



Digestive system II.

Morphology

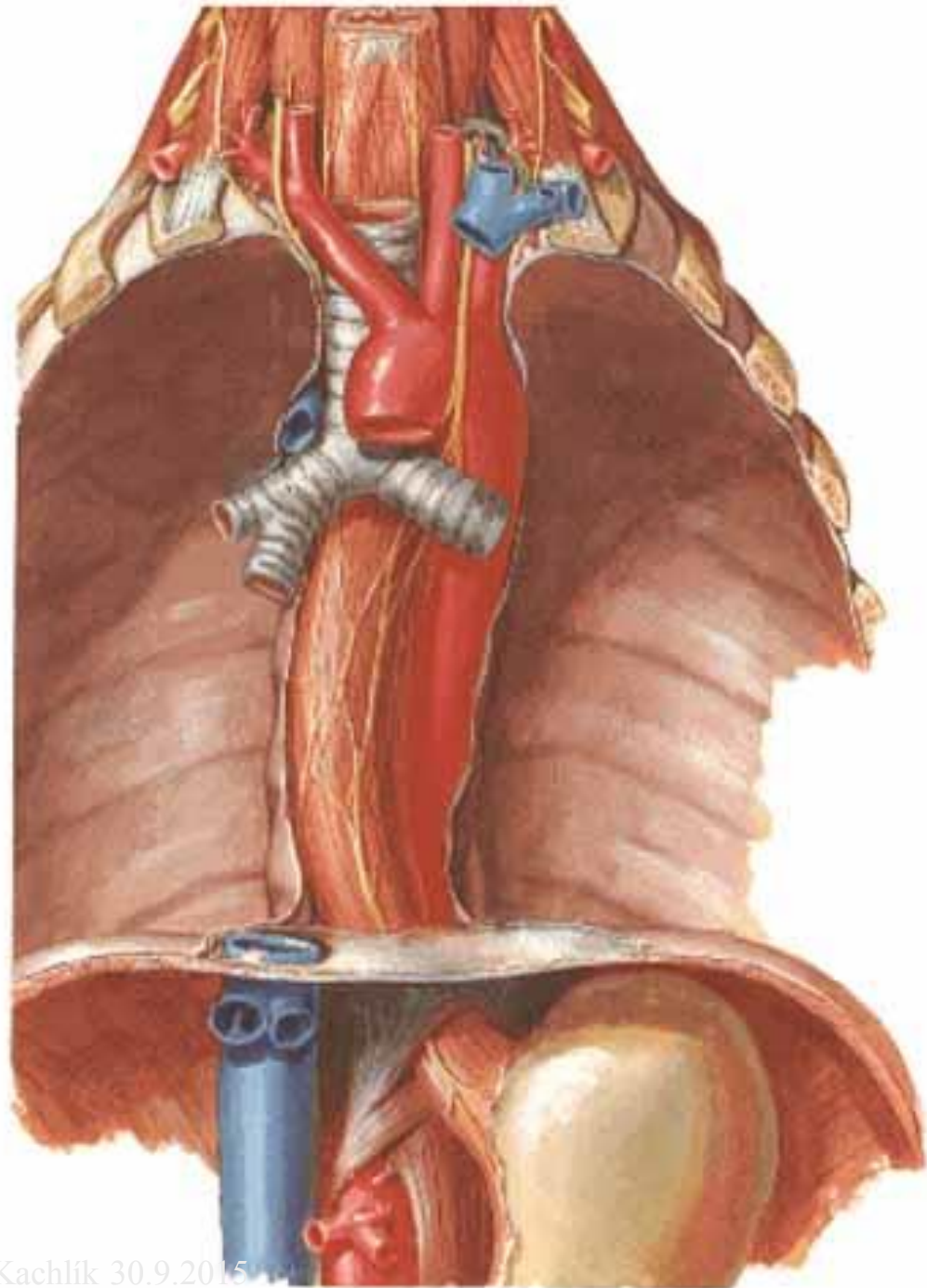


Digestive tube

- ▼ Oesophagus
- ▼ Stomach
- ▼ Small intestine
- ▼ Large intestine
- ▼ Rectum
- ▼ Anus

Oesophagus

- ✔ pars cervicalis, thoracica, abdominalis
- ✔ constictions: 3 permanent + 2 temporary
- ✔ position: relation to trachea, aorta, vertebral column, ductus thoracicus
- ✔ topography: superior + posterior mediastinum





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Oesophagus – *blood supply*

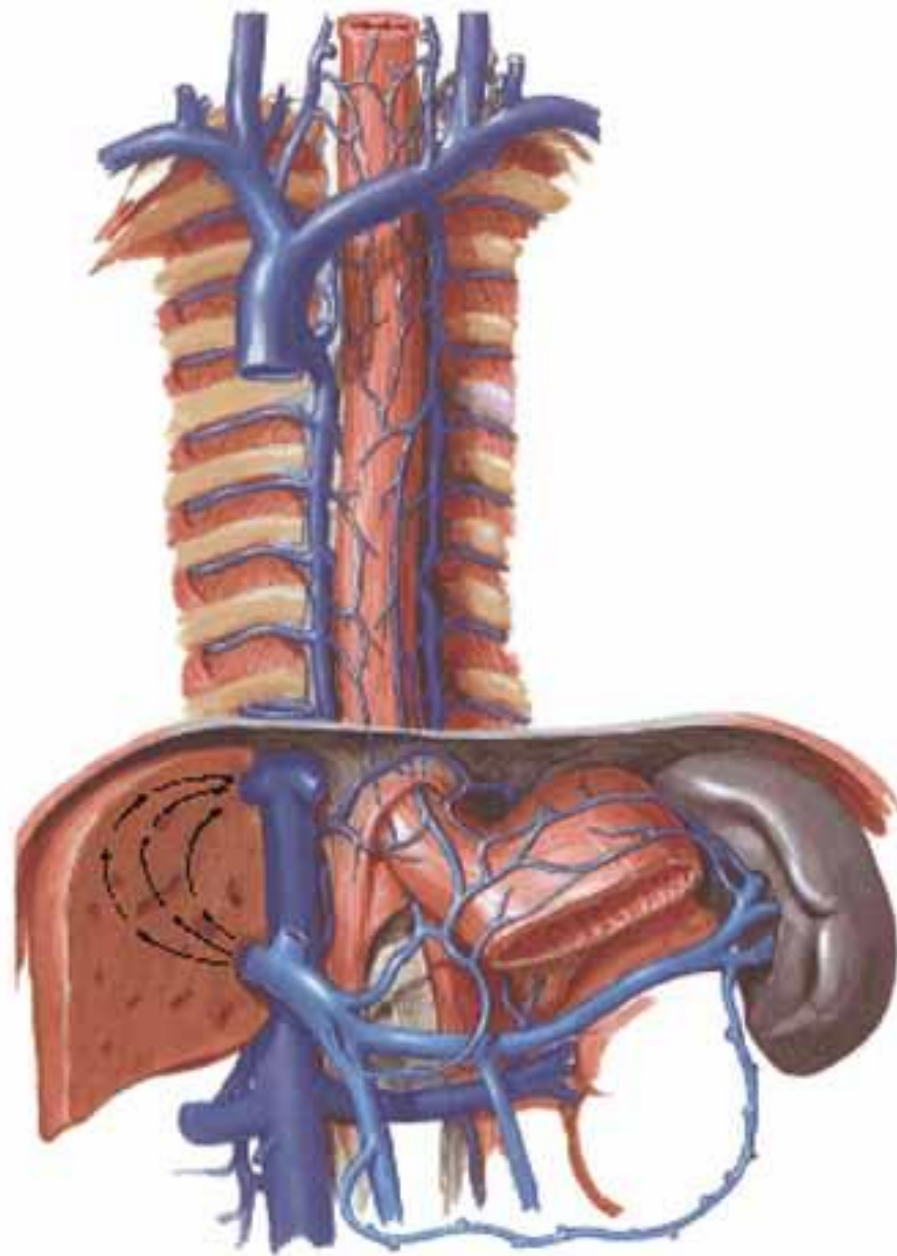
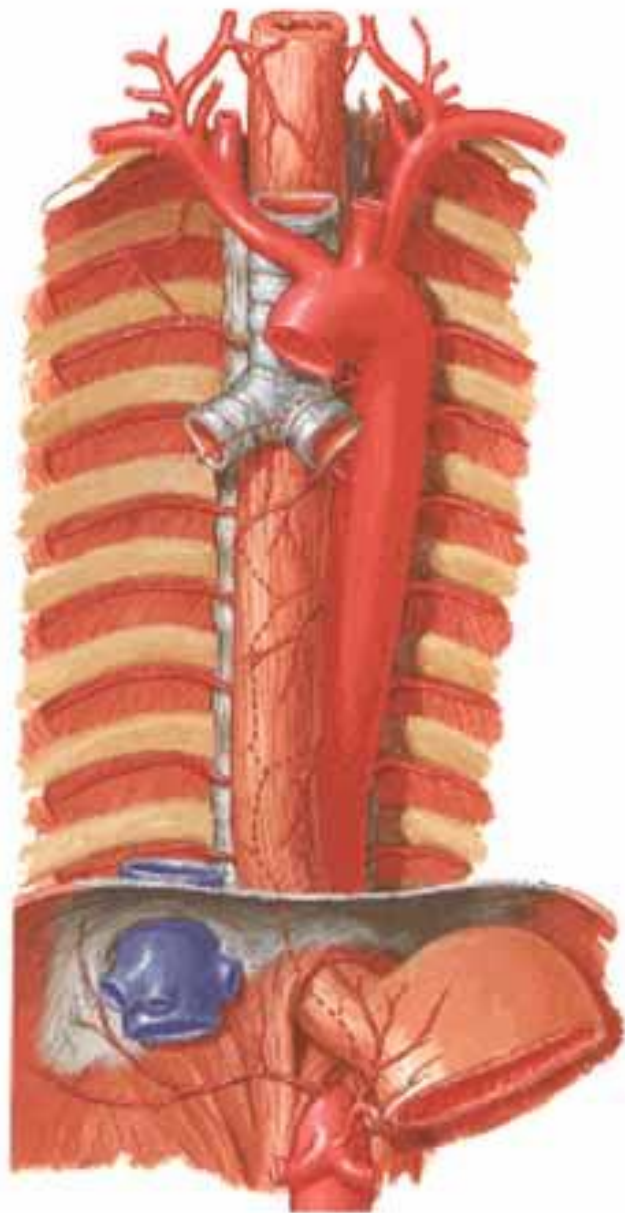
✓ Arteries:

- a. thyroidea inf.
- arcus aortae + aorta thoracica and their branches
- a. gastrica sin.

✓ Veins: vv. oesophageales

- vv. thyroideae inf.
- v. azygos + hemiazygos + hemiazygos acc.
- vv. gastricae breves

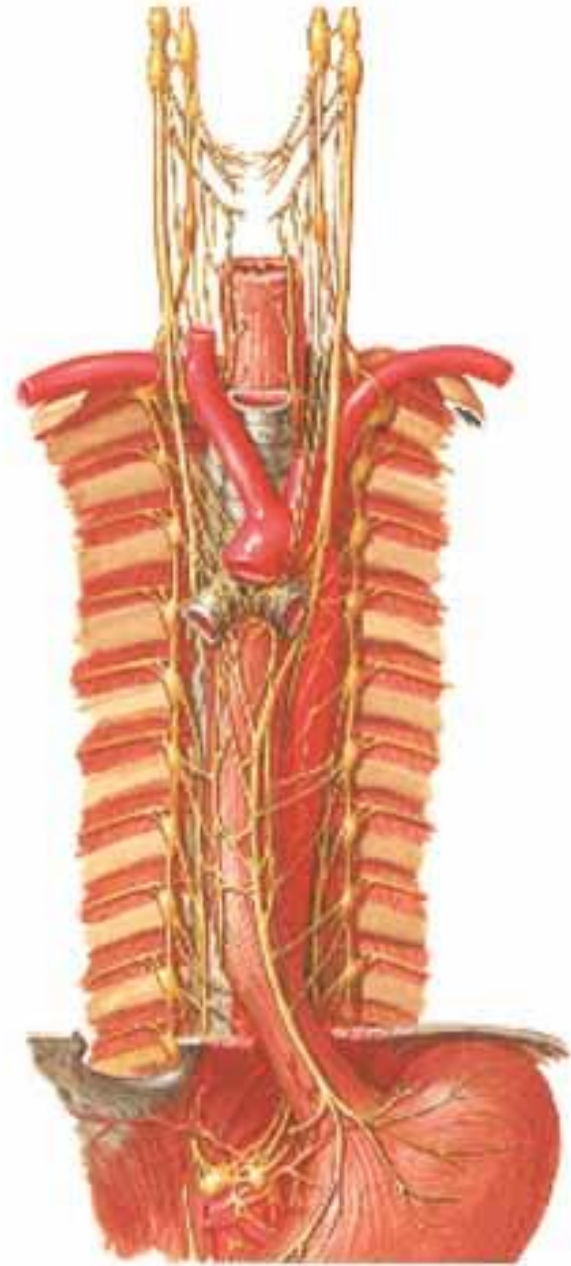
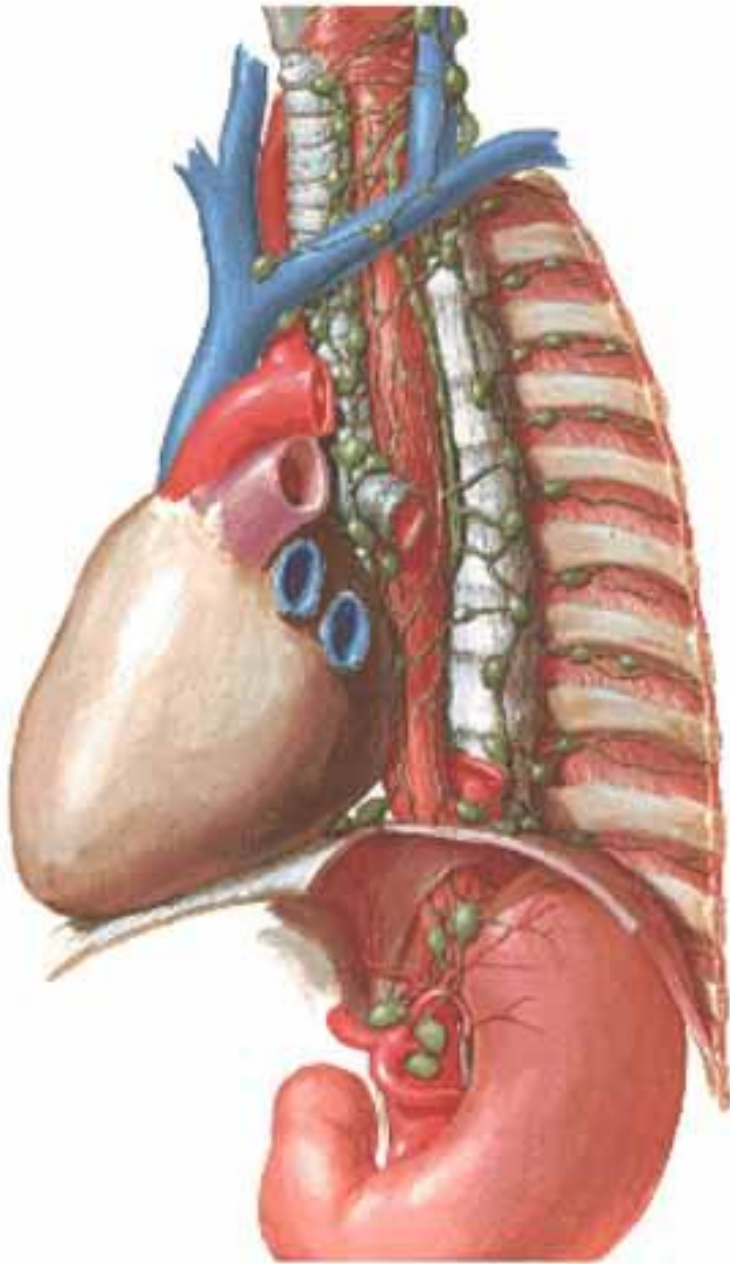
portocaval anastomosis – varices





