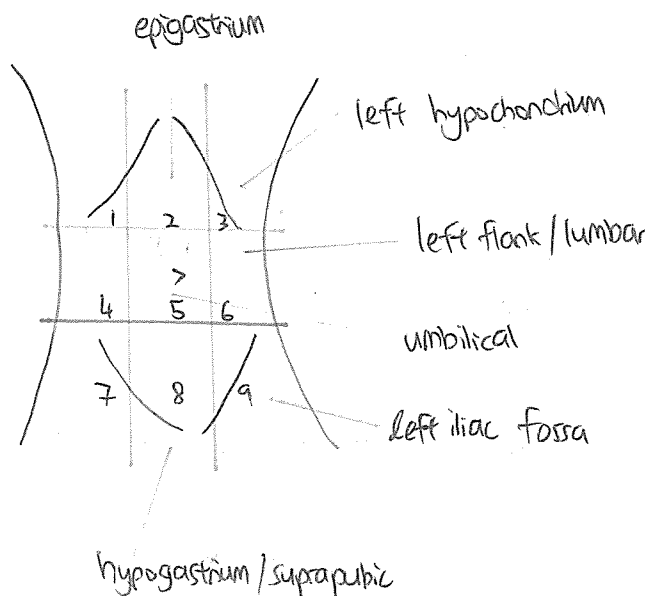
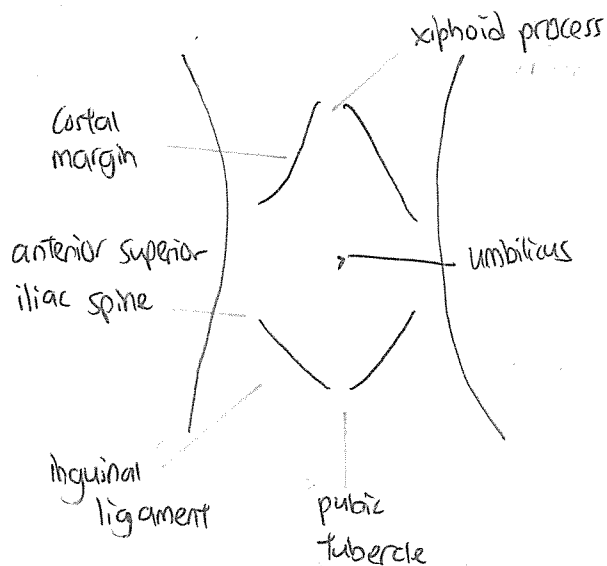


Anterior Abdominal Wall

→ Surface Landmarks of abdominal regions

midclavicular lines
subcostal lines
intertubercular lines



Layers of the Anterior Abdominal Wall

fascia = fibrous tissue
ligament - bone to bone
tendon - bone to muscle
aponeurosis - flat tendon

Superficial fatty layer (vary in different individuals)

transversalis fascia

skin

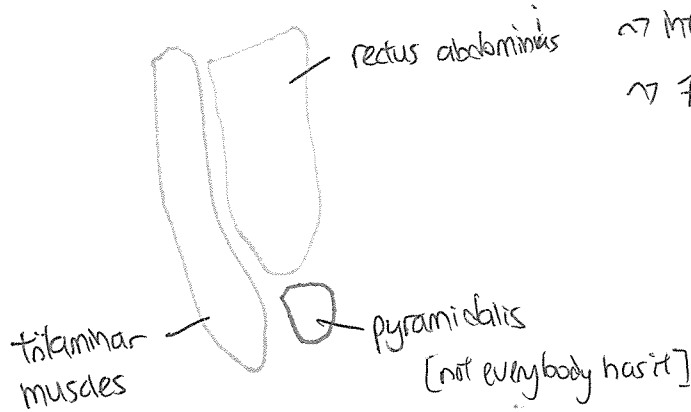
(Scarpa's fascia) → Deep membranous layer of subcutaneous tissue
↳ used by surgeons to stitch

