kocher's incision (subcostal)

common types for surgical incisions :

- Paramedian incision
- Pararectus incision
- Midline incision
- Transrectus incision
- Transverse incision
- Muscle splitting
- Abdominothoracic incision .

تم بحمد الله

Done By : Mohammad Abu Dosh

! بس والله ففعت وانا بكتبها
and I am really sorry for any mistake
wish you all the best :) !