Oesophagus – *Lymph and Nerves*

- ✓ Lymph: *nodes or directly into ductus thoracicus*
 - n.l. cervicales prof.
 - n.l. juxtaoesophageales + paravertebrales (= *n.l. mediastinales post.*)
 - n.l. gastrici sin.
- ✓ Nerves: **n.X** – plexus oesophageus – left anteriorly (rotation 90 degrees !) – *parasympathetic*
 - truncus sympathicus – *sympathetic + sensory*





Oesophagus – *wall structure*

- stratified squamous nonkeratinising epithelium
- lamina propria mucosae – distally oesophageal cardiac glands
- in submucosis mucinous glands - gl. oesophageae
- proximally skeletal musculature
- adventitia
 - serosa on the short abdominal part only





Oesophagus – *examination*

- ✓ endoscopy – rigid and flexible
 - Kilian's – 15 cm from teeth
 - transition to stomach - 40 cm from teeth
- ✓ X-ray – contrast with baryum
- ✓ oesophageal manometry
- ✓ pH-metry

- ✓ oesophageal echocardiography



Sites with weakened wall

▼ trigonum Killiani

- *cranially*: m. thyropharyngeus (m. constrictor ph. inf.)
- *caudally*: m. cricopharyngeus (m. constrictor ph. inf.)
- *diverticulum of Zenker (= pharyngo-oesophageal diverticle; dehiscence of Killian)*

▼ trigonum Laimeri

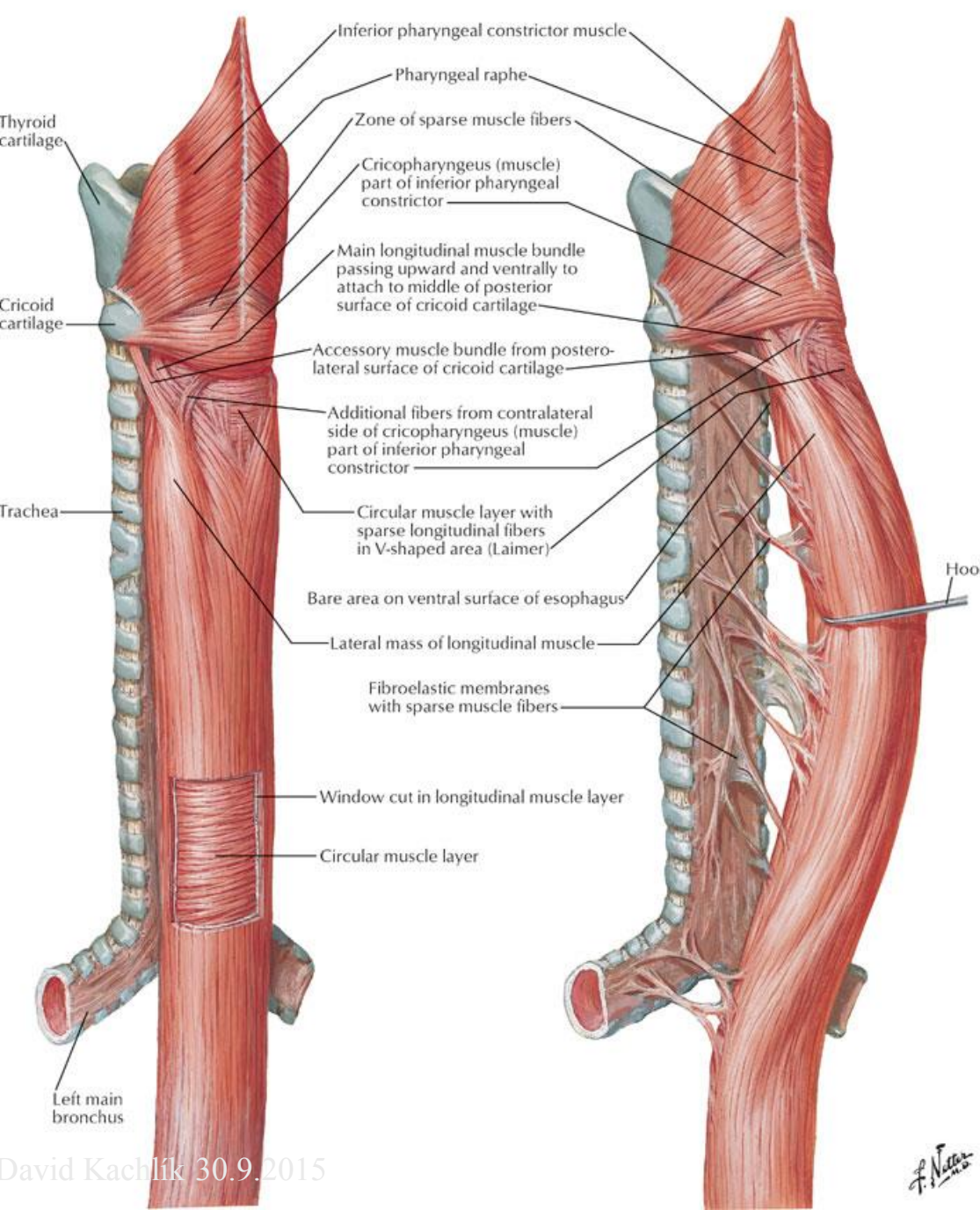
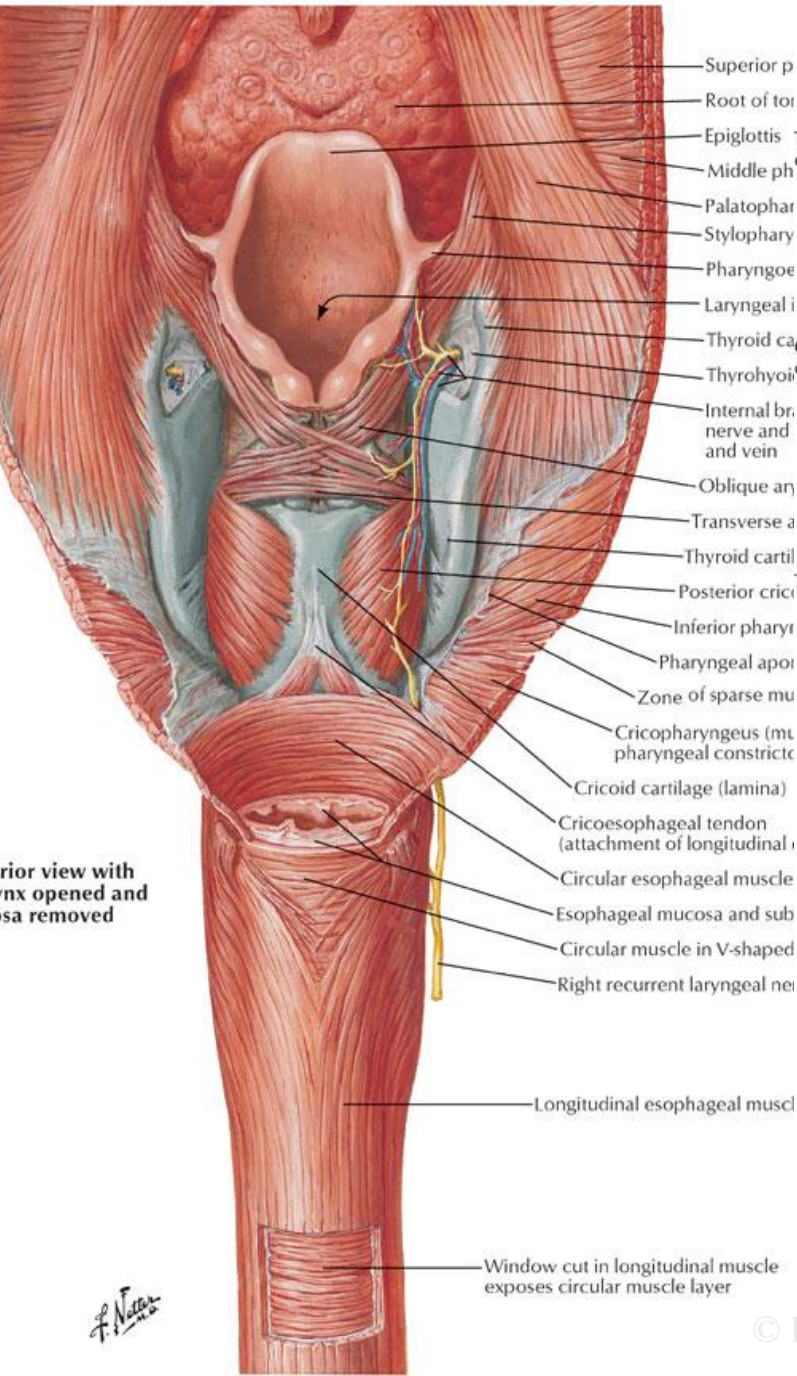
- *cranially*: m. cricopharyngeus
- *caudally*: upper oblique fibres of longitudinal muscle layer of oesophagus