Parietal peritoneum

Extrapertoneal fat

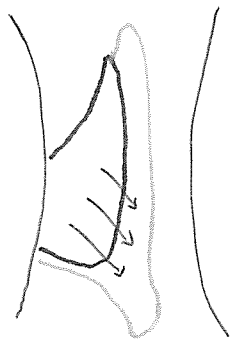
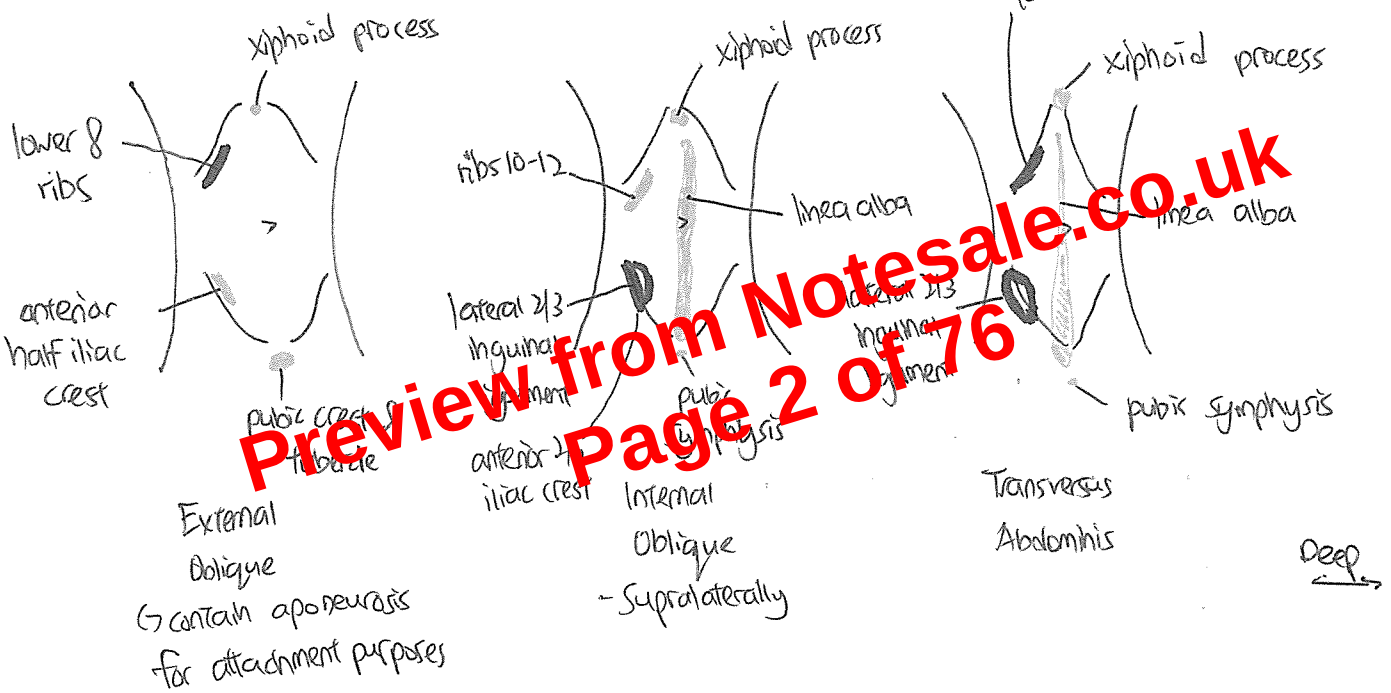
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Muscles of the Anterior Abdominal Wall

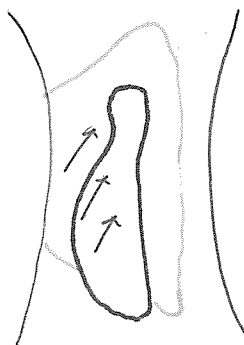


- External oblique
 - Internal oblique
 - ~~Trans~~ Transversus Abdominis
- } trilaminar muscles

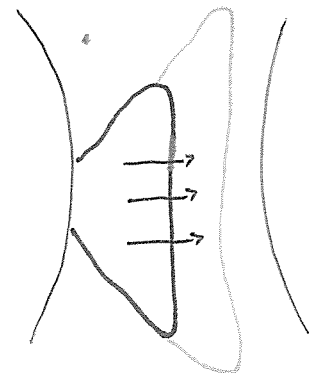
Trilaminar Muscles: → Deep — origin — end



