

THE



SYSTEM

Anatomy

Sheet

Slide

Handout

Number: **Sheet 3**

Subject: **Anterior abdominal wall**

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In this sheet we will talk about the abdomen and the digestive system in the abdominal cavity

We have anterior abdominal wall and posterior abdominal wall

● **The boundaries (borders) of the abdomen:**

➤ **Above: diaphragm:**

- the most important muscle in respiration, (equivalent to the heart in the Cardiovascular System)
- Does almost 90% of the respiration function
- Separate the abdominal cavity and the thoracic cavity
(there is only three major orifices and minor orifices that allow the some structures to pass through the diaphragm to the abdomen,
major orifices: aortic orifice, inferior vena cava orifice, and esophageal orifice
minor orifices: for phrenic nerve , sympathetic nerves and other structures)

➤ **Below: inlet of the pelvis**

*The difference between thoracic cavity and the pelvic cavity is that the pelvic cavity is opened with abdominal cavity (no separation)

➤ **Superiorly:** (in the anterior border)

- Xiphoid process (the end of the sternum)
- Lower five Costal cartilages (7-12)

➤ **Inferiorly:** (anterior border)

- Pubic bone (symphysis pubis)
- iliac crest at the level of L4

Umbilicus: at the level of IV disc (L3-L4)

❖ You notice when the doctor examine the patient, the patient should be to the left of the doctor, his head up, and his legs down, but why?

➤ Because of the orientations of the areas of the abdomen

❖ We took last year that if you want to examine the pulse of the heart you put the stethoscope on the fifth intercostal space on the left side (apex of the heart)

The same thing applies here:

upper right quadrant -> liver

Lower right quadrant -> cecum and appendix

- Previously they divided the abdomen into four quadrants formed by two intersecting lines: Vertical & Horizontal Intersect at umbilicus: upper (right and left), and lower (right and left).
- But this does not give accurate description, so they divided it into nine areas “nine regions of the abdomen” to help the localization of the organs so the doctor will exactly know what is there.
- So if a patient is having infection in an organ and the doctor puts his hand there will be pain as a result to the pressure (tenderness) and will know the exact organ under his hand.

What are the 9 regions?

They are made by:

- **Vertical Planes: (Midclavicular planes)**

From middle of clavicle to the midpoint between pubic symphysis and anterior superior iliac spine, (left and right lateral planes)

- **Horizontal Planes:**

1- **Subcostal plane:** at level of **L3** vertebra, Joins the lower end of costal cartilage on each side

2- **Intertubercular plane:** At the level of **L5** vertebra, pass through tubercles of iliac crests.

The names of the regions:

first row:

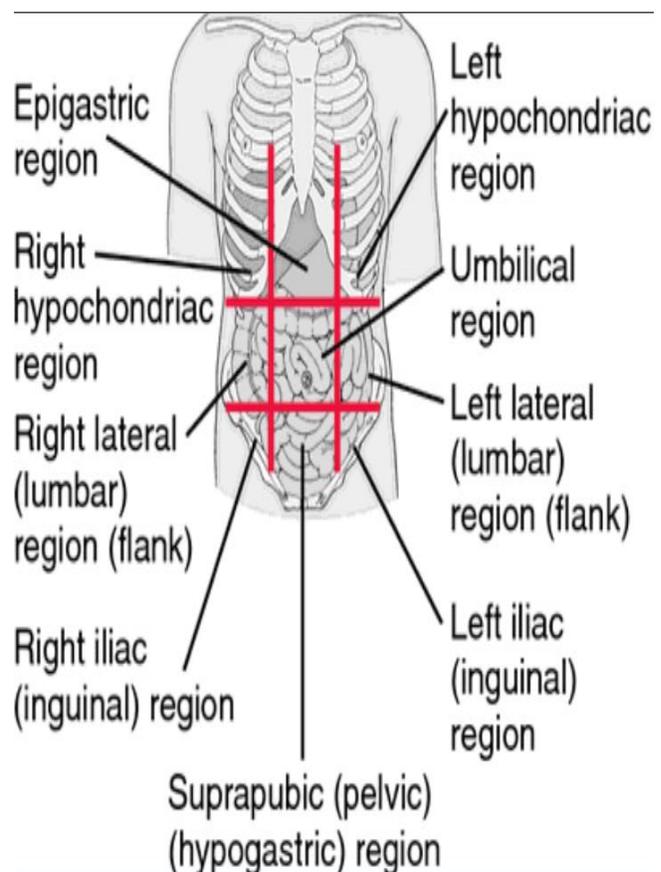
- Right hypochondriac (under the right ribs)
- Left hypochondriac (under left ribs)
- Epigastric (above the intestines)

Second row:

- Umbilical region (in the middle, around the umbilicus)
- Right lateral lumbar
- Left lateral lumbar (The kidneys lie in the posterior part of the right and left lumbar regions)

Third row:

- Right iliac (inguinal) region
- Left iliac (inguinal) region
- Suprapubic (above pubic symphysis) OR hypogastric (below stomach)



- The importance of these regions is to know the organs under every area.