▼ area Killian-Jamieson

- at lateral side of oesophagus
- *diverticulum of Killian-Jamieson*

Pharyngoesophageal Junction

Musculature of Esophagus



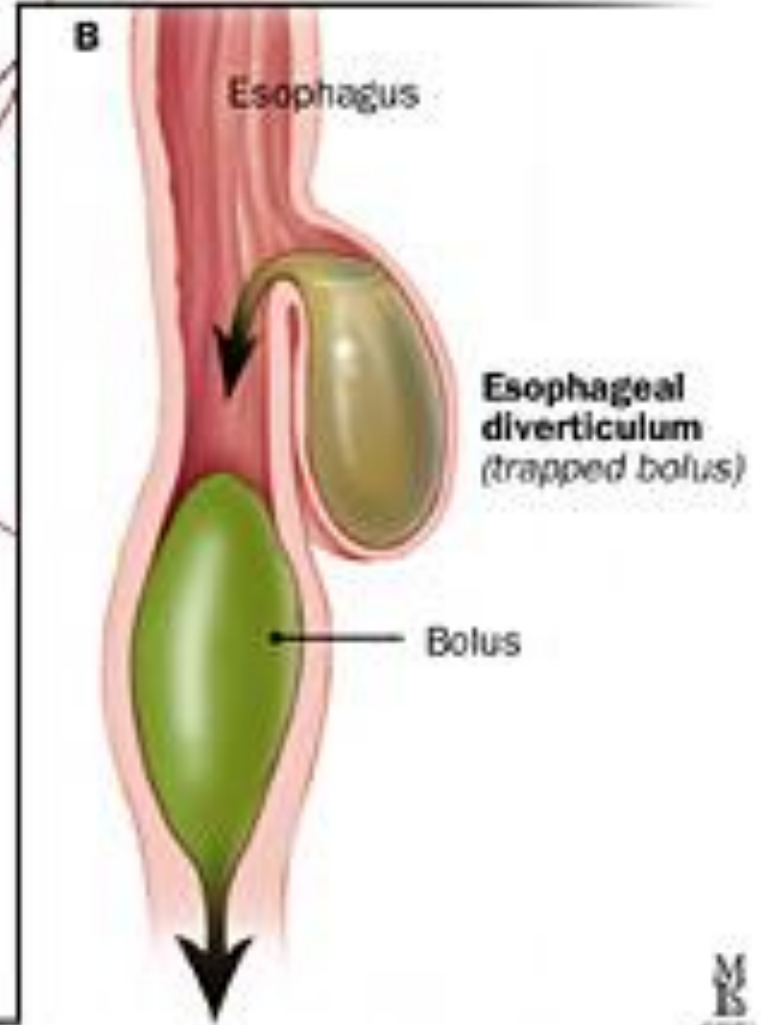
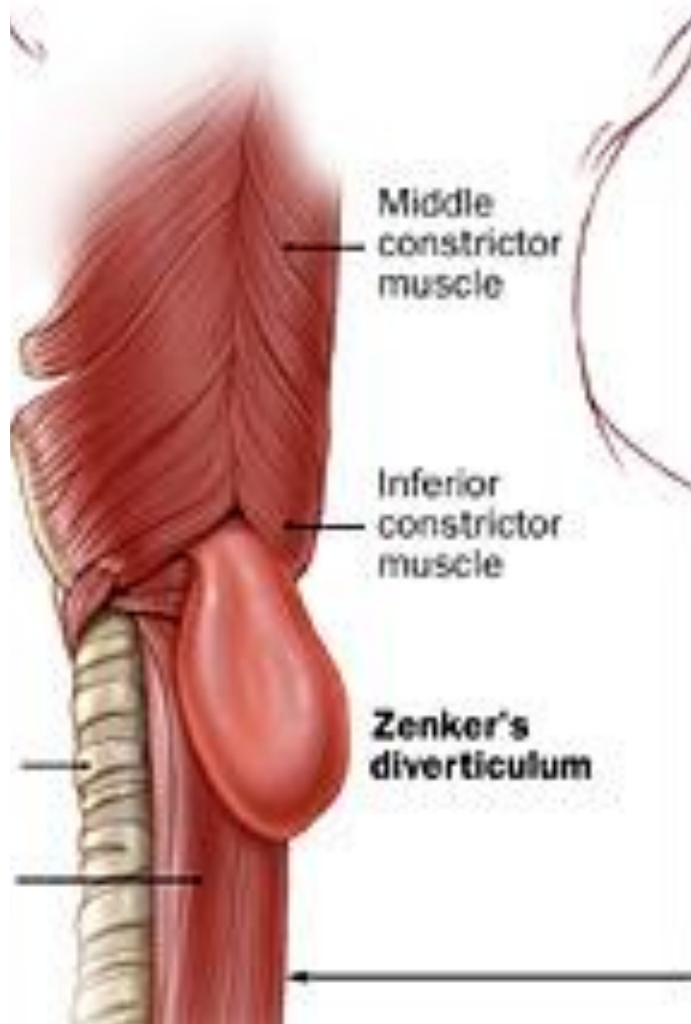
Anterior view with larynx opened and mucosa removed

F. Netter

F. Netter

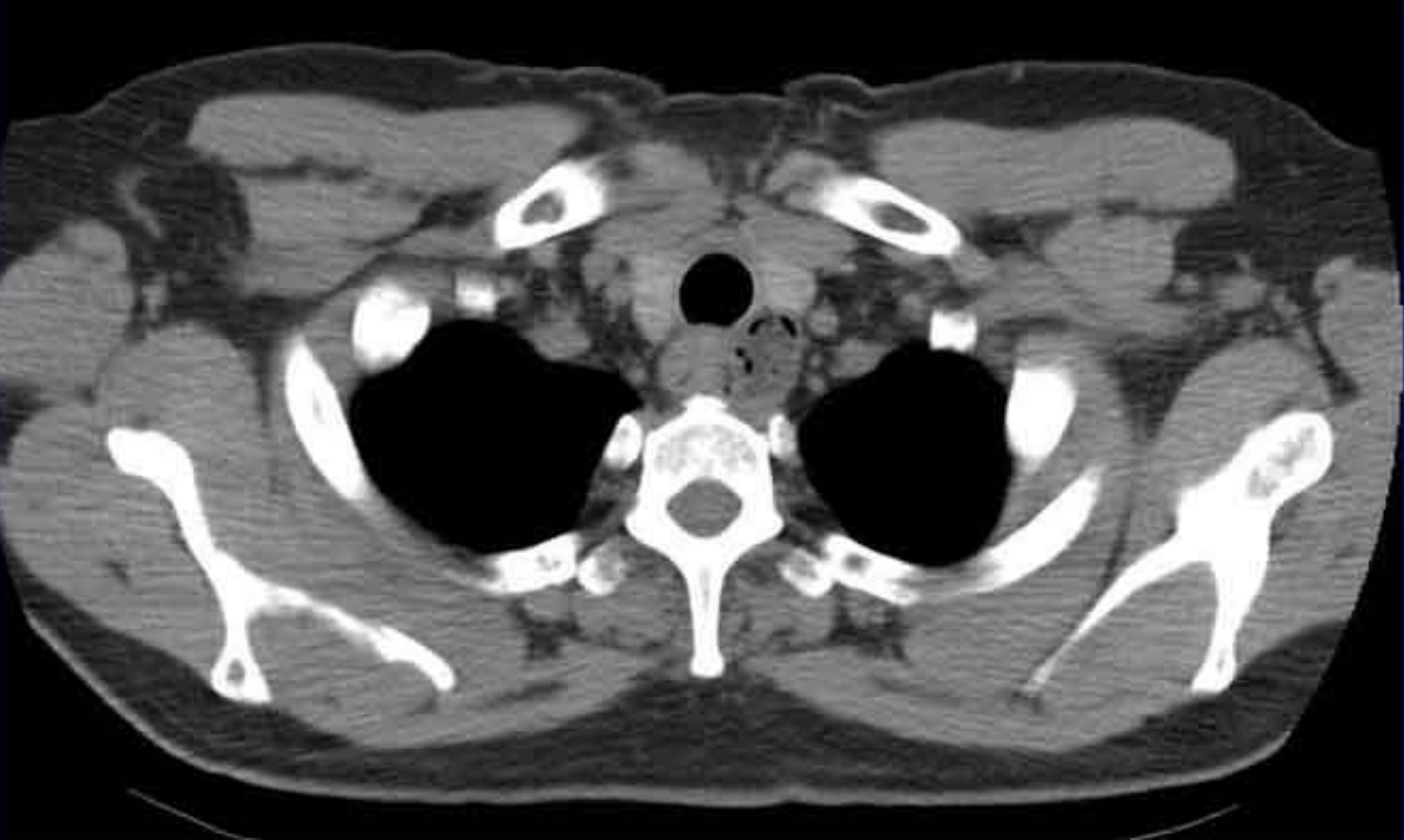


M
B
© 2015



M
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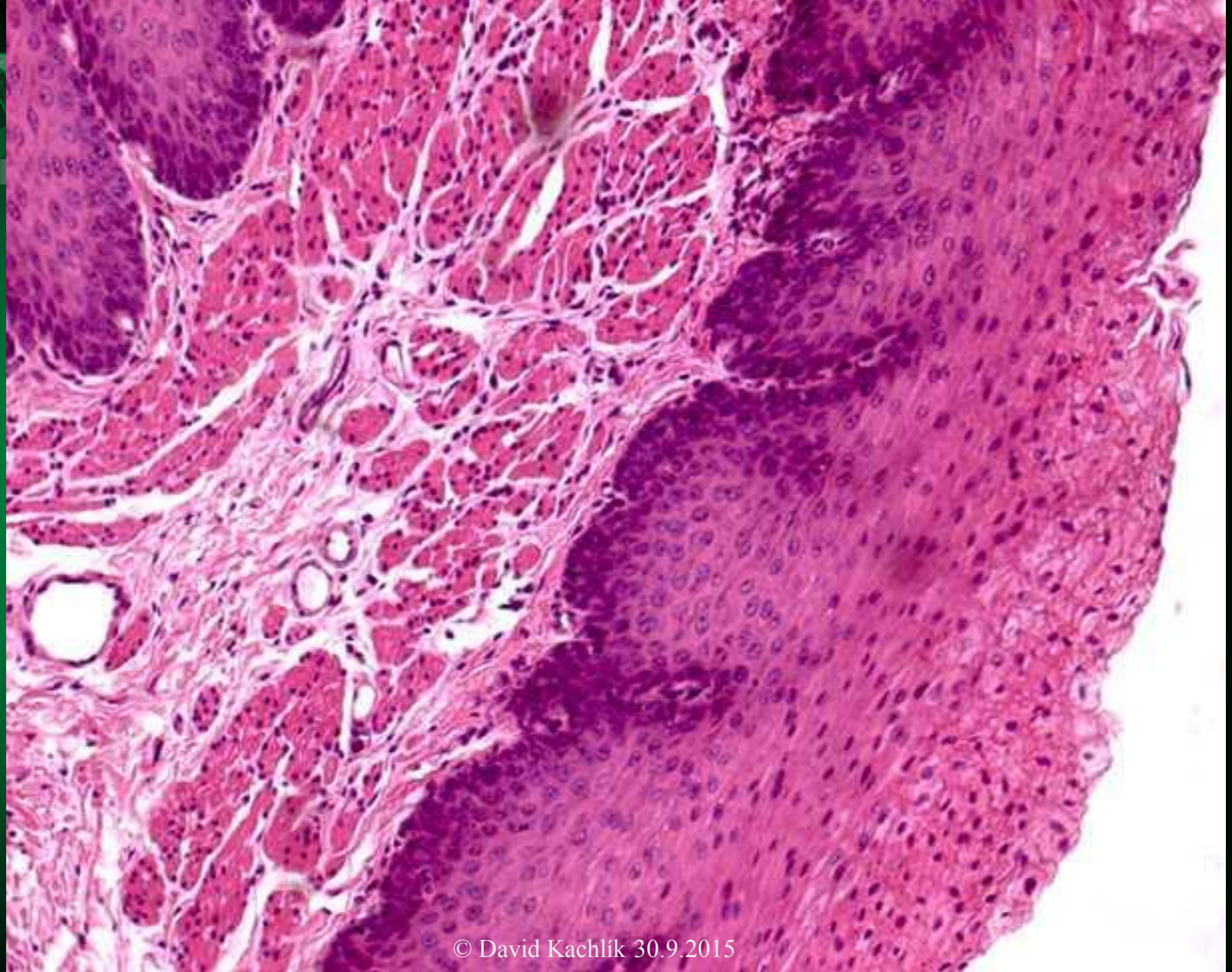




Oesophagus – *dis*

- ✓ *gastroesophageal reflux*
- ✓ *hernia in hiatus oesophageus*
- ✓ *varices*
- ✓ *diverticles – pulsatory (of Zenker), traction (of Rokitansky)*
- ✓ *tumors – stent, colon reposition*
- ✓ *lye/acid – mediastinitis*

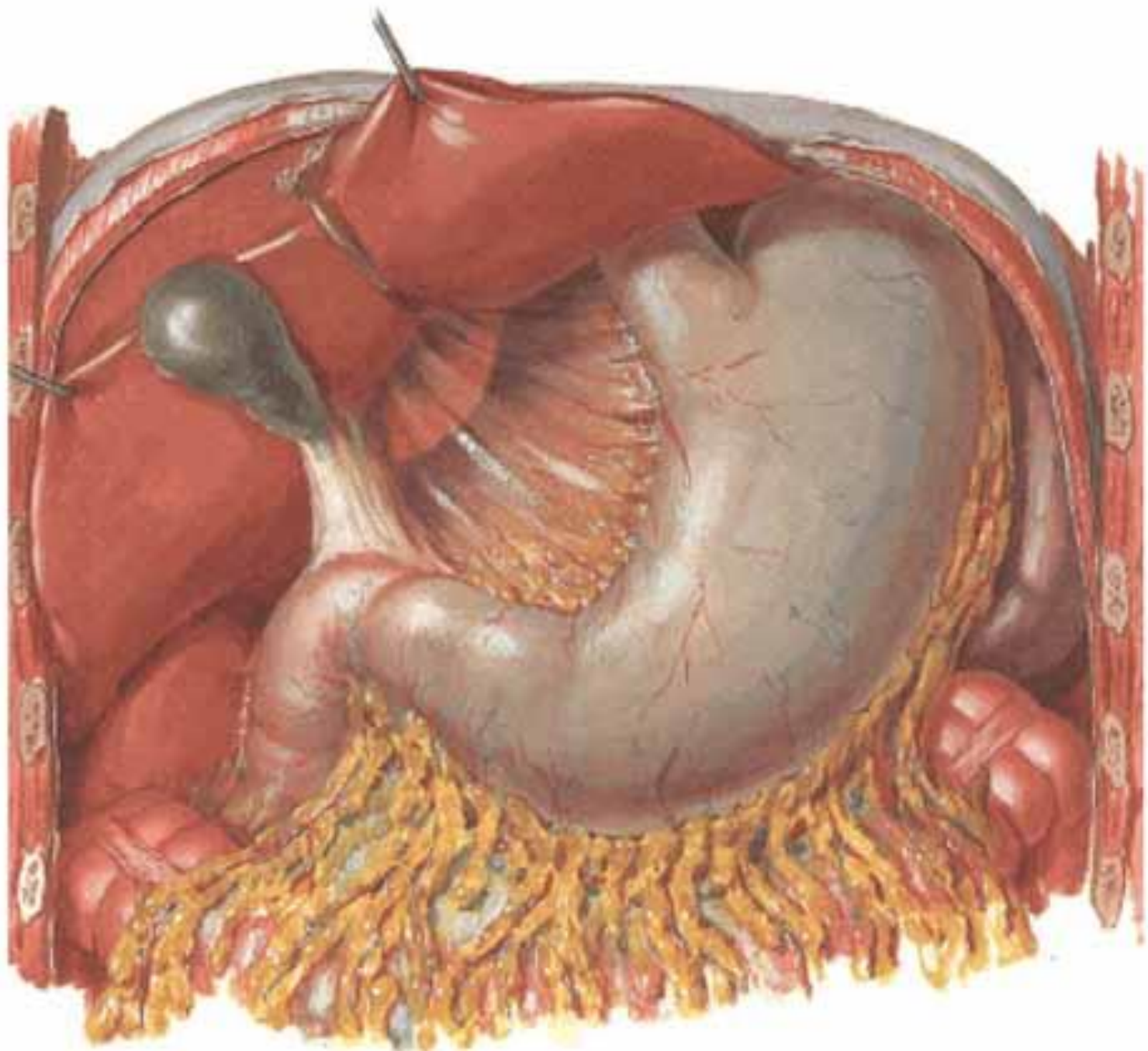






Stomach = **gaster** (*ventriculus, stomachus*)