- downward & inwards

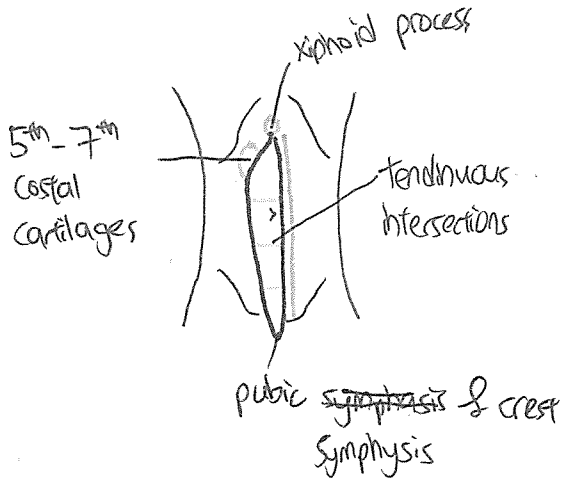


- upwards & outwards



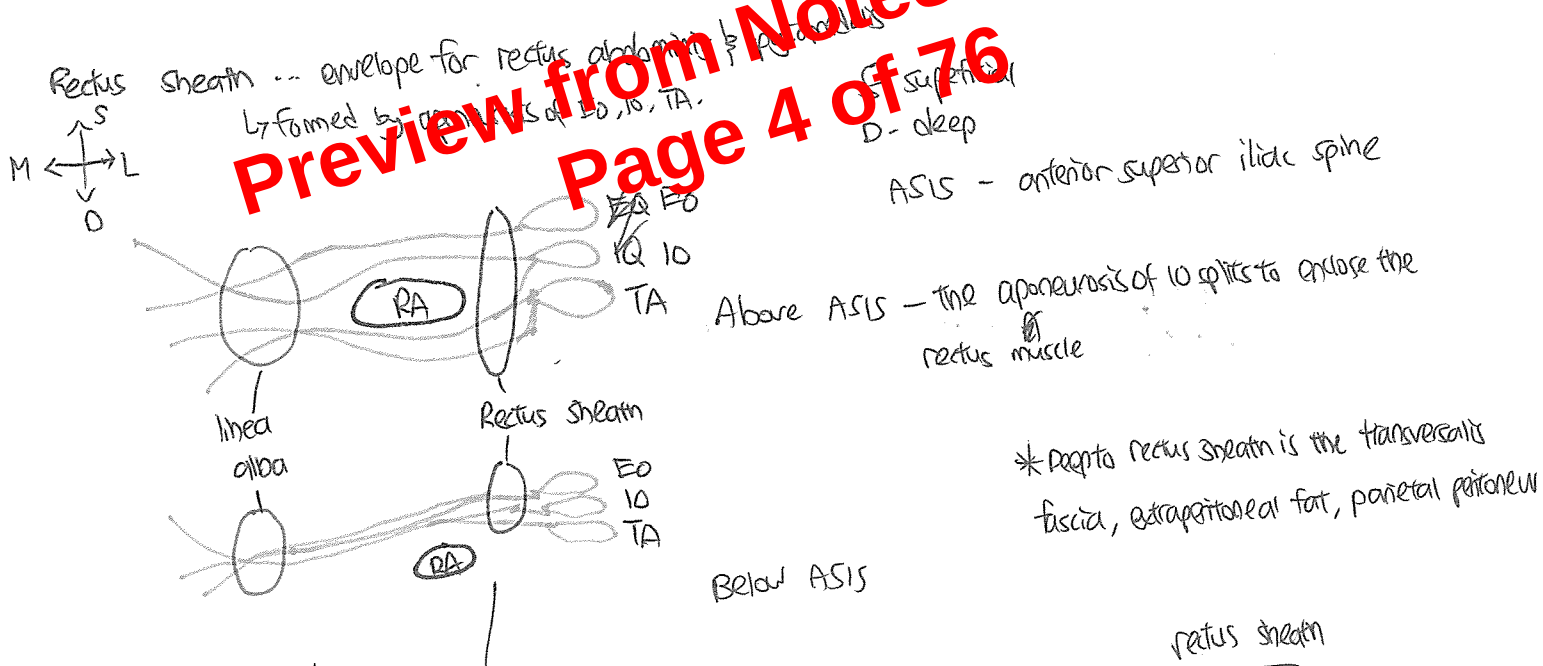
- horizontal

Rectus Abdominis



- rectus abdominis muscle has tendinous intersections
- linea alba separates the 2 rectus muscles
- when rectus abdominis muscle contracts, its lateral margin forms a curved ridge that often can be seen - linea semilunaris [from tip of 9th costal cartilage to pubic tubercle]

Muscle	Origin	Insertion	Nerve Supply	Action
Rectus Abdominis	Pubic symphysis & crest	5th-7th costal cartilages & xiphoid process	T6-T12	compress abdominal contents, flexes vertebral column, accessory muscle of respiration
Pyramidalis ↳ NOT everyone has it	Front of pubic and pubic symphysis	linea alba	T12	Tenses linea alba



swelling of clotted blood within the tissue

↑
Hematoma of rectus sheath may

occur following a blunt trauma to the abdominal wall.

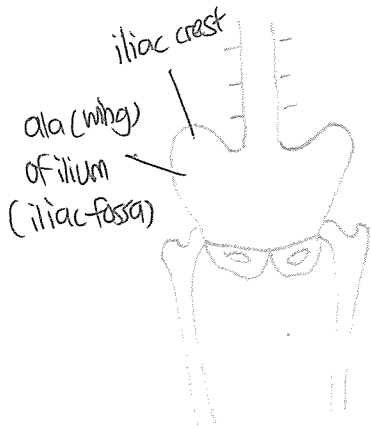
Source of bleeding is usually = inferior epigastric vein / artery

envelope is deficient posteriorly, allowing space for blood supply

rectus sheath

- above costal margin, anterior wall is formed by Eo aponeurosis while posterior wall is formed by thoracic wall < 5th-7th costal cartilages & intercostal spaces

3 muscles $\leftarrow$ Quadratus lumborum
Psoas major + minor
Iliacus



Quadratus Lumborum

Origin: iliac crest, ilio-lumbar ligament, tips of transverse process of lower lumbar vertebrae
Insertion: transverse process of L1-L4, 12th rib
Function: lateral bending of trunk; holds 12th rib down during inspiration hence aids in inspiration

Iliacus

Origin: Ala of Ilium
Insertion: lesser trochanter of the femur
Function: flexion of thigh at hip joint
Innervation: Femoral nerve, a branch of lumbar plexus

not best part of cow for tender steak

Psoas Major

Origin: lateral surface of T12 to L5
Insertion: lesser trochanter of the femur
Function: flexion of thigh at hip joint

* Not everyone has psoas minor (anterior to psoas major)
origin: ~~lateral surface of T12~~ ^{transverse process of T12}

muscle + a long tendon

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* all these 3 muscles innervated by lumbar plexus
iliacus + psoas major $\rightarrow$ iliopsoas

Arteries:

Abdominal aorta and its main branches:

1) Unpaired branches to digestive organs
Superior $\uparrow$ celiac trunk - eg stomach, liver, spleen
Superior mesenteric artery - eg: duodenum, jejunum
Inferior $\downarrow$ inferior mesenteric artery - eg: des. colon, rectum

2) paired branches to organ
suprarenal, renal $\frac{1}{2}$ gonadal arteries
[3 paired lateral branches]

middle suprarenal arteries - supply suprarenal gland
renal arteries - supply the kidneys
testicular / ovarian arteries - supply testes / ovaries