Examples:

- **Right hypochondriac:** (right lobe of liver and gall bladder)
if a patient with cholecystitis (gall bladder inflammation) will have pain in the right hypochondriac region.
- On the **Left hypochondriac side** the most important structure is the **spleen**, which is related to the 9th, 10th, 11th ribs.
if car accident or any other reason caused fracture of these ribs, the first thing that should come to your mind is a ruptured spleen (needs a fast diagnosis and fast treatment)
- **Umbilical region** is mostly made by **small intestines** .
if a patient is having abdominal colic mostly it is in the small intestines around the umbilicus
- **Right and left lumbar regions** contain **ascending and descending colon**, and posteriorly they contain the **kidneys**.
- **Right iliac: appendix** is the most important, because it is common to have appendicitis.
in females: there is right ovary in right iliac fossa and left ovary in left iliac fossa, sometimes with menstrual cycle, girls may suffer severe pain, so you have to differentiate between appendicitis and pain due to ovaries
- **Suprapubic (hypogastric):** urinary bladder .

As we said, we have anterior abdominal wall and posterior abdominal wall.

❖ Anterior abdominal wall

What are the Layers of Anterior Abdominal Wall? *it is important for surgeons to know the layers in order to know how to open the abdomen .

- 1- **Skin**
- 2- **Superficial Fascia (two layers):**
 - Above the umbilicus one layer (fatty layer).
 - Below the umbilicus two layers (fatty and membranous layers).

these two layers below the umbilicus are:

♣ **Camper's fascia** - fatty superficial layer.

In the scrotum it is called **dartos** muscle.

**Muscles and fascia descend and surround the scrotum and testes (in males)

♣ **Scarp's fascia** - deep membranous layer:

In the perineum, it enters the wall of scrotum . From there, it passes to be attached on each side to the margins of pubic arch ; it is here referred to as **Colles' fascia**.

- **Attachment of scarp's fascia:**

fascia lata in the lower limb (upper 4 cm of the thigh), on the sides with pubic arch and posteriorly with the perineal body.

** they found out that scarp's fascia and its attachments is continuous around the penis and scrotum, so when we have a rupture in the penile urethra, this leads to extravasations of urine into(scrotum, perineum, penis, lower abdomen and 4 cm in the thigh)

3- **Deep fascia:** always under the superficial fascia there is deep fascia

very thin layer of connective tissue covering the muscle, it may be absent especially in women, but why? To allow the protrusion of the uterus in pregnant women, if it is there it prevent this from happening.

4- **Muscular layer:** four muscles .

*****Linea alba** have the insertion of all the abdominal muscles.

- **External oblique muscle**(external abdominis muscle)

external -> outer muscle

oblique -> the fibers are oblique

(downward forward and medially)

- **Origin:**

outer surface of lower 8 ribs.

- **Insertion:**

Xiphoid process

Linea alba (**fibrous line with little supply of blood starts from xiphoid process to symphysis pubis, used in midline incisions during surgeries because of small amount of bleeding, but longer time in healing**)