- ✓ paries anterior + posterior
- ✓ curvatura major + minor
- ✓ cardia, fundus /fornix/, corpus /canalis/,
pars pylorica (antrum, canalis, pylorus)
- ✓ incisura angularis
- ✓ ostium cardiacum + pyloricum

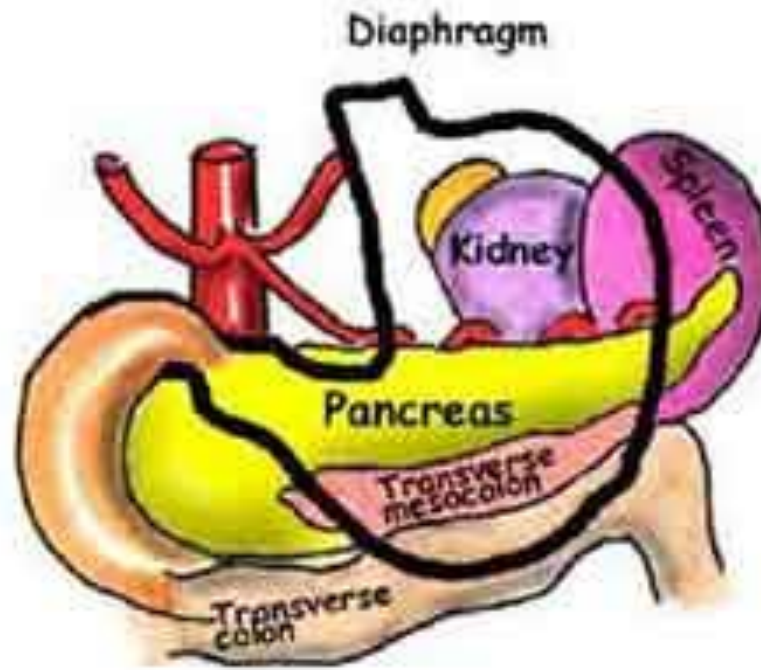




Stomach

- ✓ shape: hook, spindle, bull horn
- ✓ position: Th11-L3
- ✓ projection: *Labbé's* \triangle
- ✓ topography: organ impressions
- ✓ relation to peritoneum: intraperitoneally
- ✓ suspended with: omentum majus + minus, bursa omentalis (= lesser sac)

STOMACH - RELATIONS



ANTERIOR

Abdominal wall
Left costal margin
Diaphragm
Left lobe of liver

SUPERIOR

Left dome of diaphragm

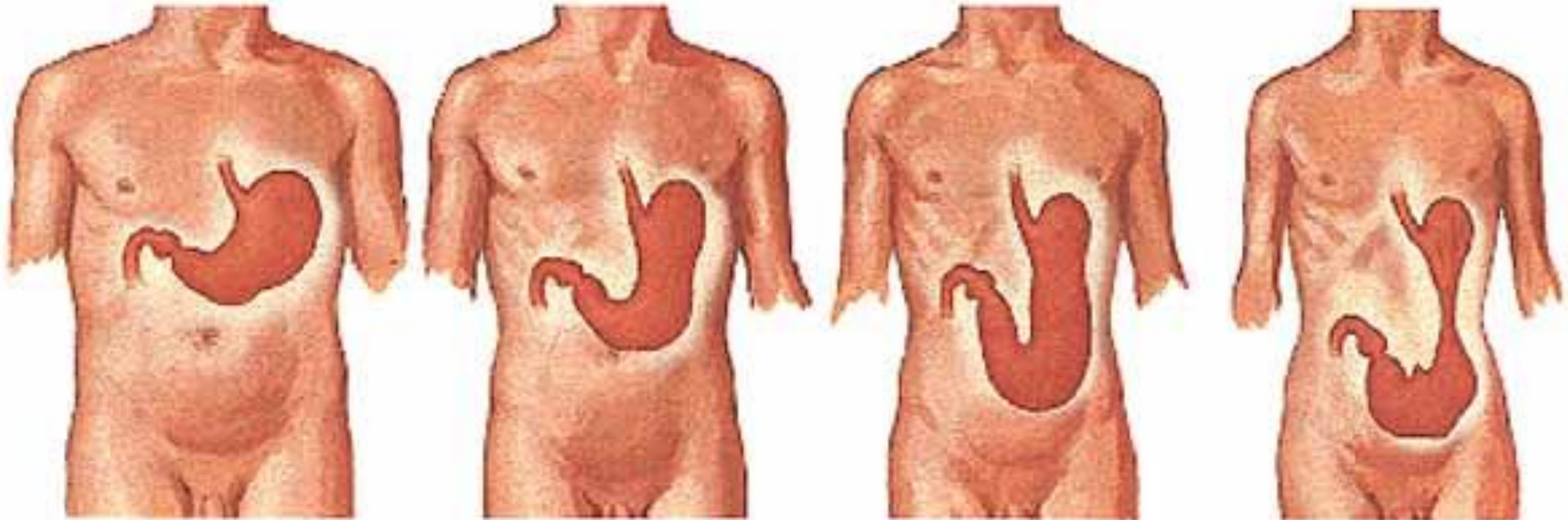
POSTERIOR

Lesser sac
Pancreas
Transverse mesocolon
Transverse colon
Left kidney/suprarenal gland
Spleen/splenic artery



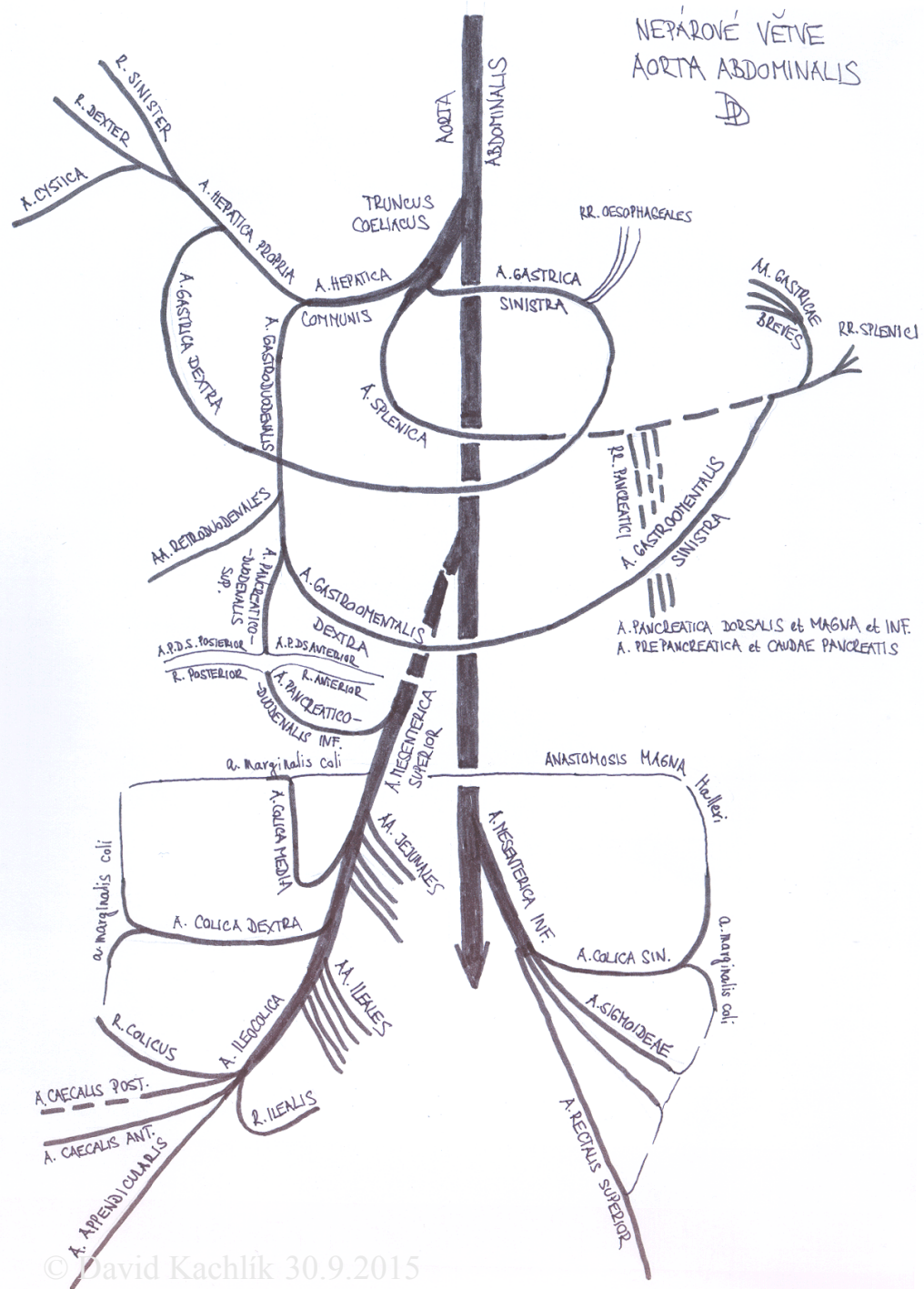
Stomach

Variations in Position and Contour





Impaired branches of the aorta abdominalis

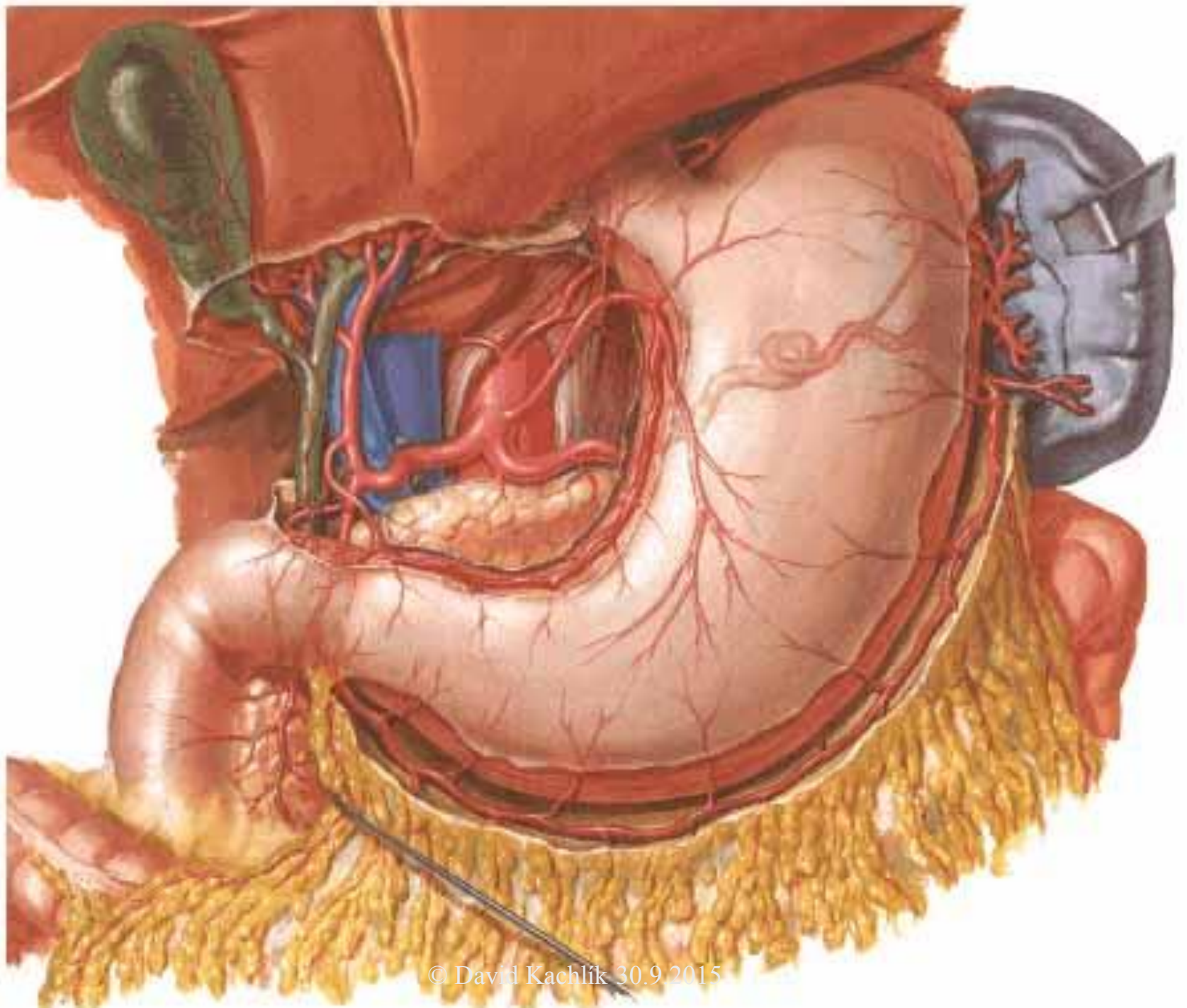




Stomach – *arterial supply*

truncus coelicacus

- ✓ → aa. gastrica sin.
- ✓ → a. hepatica communis
 - → a. hepatica propria → a. gastrica dx.
 - → a. gastroduodenalis → a. gastromentalis dx.
- ✓ → a. splenica → a. gastromentalis sin., aa. gastricae breves (fundus), a. gastrica posterior (*variability*)