3) 4 Paired branches to posterior structure

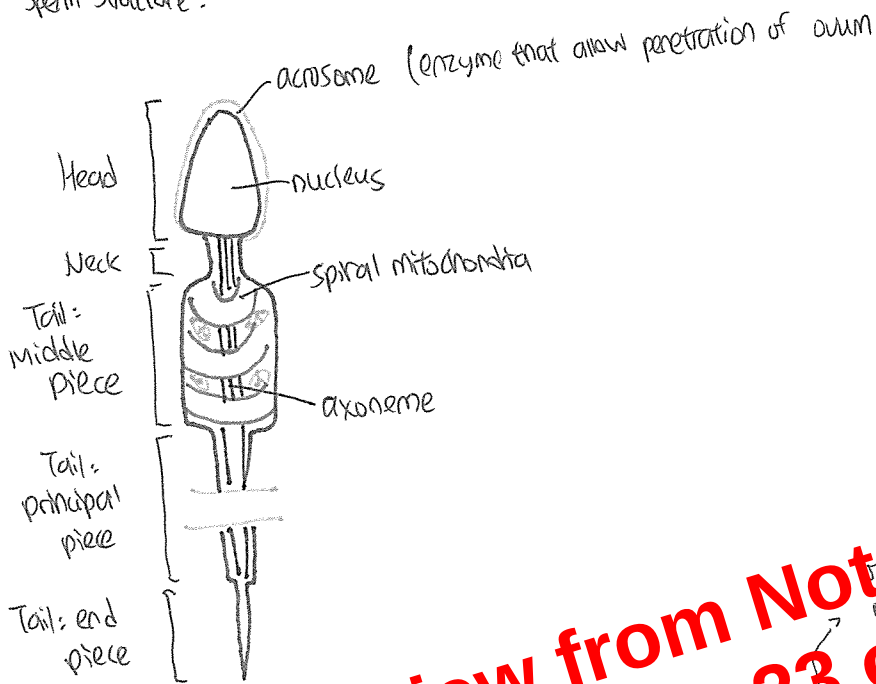
Lumbar arteries $\rightarrow$ usually four pairs of lumbar arteries that supply the posterior abdominal wall

Inferior phrenic artery

Spermatogenesis

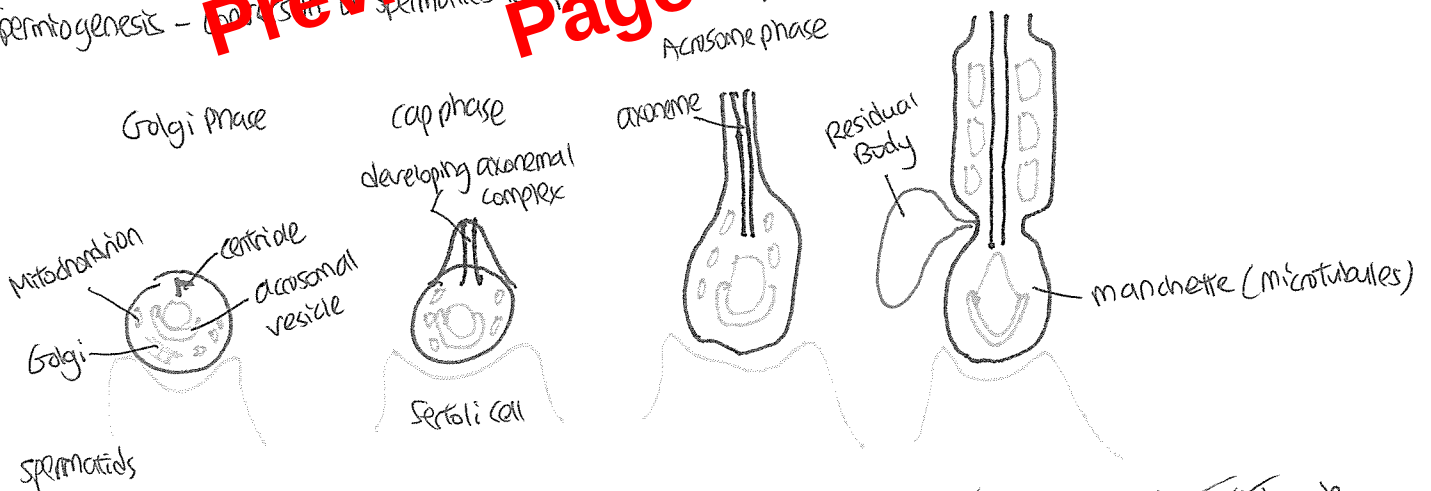
- Mitosis (spermatocytogenesis) $\rightarrow$ ~~divide~~ diploid spermatogonia (stem cells) duplicate themselves forming diploid primary spermatocytes
- 1st phase of meiosis $\rightarrow$ The 1^o spermatocytes divide to form 2 haploid daughter cells - Secondary spermatocytes
- 2nd phase of meiosis $\rightarrow$ The 2^o spermatocytes divide to form 4 haploid daughter cells - Spermatozoa

Sperm Structure:



Spermatogenesis - process of spermatids to spermatozoa

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- $\rightarrow$ axoneme extends & mitochondria align
- $\rightarrow$ Sertoli cells phagocytose residual body of cytoplasm
- $\rightarrow$ Sperm released

$\rightarrow$ Sertoli cells digest the cytoplasm in the head

- $\rightarrow$ Centrioles elongate to become tail of the sperm. A temporary structure "manchette" assists in this elongation
- $\rightarrow$ Nucleosomal histones replaced by protamines

Blastocyst

- Comprised of outer trophoblast and inner embryoblast
- trophoblast becomes foetal component of placenta
- embryoblast splits to become bilaminar embryonic disc
- cells of ~~the~~ this disc develop into embryo proper
- in 3rd week cranio-caudal primitive streak forms
- cells migrate into streak — leads to trilaminar disc