Pubic crest

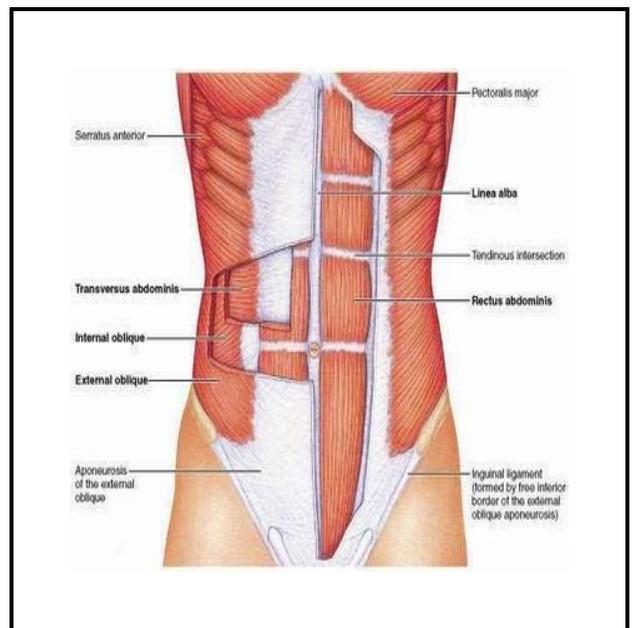
Pubic tubercle

Iliac crest

- **Nerve Supply**

Lower 6 th thoracic nerves

L1(iliohypogastric n., ilioinguinal n.)

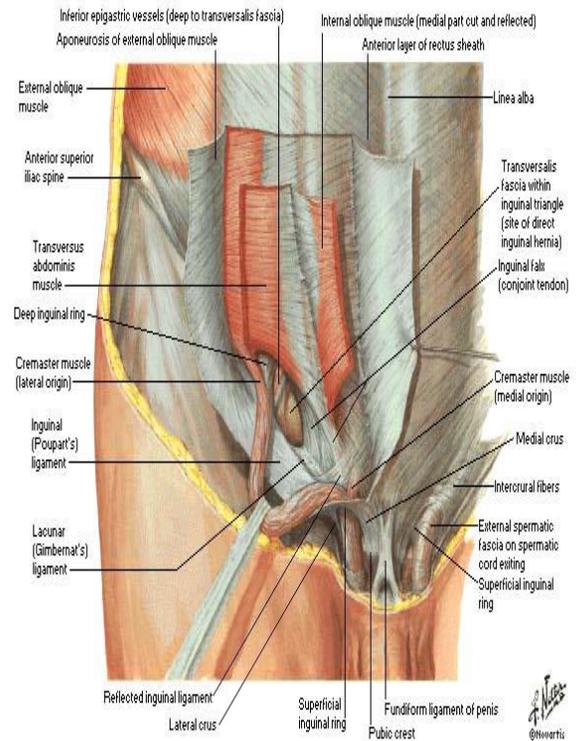


Aponeurosis of external oblique muscle

External oblique is converted to aponeurosis before reaching linea Alba, so what is aponeurosis?

It is a non-fleshy fibers, it makes:

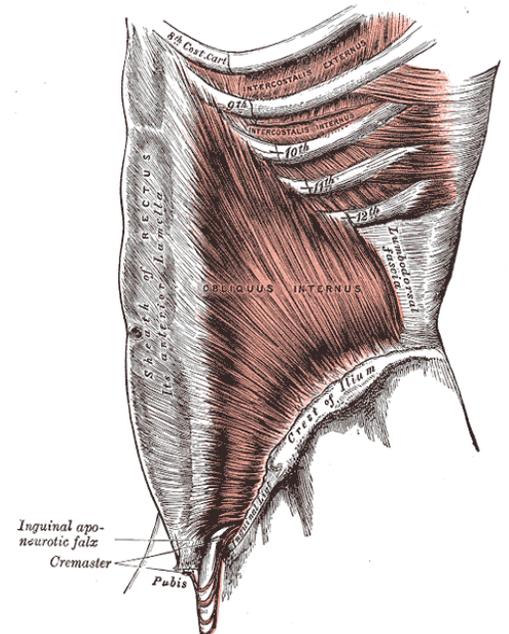
- 1) **Inguinal ligament:** folding of the aponeurosis of external oblique upon itself, attaches between anterior superior iliac spine and pubic tubercle.
- 2) **Lacunar ligament:** crescentic in shape, extension of aponeurosis of external muscle backward and upward to the pectineal line forming the medial boundary to the femoral ring.
- 3) **Pectineal ligament:** extension of aponeurosis attached to the pectineal line of pubis, thickening and continuation of the periosteum, and continuation of the lacunar ligament at pectineal line.
- 4) **Superficial inguinal ring:** triangular shape, it is a defect in external oblique aponeurosis for the passage of the spermatic cord (males) or ligament of uterus (females).



Inguinal canal lies between superficial and deep inguinal rings .

- **Internal oblique muscle (deep to external oblique muscle and opposite to it, but in different direction)**
the direction of this muscle is **(upward forward and medially)**.