Stomach – other supply

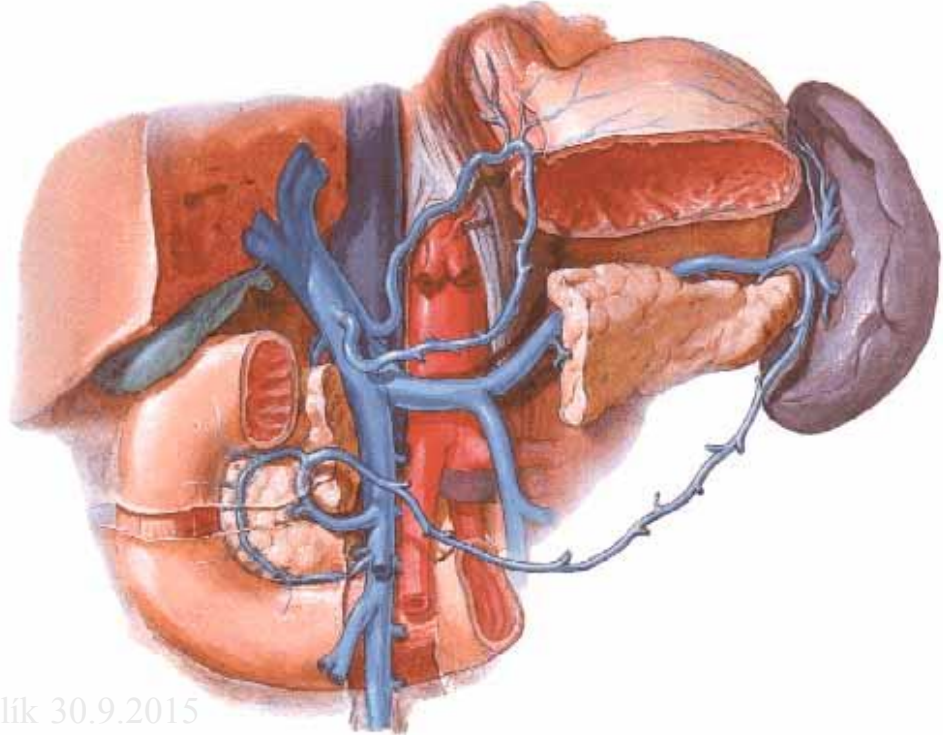
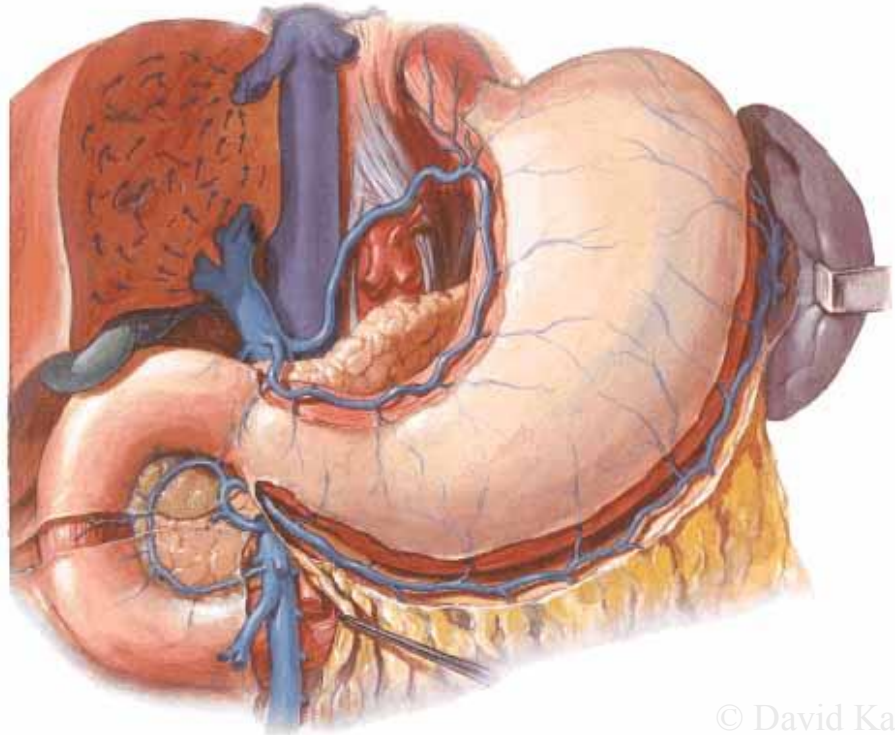
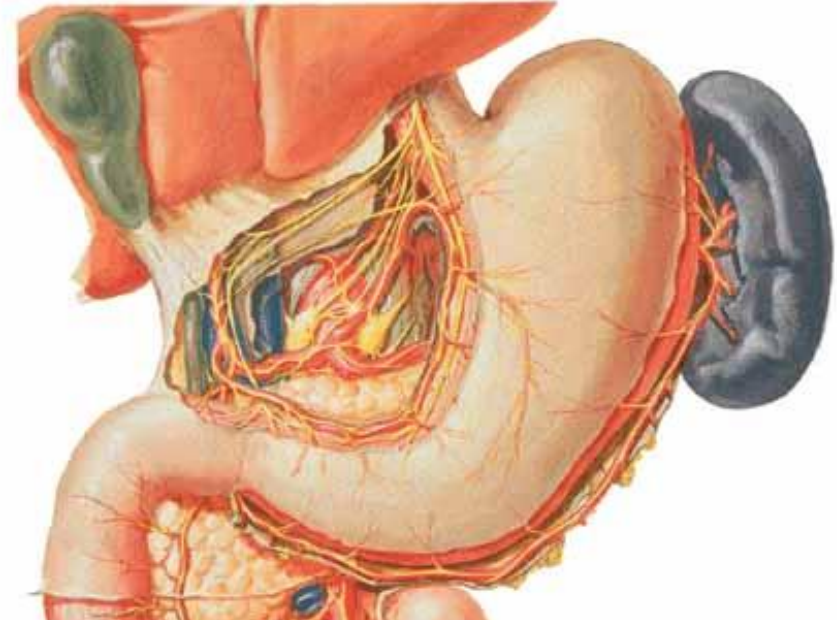
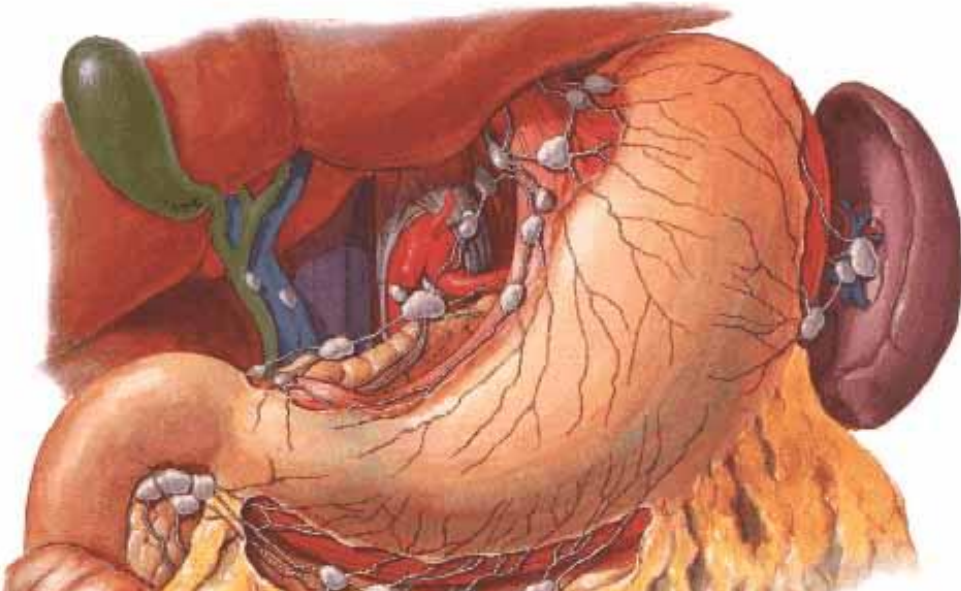
- ✓ Veins: correlate to arteries + v. prepylorica → v. portae

portocaval anastomosis between v. gastrica sin. and vv. oesophageales → **varices**

- ✓ Lymph: n.l. gastrici, gastromentales, pylorici, splenici, pancreatici → **n.l. coeliaci**

- ✓ Nerves: parasympathetic – n. X

sympathetic – nn. splanchnici major+minor → ggl. coeliacum + mesentericum sup.