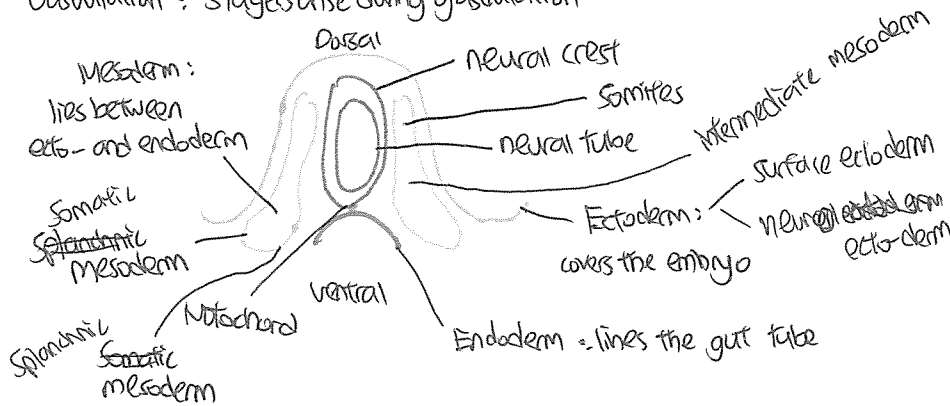
Rostral, towards the nose

blastocoel - hollow part of blastocyst

trophoblast → umbilical cord,
(thicker) amnion
chorion

embryoblast →
(thinner)

Gastrulation: 3 layers arise during gastrulation



Ectoderm — covers the embryo, continuous w the amnion

FATE: epidermis of skin (hair, nails and skin gland)

Mesoderm

FATE: muscles, bones, and connective tissue

Somites: paired mesoderm blocks that lie lateral to the neural tube

Neuroectoderm: Neural tube and neural crest tissue derived from ectoderm

- neural crest tissue is unique to vertebrates

- Notochord: cranio-caudal stiffening rod that is characteristic of chordates

FATE: nucleus of pulposus of IV discs during infancy

- Neural crest: dorso-lateral to neural tube

FATE: PNS, structures in head & neck

- Neural tube: FATE → CNS (spinal cord + brain)

Intermediate mesoderm — lies lateral to notochord, ventral to the somites and dorsal to the lateral plate

FATE: kidneys, ureters and gonads

- between somites and the lateral plate

Lateral plate mesoderm: surrounds coelom (body cavity)

Splanchnic mesoderm — visceral (inner)

Somatic mesoderm — parietal (outer)

pleurae, peritoneum
smooth muscles
of heart

FATE: heart, blood vessels, gut musculature and lining of body cavities

Spina bifida → failure of neural tube to close, meningeals pop out

Notochord — derived from mesoderm
↳ signalling centre for development of anterior-posterior axis

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Longitudinal Muscles

- 3 muscles that run in a vertical direction
 - Salpingopharyngeus
 - palatopharyngeus
 - stylopharyngeus
- Salpingopharyngeus and palatopharyngeus lie medial to the constrictors
- Stylopharyngeus passes between the superior and middle constrictors before merging with the palatopharyngeus

salpinx-tube

Salpingopharyngeus

O: auditory tube

I: lateral pharyngeal wall

Action: elevates pharynx and assists in opening of auditory tube

Innervation: vagus nerve (pharyngeal plexus)

Palatopharyngeus

O: palatine aponeurosis

I: posterior aspect of the thyroid cartilage and lateral pharyngeal wall

A: elevates pharynx & larynx / depresses soft palate?

Innervation: vagus nerve (pharyngeal plexus)

Stylopharyngeus

O: styloid process of the temporal bone

I: posterior aspect of the thyroid cartilage and lateral pharyngeal wall

Action: elevates pharynx and larynx

Innervation: glossopharyngeal nerve

Pharyngeal plexus

• Nerve plexus consisting of

motor fibres from vagus

Sensory fibres from glossopharyngeal

Parasympathetic fibres from glossopharyngeal

Sympathetic fibres from superior cervical ganglion

• located in buccopharyngeal fascia, superficial to constrictor muscles

Vascular supply of the pharynx

Arteries - supplied by 4 branches of the external carotid artery

1) ascending pharyngeal

2) maxillary → pharyngeal branches

3) Facial → ascending palatine and tonsillar branches

4) superior thyroid + inferior thyroid

venous drainage via pharyngeal plexus of veins then to pterygoid plexus of veins or internal jugular or facial

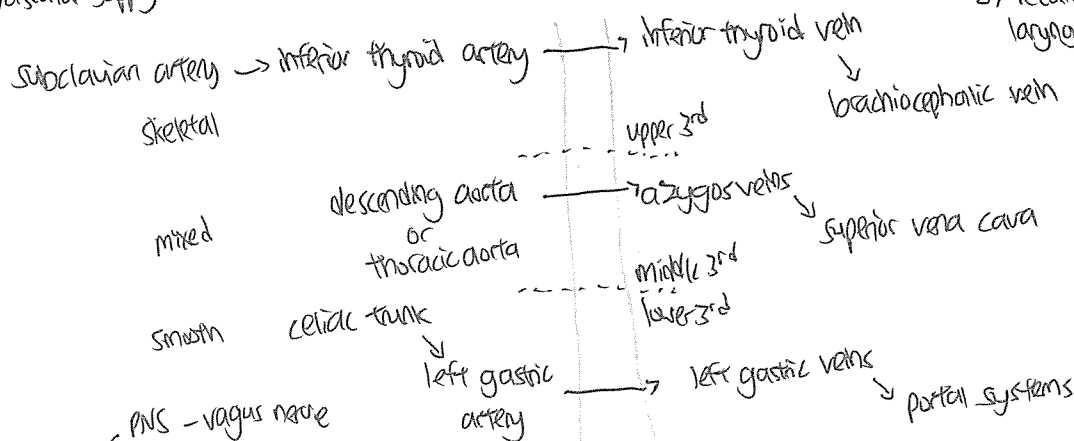
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Oesophagus