- **Origin**
Lumbar Fascia
Anterior 2/3 of iliac crest
lateral two thirds of inguinal ligament.
- **Insertion**
Lower three ribs and costal cartilage
Xiphoid process
Linea alba
Symphysis pubis.
- **Nerve Supply**
Lower 6th thoracic nerves, iliohypogastric nerve & ilioinguinal nerve (L1).



➤ **Conjoint tendon:**

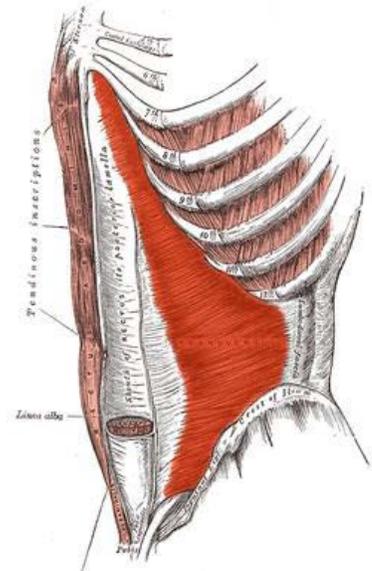
- Fusion of the fibers of internal oblique and transversus abdominis.
- Attached medially to linea alba supporting the inguinal canal
- Has lateral free border
- Used to take stitches in **herniorrhaphy**(in inguinal hernia فتق) because it is very strong tendon.

➤ **Cremastric fascia:**

Follows internal oblique and starts from inguinal canal and descend until reaching the scrotm.

• **Transverses abdominis muscle**

- **Origin:**
lumbar fascia
lower 6 costal cartilage
anterior 2 thirds of the iliac crest
the lateral third of the inguinal ligament.
- **Insertion:**
in the **linea alba** only from the xiphoid process to symphysis pubis.
- **Its lower fibers fuse with the internal oblique fibers forming conjoint tendon.**
- **Nerve supply :**
Lower 6 thoracic nerves
L1 (illiohypogastric and illioinguinal nerves)
- *So the innervation of the previous three muscles is the same (lower 6 thoracic nerves and L1).*
- It also contributes to form the **rectus sheath.**
- Its fibers run in transverse manner.



The collection of the abdominal muscle fibers (downward, upward, transverse) make a very strong network, thus the abdominal muscles are very strong muscles. **(This is to protect the abdominal viscera)**

- **Rectus abdominis muscle**

- The abs (عضلات المعدة), obvious in body builder, because of **the tendentious intersection** between the muscle parts.
- In the embryo it comes from the myotome, continue as a separated myotome because of the tendons.
- **Origin:**
symphysis pubis (downwards)
- **Insertion:**
upwards in the 5th,6th,7th costal cartilage and xiphoid process.
- **Nerve supply:**
lower 6 thoracic nerves. (**NOT L1**)



- Its lateral edge is called **semilunaris**.
It has tendinous intersections attached to the anterior wall (not the posterior, it is separated from the wall posteriorly).

- **Pyramidalis muscle:**

- May be absent
- Within the rectus sheath in the lower part (if present).
- Origin: from the anterior surface of the pubis.
- Insertion: linea alba .
- Action: pulls linea alba.
- N. supply: **12th subcostal nerve (the last intercostal N.)**

5- **Transversalis fascia:** fibrous connective tissue covering the muscles from inside (deep to the muscle)

6- **Extraperitoneal fascia or fat.**

7- **Parietal Peritoneum.**

Peritoneum: is a membrane, the same as a balloon, it contains cavity which is the abdomen, the wall is parietal peritoneum .

So the layers are:

External > internal > transversus > transversalis fascia >extra peritoneal fat> peritoneum

❖ Rectus sheath:

- It has anterior and posterior wall.
- Starts from **linea semilunaris** and **fuses** in the **linea alba** (in the midline).

- Formed by the aponeuroses of the abdominal muscles (external and internal oblique muscles and transversus abdominis muscle) .

Contents:

- **Two muscles:** rectus abdominis and pyramidalis.
- **two arteries: inferior epigastric** (from external iliac) and **superior epigastric** (from internal thoracic artery which is a branch from the brachiocephalic artery) .
- Lower 6 intercostal nerves (called the thoracic nerves and subcostal nerves).
- Lymphatic vessels.