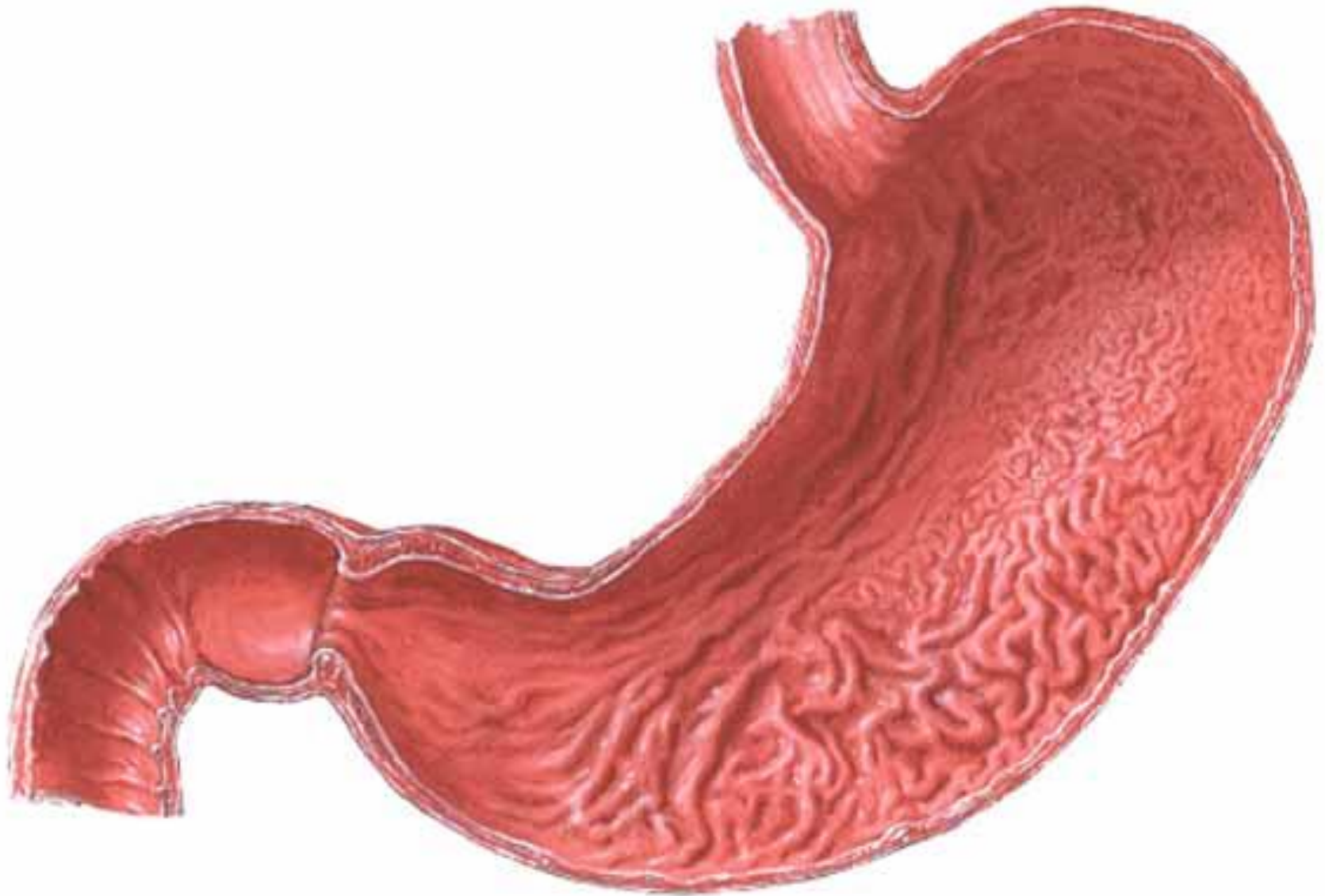
Stomach – *wall structure*

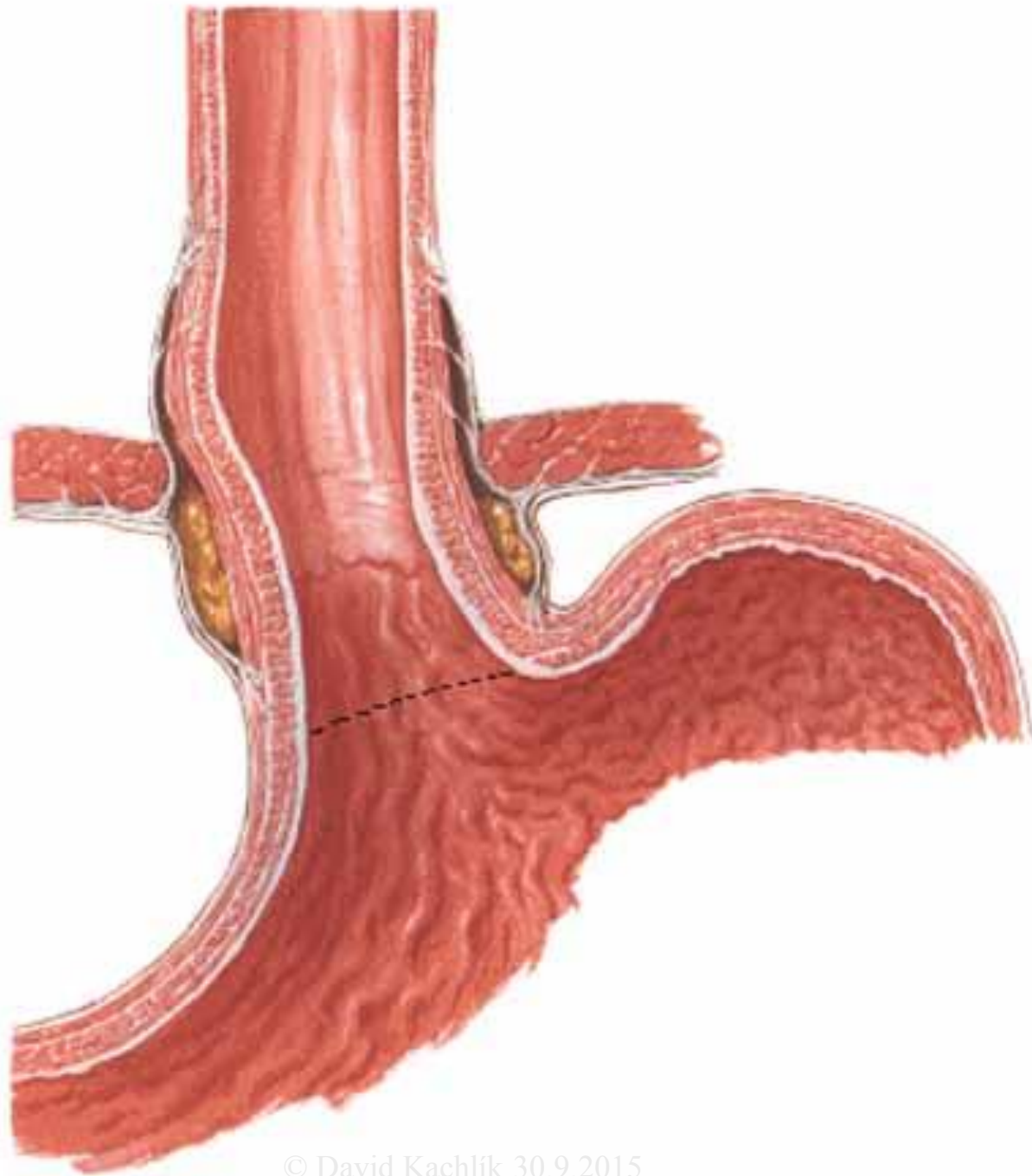
▼ tunica mucosa

- plicae gastricae (sulcus salivatorius *Waldeyeri*) →
areae gastricae → foveolae gastricae
- simple columnar epithelium – mucous production
- lamina propria mucosae
 - gastrical glands, lymphatic follicles

▼ tunica muscularis

- inner - *fibrae obliquae*
- medial - circular - *m. sphincter pylori*
- outer - longitudinal



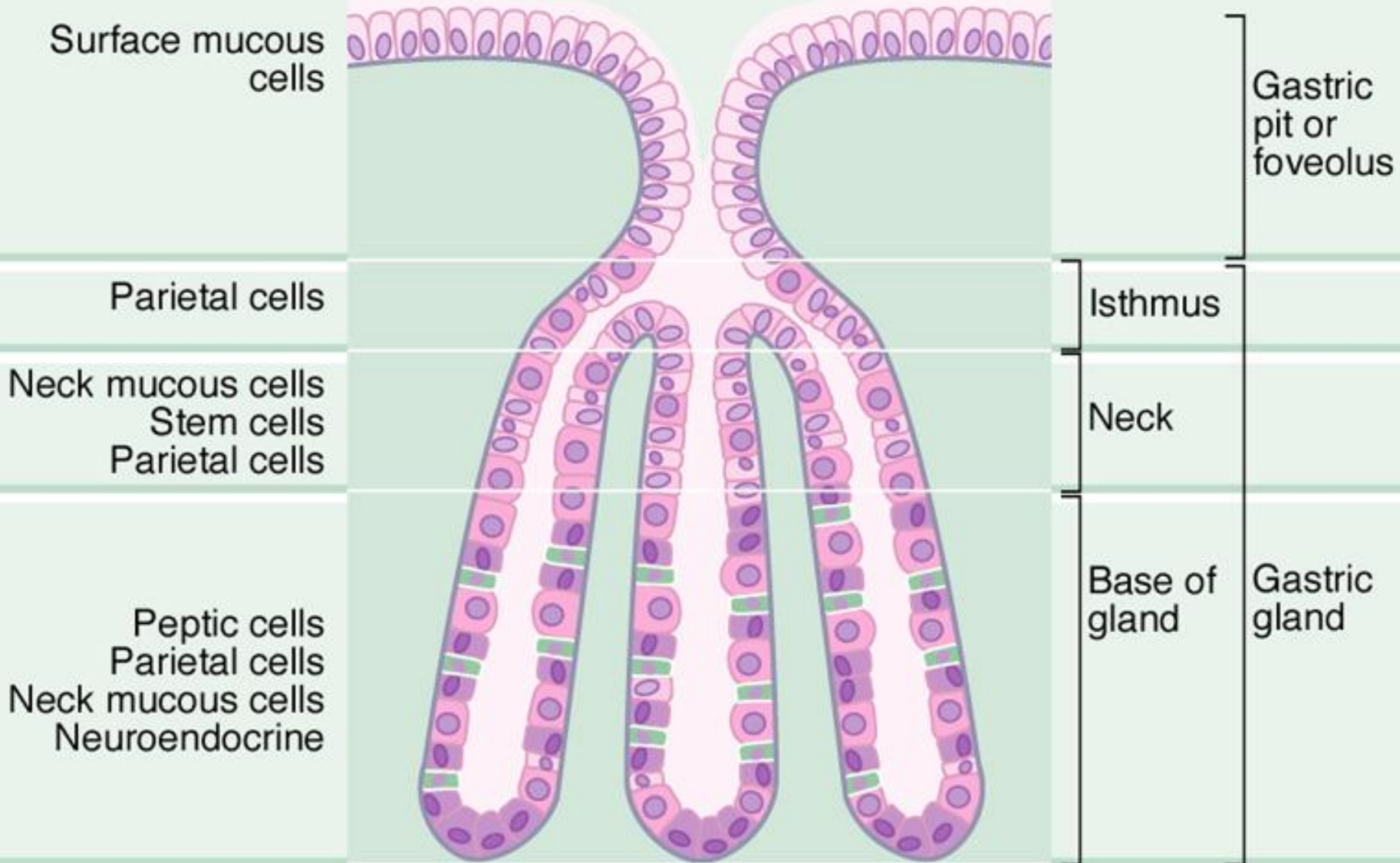


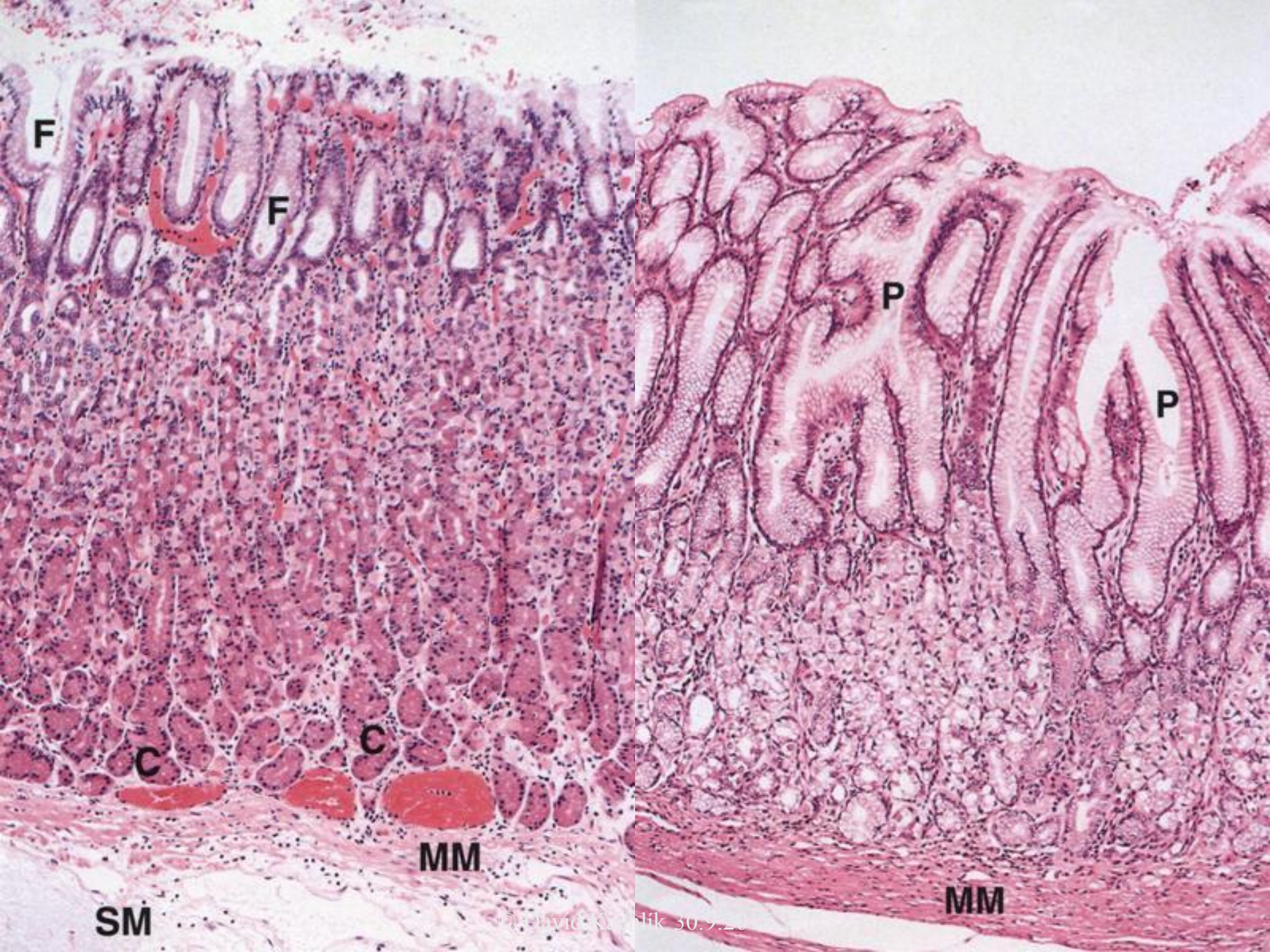


Tunica mucosa of gaster

▼ gastric pits

- deeper in pyloric part
- glands enter these pits
- gl. cardiacae - deep
- gl. gastricae propriae
- gl. pyloricae - shallow