- muscular tube, 25-30cm long, forms a passageway for food
- extends from laryngopharynx to the stomach (C6-T10)
- passes through diaphragm at the oesophageal hiatus (T10)
- along its length it passes through the neck, thorax and abdomen

Achalasia: muscles of lower $\frac{1}{3}$ of oesophagus fail to relax due to degeneration of Auerbach's plexus

Vascular supply



Nerve Supply Lymphatic drainage:

→ recurrent laryngeal nerves → deep cervical nodes

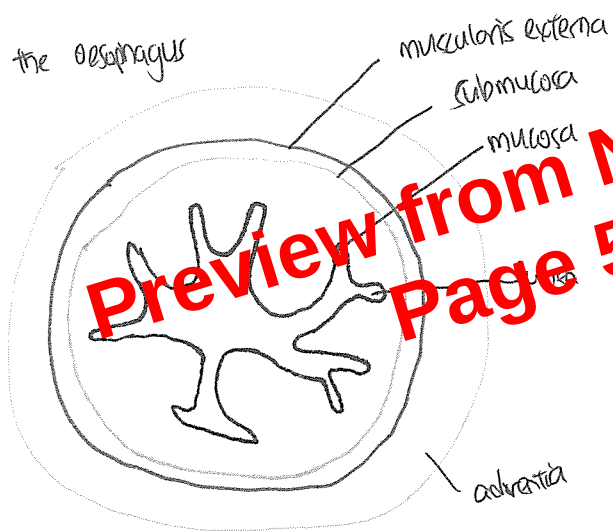
→ superior and posterior mediastinal nodes

→ coeliac nodes

Innervation { PNS - vagus nerve
SUS - sympathetic trunk

- stratified squamous epithelium provide protection

Histology of the oesophagus



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- 1) cricoid cartilage of larynx
- 2) left bronchus and aorta cross the front of oesophagus
- 3) where oesophagus enters the stomach

Mucosa

- non-keratinised stratified squamous epithelium
- protective loose connective tissue
- lamina propria - contains oesophageal cardiac glands which secrete mucus to protect against acid reflux

- muscularis mucosa - smooth muscle

Adventitia - loose connective tissue layer

Serosa - lower $\frac{1}{3}$

Submucosa

- loose connective tissue layer containing blood vessels and the submucosal nerve plexus
- contains oesophageal glands which secrete mucus to aid passage of food (bolus)

Muscularis externa

- inner circular, outer longitudinal fibers
- upper 3rd - skeletal muscle (glossopharyngeal CN IX)
- middle 3rd - skeletal and smooth muscle
- lower 3rd - smooth muscle (vagus CN X)

Omentum

- double fold of peritoneum that attaches stomach to another organ
- the lesser omentum extends from lesser curvature to the liver (ligamentum venosum & porta hepatis)
- the greater omentum extends from greater curvature to the transverse colon
- gastrosplenic omentum extends from greater curvature to the spleen

How is the mucosa protected from the acidic environment?

- 1) The surface cells and the cells of the pits produce a protective mucous layer
- 2) surface epithelial cells possess tight intercellular junctions
- 3) Rich submucosal vasculature - provides bicarbonate ions, nutrients and O_2 and remove toxic products

Stretching of stomach due to ingestion → stimulates the myenteric nerve plexus (Auerbach's) in pyloric sphincter to relax

Mucosa

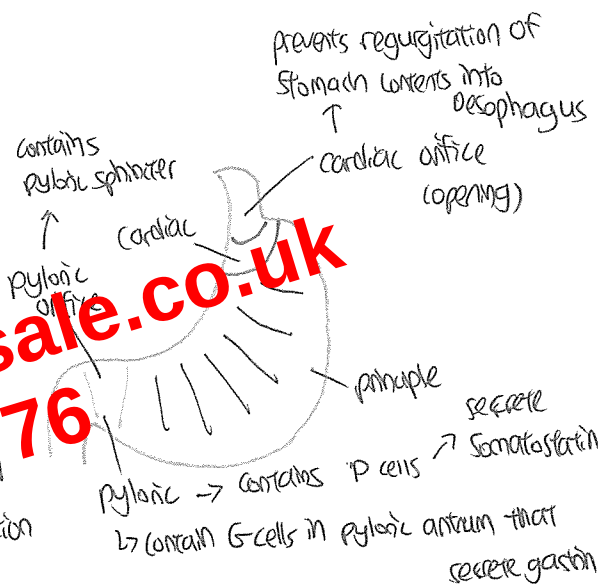
- 3 distinct histological zones
- Contains rugae
- Cardiac - branched tubular glands with coiled secretory portions
- Pyloric - branched tubular glands with coiled secretory portions
- Principle - branched tubular glands