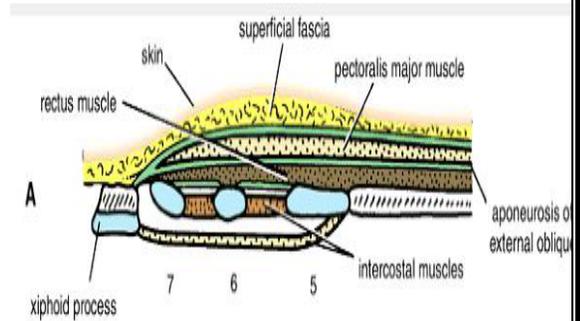
- It has different relations at different levels:

❖ **Above costal margin(5th,6th and 7th) and xiphoid process: (look at figure A)**

-**The anterior wall:** only aponeurosis of external oblique muscle.

-**Posterior Wall** : costal cartilage number 5,6 and 7.

-**Content:** rectus abdominis muscle.

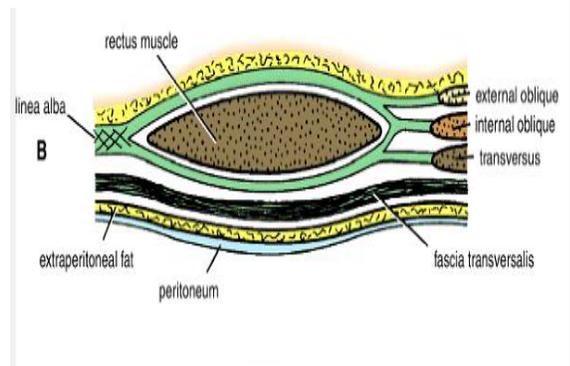


❖ **Mid way between umbilicus and xiphoid and Mid way between umbilicus and symphysis pubis:(between the costal margin and ant. Superior iliac spine): (look at figure B)**

-**Anterior Wall:** the aponeurosis of external oblique and one layer of internal oblique.

-**Posterior Wall:** one layer of internal oblique aponeurosis and transversus abdominis aponeurosis.

- **Contents:** rectus abdominis muscle (notice that it is enclosed by the 2 layers of internal oblique).

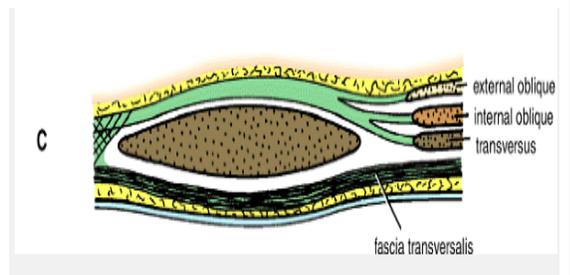


❖ **Below ant. Sup. Iliac spine (below Mid way between umbilicus and symphysis pubis): (look at figure C)**

Ant. Wall: the aponeurosis of all muscles (external,internal and transversus).

Post. Wall: transversalis fascia only (that ends in the peritoneum).

Content: rectus abdominis muscle.



➤ **Arcuate line (linea semicircularis):**

The end of the muscles in the posterior wall where they attach to the anterior superior iliac spine.

Under it is the transversalis fascia.

❖ Other fascia in the anterior Abdominal wall:

- **Transversalis fascia:**
 - Deep to the muscles
 - Starts below the diaphragm.
 - Continue downwards to the pelvis forming pelvic fascia and the femoral sheath.

- **Extrapertoneal fascia:**
 - Usually it is in the form of adipose tissue(fat).
 - Located above the parietal peritoneum.

- **Parietal peritoneum:**
 - The membrane which covers the abdominal viscera
 - While the visceral peritoneum is adherent to the viscera.
 - So we can't reach any organ in the abdomen without opening the parietal peritoneum.
 - Inferior epigastric artery is branch from the external iliac artery and it is an important landmark
 - Medial to inferior epigastric artery is inguinal triangle (where **direct** inguinal hernia occurs) and lateral to it is the inguinal canal (where the **indirect** inguinal hernia occurs).

Note: The lumbar triangle is not required.

❖ The action of the anterior abdominal muscles:

- Increase the ***intra-abdominal pressure*** where is needed in the following processes:
 - Vomiting
 - Coughing
 - Defecation
 - Labour
 - micturition
 - Bending the trunk
- Protect the viscera when **contracted**(when you are playing boxing, you have to protect your visceral organs from the boxes you take, so the muscles of the abdomen take the role of the protection when contacted. If contraction didn't take place the viscera will be affected and bleeding may occur)
- Keep the viscera in position
- They help in raising heavy objects (people who lift heavy object they tie a strap on the abdomen to help the muscles doing their action).