F

F

C

C

MM

SM

P

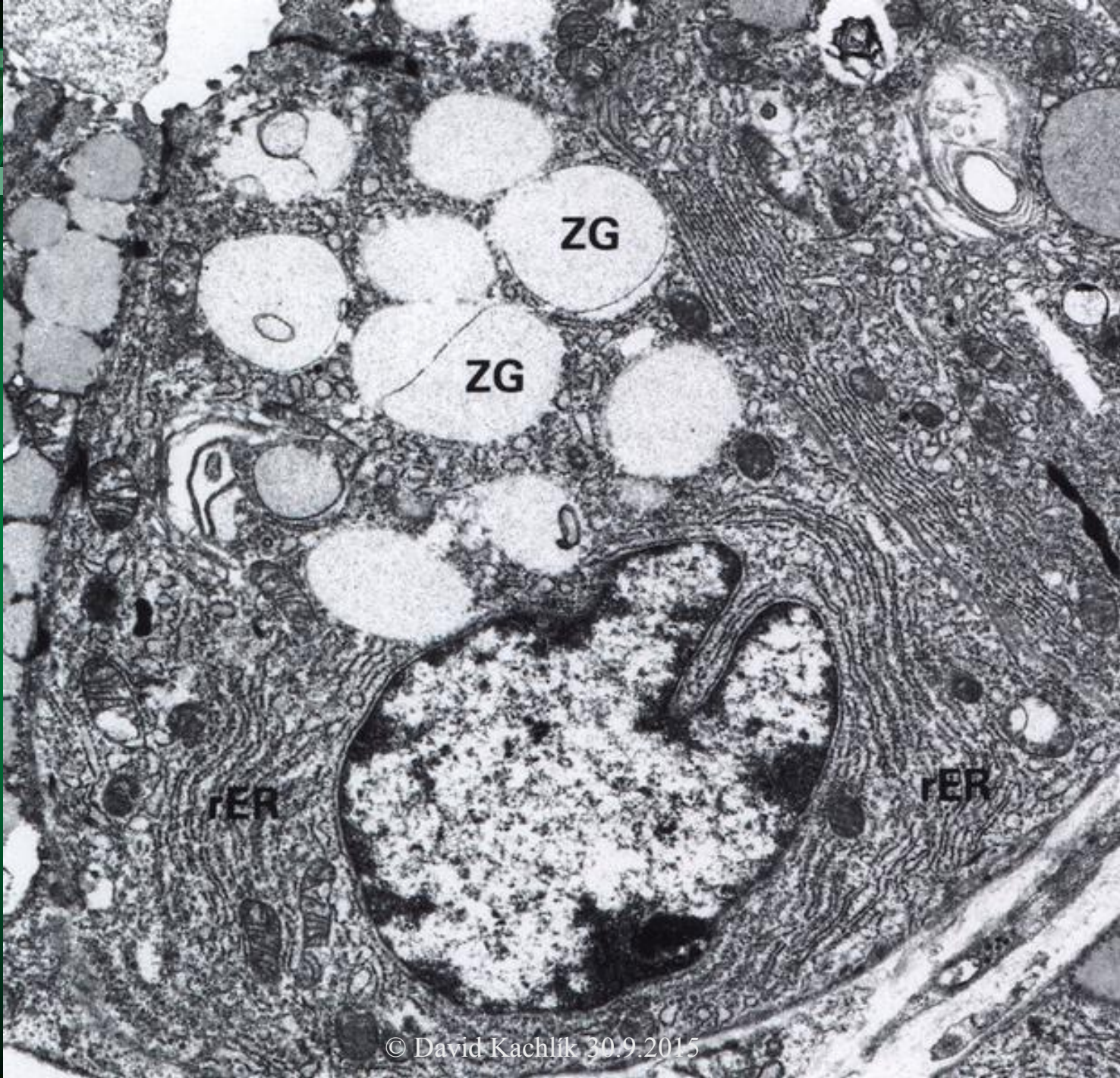
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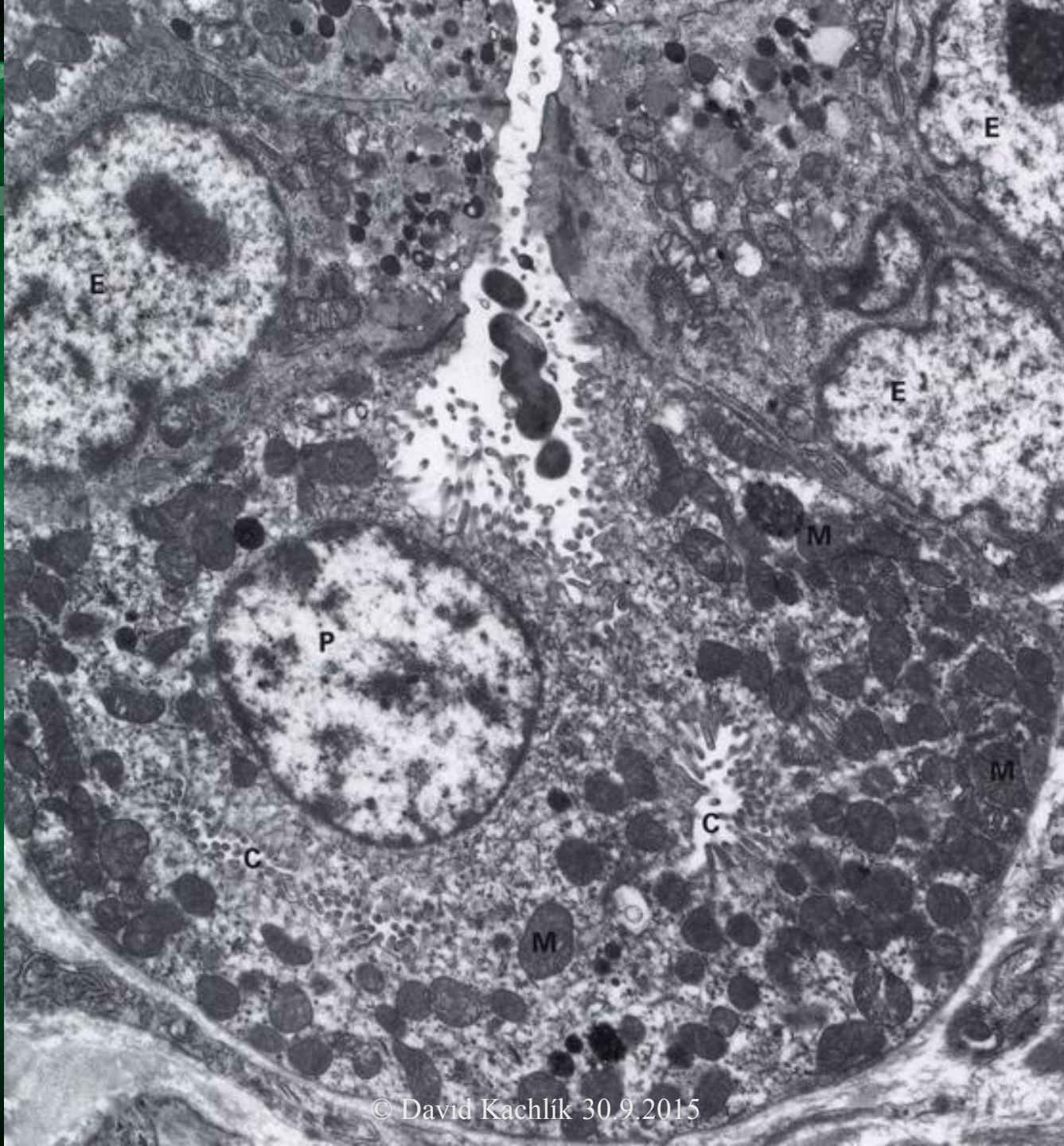
MM



Gastric cells

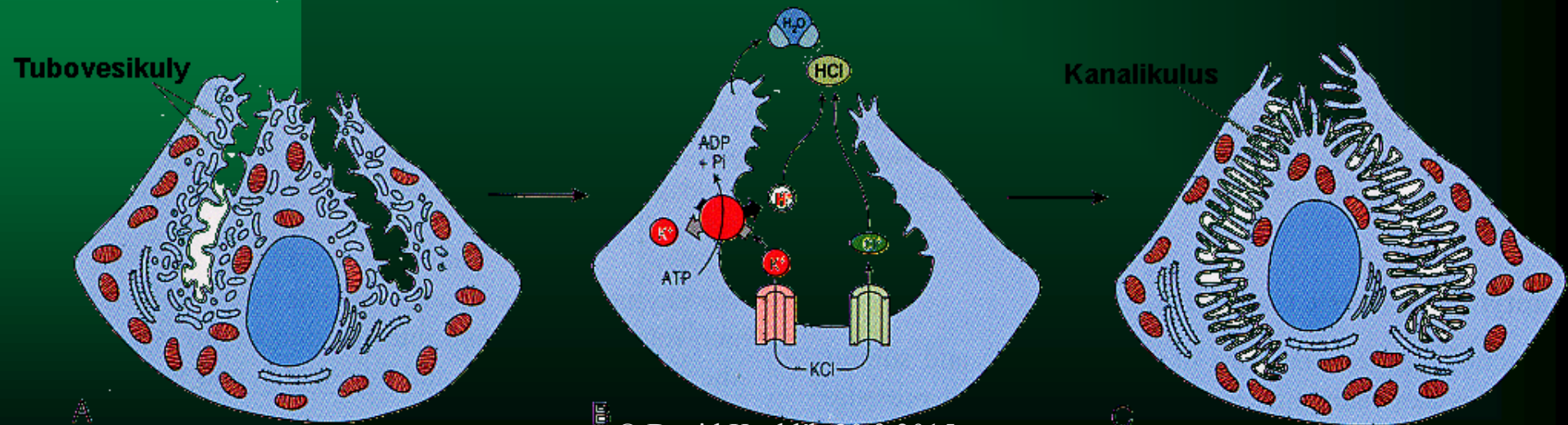
- ✓ main cells - pepsinogen, lipase
- ✓ parietal cells - HCl, intrinsic factor
 - abundant intracellular channels
- ✓ mucinous cells – mucus
- ✓ enteroendocrine cells (DNES) - gastrin, somatostatin
- ✓ undifferentiated cells - mitotically active



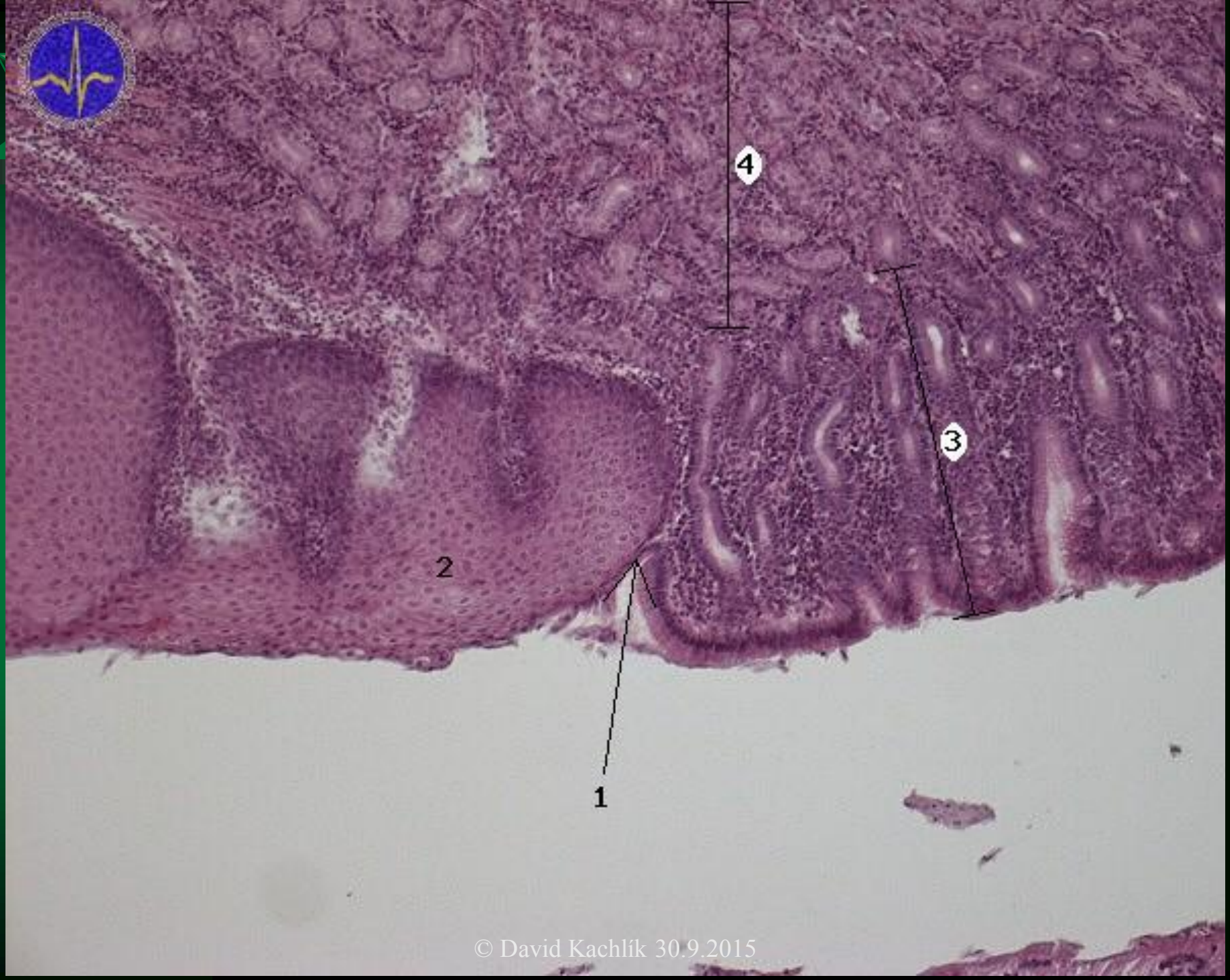


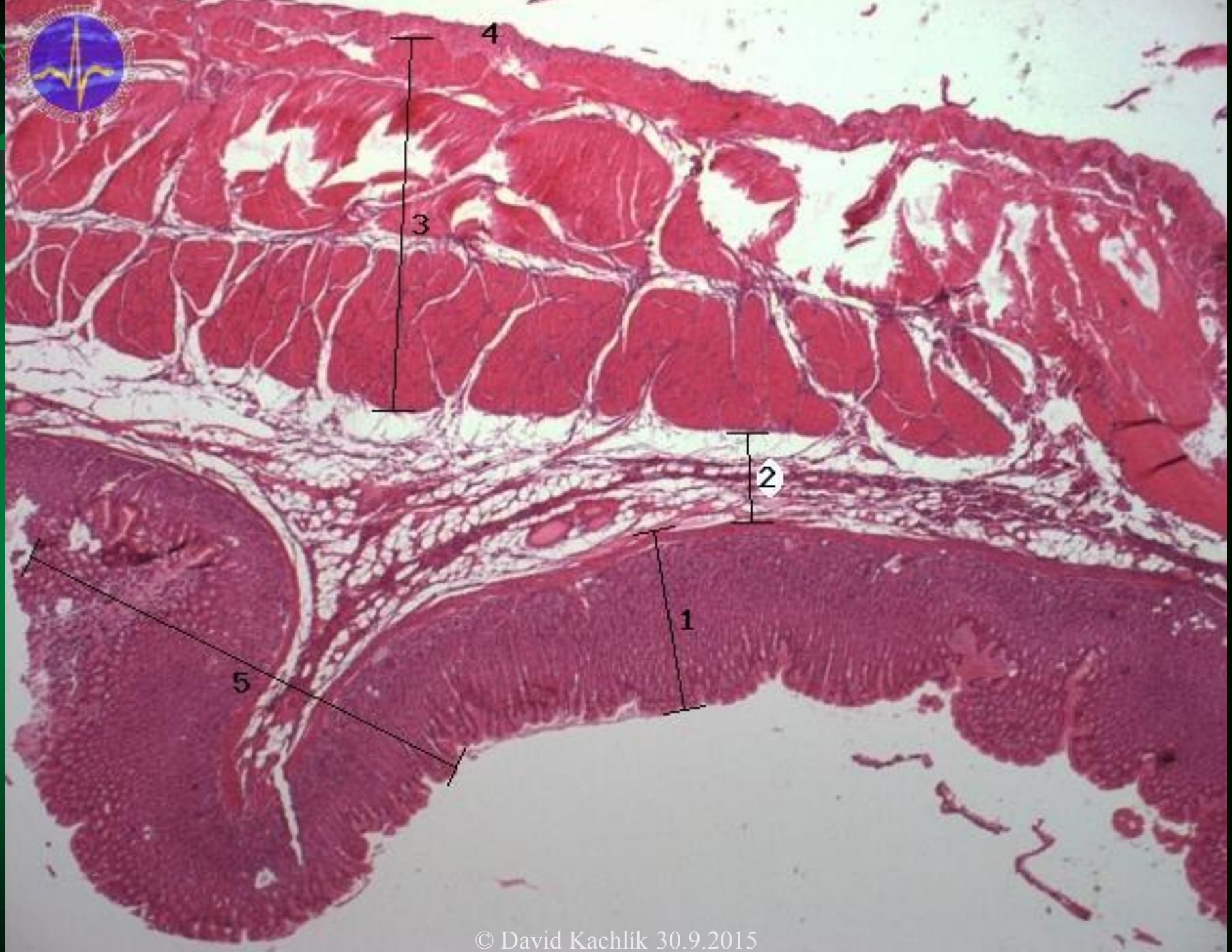
Synthesis of HCl

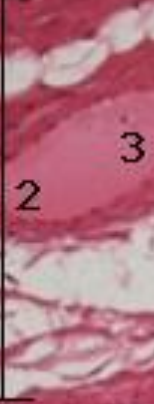
- ✓ in parietal cells
- ✓ Cl^- - from plasma
- ✓ H^+ - from H_2CO_3
 - by carboanhydrase from CO_2 and H_2O