- Secrete mucus and lysozyme

- long pits

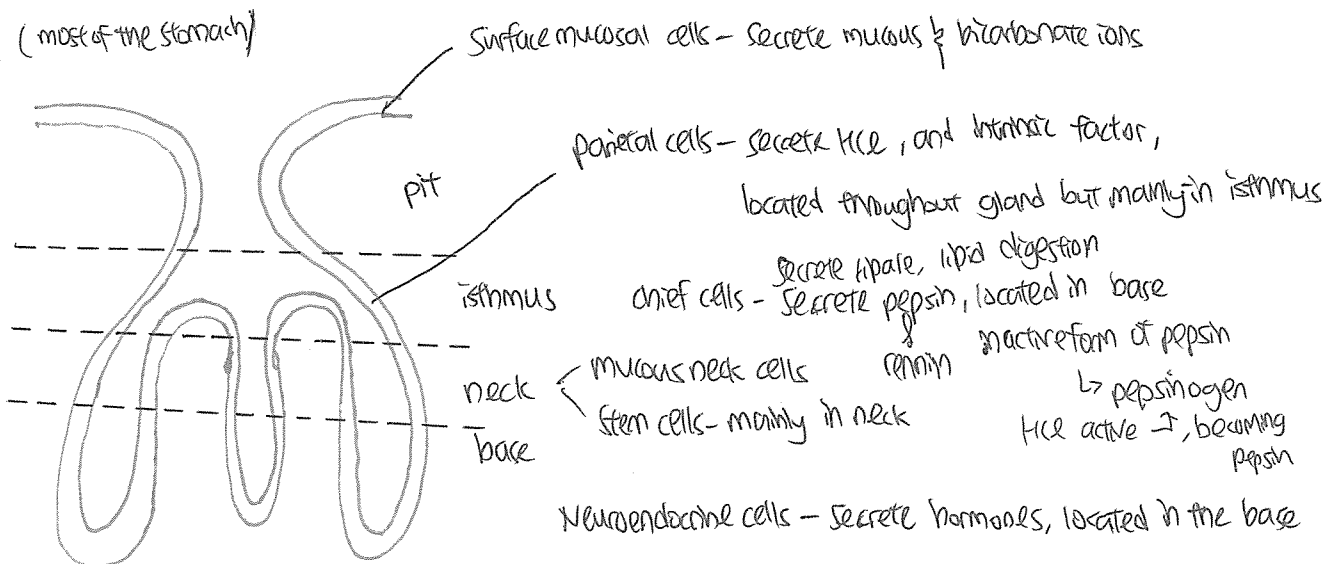
- Secrete mucus, lysozyme & gastrin

- Principle - branched tubular glands



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Gastric Glands (most of the stomach)



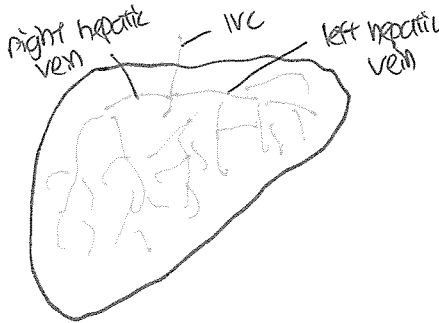
these cells are changed entirely between 4-7 days (high turnover)

* gastrin release is inhibited by amino acids

Flow of Blood and Bile

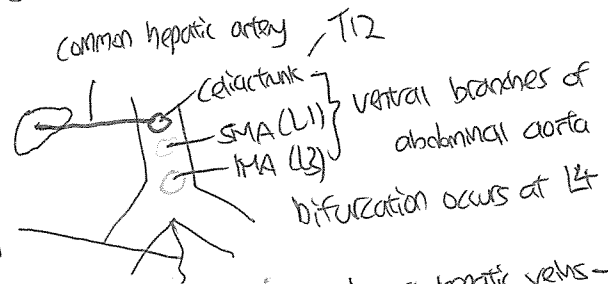
- Blood is brought to the lobule by branches of the hepatic artery and portal vein
- passes through sinusoid to central vein - nutrients, O_2 , toxins picked up by hepatocytes en route
- Blood flows from central veins to the hepatic veins and then to IVC
- Bile is secreted by hepatocytes into bile canaliculi (large intercellular spaces)
- Blood and bile flow in opposite direction

Dual blood supply to liver
[lungs also have dual blood supply]
Venous drainage of liver



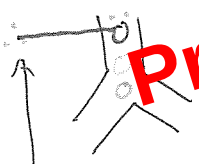
interlobular biliary ducts → bile ductule → ~~bile ducts~~ hepatic ducts

common hepatic artery (30%)
hepatic portal vein (70%)
median sacral artery: avascular structure in man



* blood flow central veins drain into right & left hepatic veins → IVC
hepatic portal vein (nutrient rich)
hepatic vein (deoxygenated)