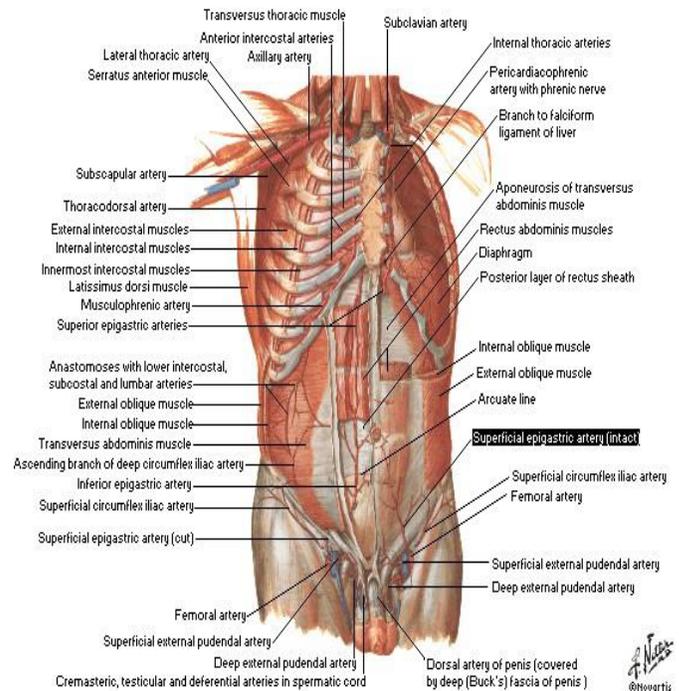
❖ Blood supply of the abdominal muscles:

- Superior and inferior epigastric arteries supply the abdomen (remember they are from the rectus sheath contents).
- Intercostal arteries (lower 6) which arise from the thoracic aorta.
- Lumbar arteries and they are 4 in number. They arise from the abdominal aorta.
- Deep circumflex iliac artery (arises from the external iliac artery and heads towards superior iliac spine)

➤ And the corresponding veins and they drain into:

- Lateral thoracic vein which drains into the axillary vein (in the upper limb) >>>>> **above the umbilicus**
- Inf. Epigastric draining into the femoral vein >>>>> **below the umbilicus**
- Paraumbilical veins in the ant. Abdominal wall and then pass through **ligamentum teres** of the liver to drain into the portal vein (Porto-systemic anastomosis). And if there is portal-hypertension, these veins will be affected and form something called **caput medusae** (like a scar around the umbilicus).

Arteries of Anterior Abdominal Wall



❖ Nerve supply of the ant. Abdominal wall:

- Lower 6 subcostal nerves (segmental nerves).
- **Dermatomes:**
 - Skin around or below the xiphoid process >>> lateral cutaneous terminal branches of **T7**.
 - Skin around the umbilicus >>> from **T10**.
 - Skin below the umbilicus (above symphysis pubis) >>> from **L1** (ilio-hypogastric and ilio-inguinal).
- **Note:** L1 nerve passes above inguinal ligament and divides into 2 branches: ilio-hypogastric and ilio-inguinal.

❖ Lymphatic drainage of the ant. Abdominal wall:

Above the umbilicus>>> Ant. Axillary L.N.

Below the umbilicus>>> superficial Inuinal L.N.

- Posteriorly,
Above iliac crest >>>post.axillary L.N.
Below the iliac crest>>> superficial Inguinal L.N.

The direction of the skin is known as cleavage

❖ Clinical notes:

➤ Abdominal stab wound:

We should be able to know the layers, muscles, organs and structures affected by a stab wound by knowing the region only.

➤ Surgical incision:

- Doctors seek to make the incision in an area where healing is fast (and without leaving a scar) and bleeding is minimal.
- And the surgical incision should be parallel to skin cleavage so that it won't leave a scar. doctors should also be aware of the pathway of the nerves. So they pull rectus sheath laterally to protect the nerves which pass from medial to lateral. And the direction of the muscle fibers is also important.
- If there is a large tumor on the abdomen for example so we need to make a large incision, **we open the linea alba.**
- To remove the gallbladder when inflamed (on the right side) we make a **subcostal incision** (also called **kocher** incision).
- To reach the **kidney** we make an incision on the back called **Morrison incision.**
- To remove the **appendix**>>> the incision is called **McBurney's incision** (**parellal to the inguinal ligament**).

Sorry for any mistakes~