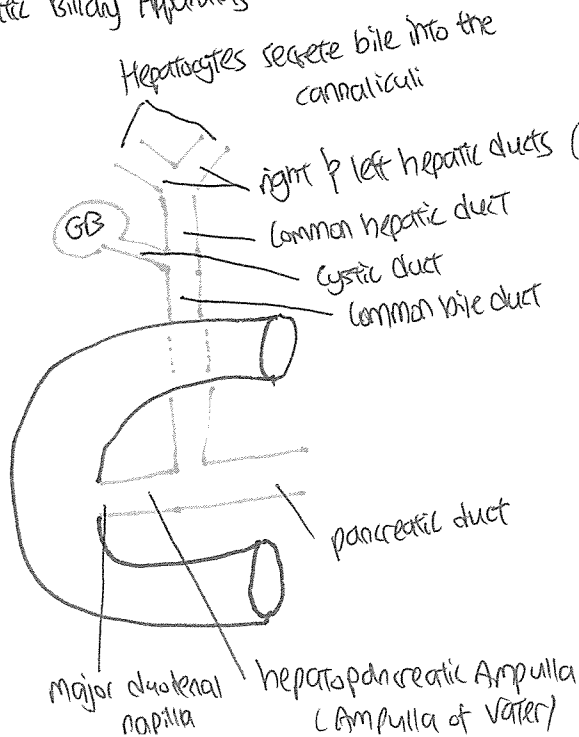
Lymph Drainage and Nervous Innervation



Sympathetic fibres pass in greater splanchnic nerve to coeliac plexus → hepatic plexus
parasympathetic fibres vagus nerve
- anterior vagal trunk → a large branch = hepatic branch

Hepatic nodes → celiac nodes → intestinal trunk → aorta arch → anterior thoracic duct
* liver produces $\frac{1}{3}$ - $\frac{1}{2}$ of body's lymph
* lymph from bare area → posterior mediastinal lymph nodes

Extrahepatic Biliary Apparatus



* cystic duct contains mucosal foldings → spiral valve which function to keep lumen constantly open

Swallowing (Deglutition)

3 stages - 1) oral phase

2) pharyngeal phase

3) oesophageal phase

aspiration - food enter vocal chord

use coughing to remove things from vocal chord

oral phase

- Voluntary
- lips brought together and teeth occluded
- bolus formed and moved into oropharynx
- oropharyngeal seal established

• lips brought together (orbicularis oris)

• teeth occluded (masseter, temporalis, medial pterygoid)

• bolus formed (intrinsic muscle of tongue)

Pharyngeal phase

- involuntary
- velopharyngeal (nasopharyngeal) seal established
- pharynx shortened & widened, larynx elevated
- laryngeal inlet narrowed and glottis closed
- bolus moved ~~into~~ through pharynx into oesophagus

glottis - space between vocal chords

oesophageal phase

- involuntary
- bolus moved into stomach
- respiratory passage reopened
- larynx repositioned

oropharyngeal isthmus sealed

• oropharyngeal isthmus narrowed and posterior part of tongue elevated

↳ palatoglossus

Muscles used in swallowing

oral phase - bolus moved into oropharynx

- elevation of the hyoid bone raises the tongue to the roof of the mouth

and presses the bolus against the hard palate

↳ mylohyoid and anterior & posterior digastric

• shape of tongue altered to form a trough - genioglossus

• sides of tongue elevated to assist in trough formation - styloglossus

• tip of tongue pressed against maxillary incisors and hard palate - genioglossus

• tongue retracted and ~~bolus~~ bolus dragged posteriorly - styloglossus

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Mesenteries

- the mesenteries of ascending & descending colon are obliterated by fusion to posterior abdominal wall
- they become secondarily ~~per~~ retroperitoneal

Anal canal

- superior mucosa from hindgut & endoderm (endoderm)
- inferior mucosa from ectoderm of proctodeum
- therefore different arterial supply, venous drainage, lymphatic drainage and innervation
- sphincters from mesoderm

• pectinate line ~~def~~ was formerly cloacal membrane

Innervation of Gut

- neural crest forms the ANS
- migrates along well defined pathways
- migrate to the gut from dorsolateral to the neural tube
- migrate caudally to populate the gut

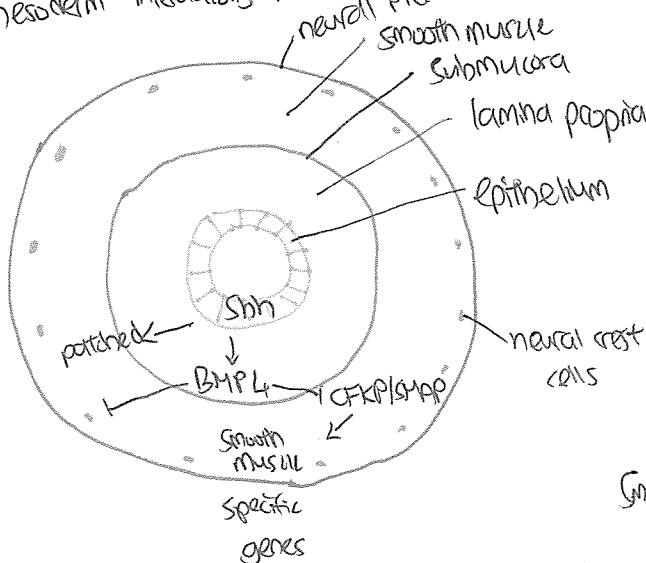
• Hirschsprung disease - failure of neural crest to migrate to the colon (reduced GI motility can lead to megacolon)

Anterior-posterior Gut patterning

- combinations of Hox genes are specific to particular regions of GI tract
- regional differences in gross morphology
- epithelium remains more plastic
- endodermal lining a single layer of cuboidal / columnar cells

- enclosing splanchnic mesoderm develops into muscle
- endoderm-mesoderm interactions involved to ensure appropriate plexus

Gut Patterning



amount of mucosa, submucosa, ...

4 concentric layers

- Mucosa
- Submucosa
- Muscularis (smooth muscle)
- Serosa

Shh emanates from the endoderm

Shh inhibits Smad: smooth muscle restricted to outer layer

Shh induces BMP4: enteric neural cells restricted to outer layer

Smad: smooth muscle activating protein