3

1c

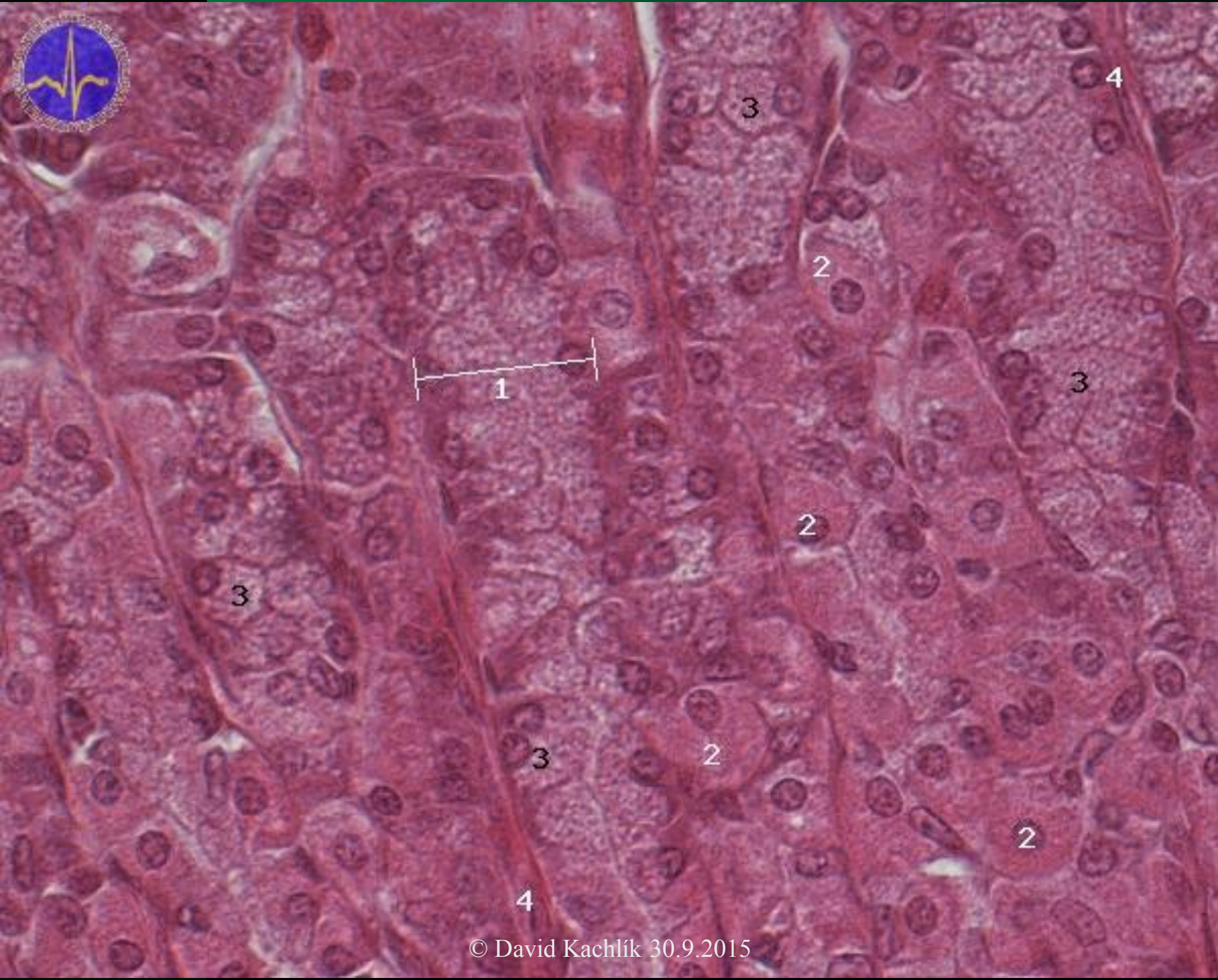
1b



1



1a





Stomach – *examination + diseases*

- ▼ *peptic ulcer*
- ▼ *gastritis A,B (Helicobacter pylori)*
- ▼ *tumors*
- ▼ *pylorostenosis*


gastroscopy

X-ray – contrast with baryum

gastrostomy



Break



Small intestine = Intestinum tenue

▼ duodenum

▼ jejunum

▼ ileum

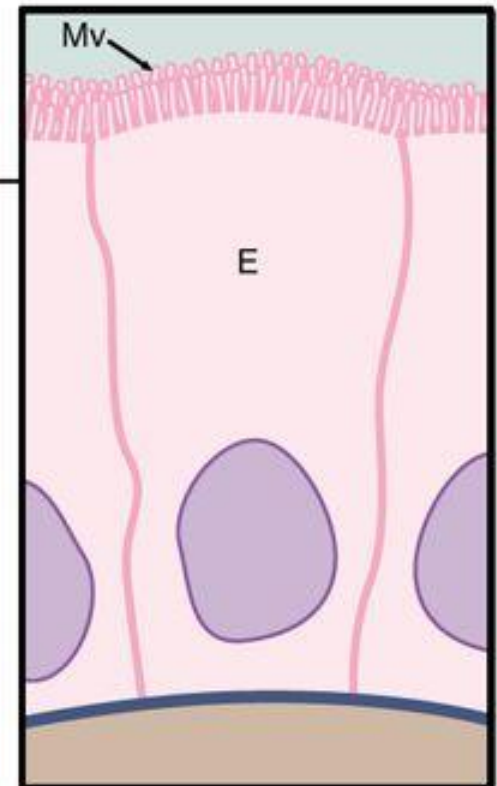
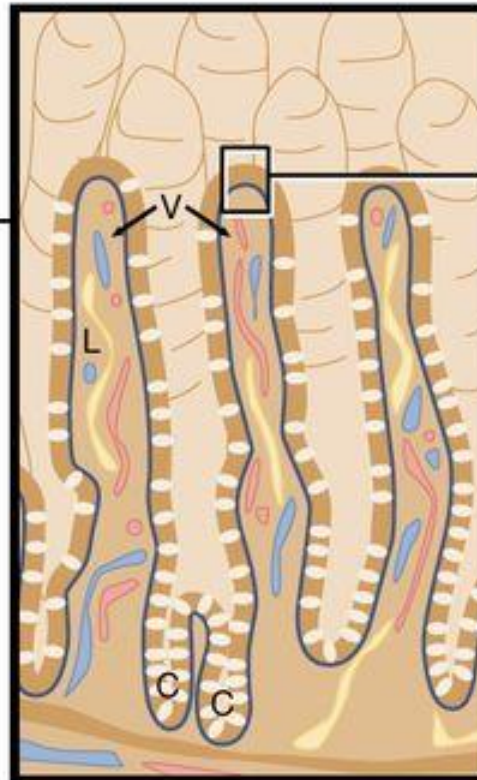
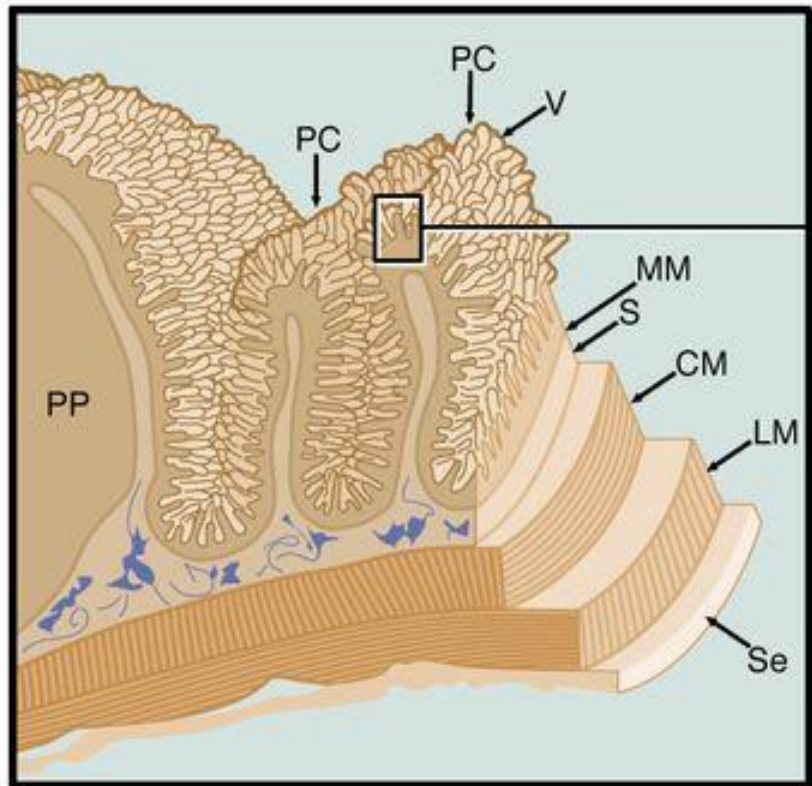
mesenterium

- radix mesenterii



Tunica mucosa of small intestine

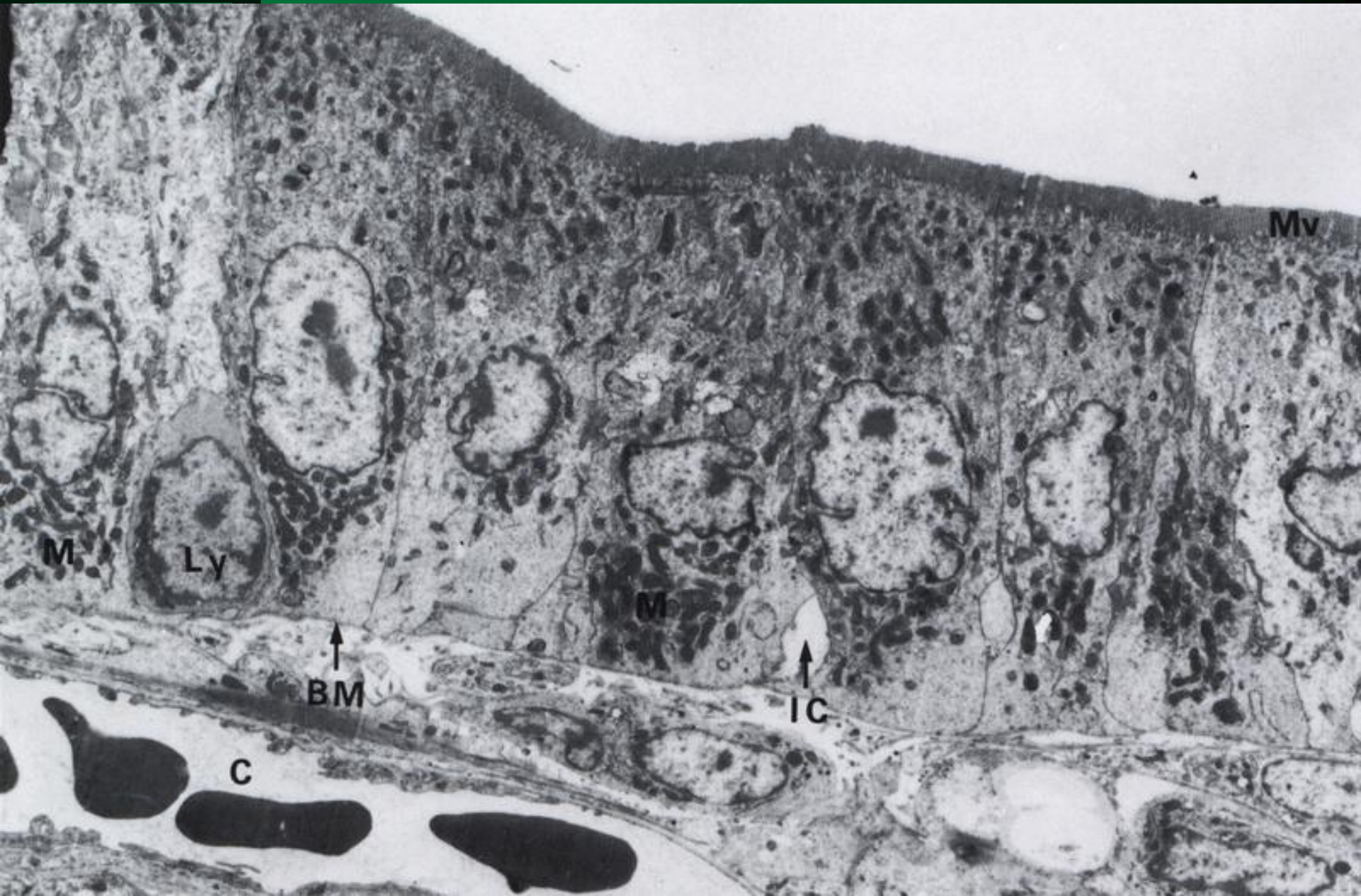
- ✓ *plicae circulares* (Kerkringi) → villi
intestinales → microvilli
- ✓ glandulae intestinales = *Lieberkühn's crypts*
- ✓ simple columnar epithelium
- ✓ lamina propria mucosae
 - vessels, smooth muscles, noduli lymphoidei



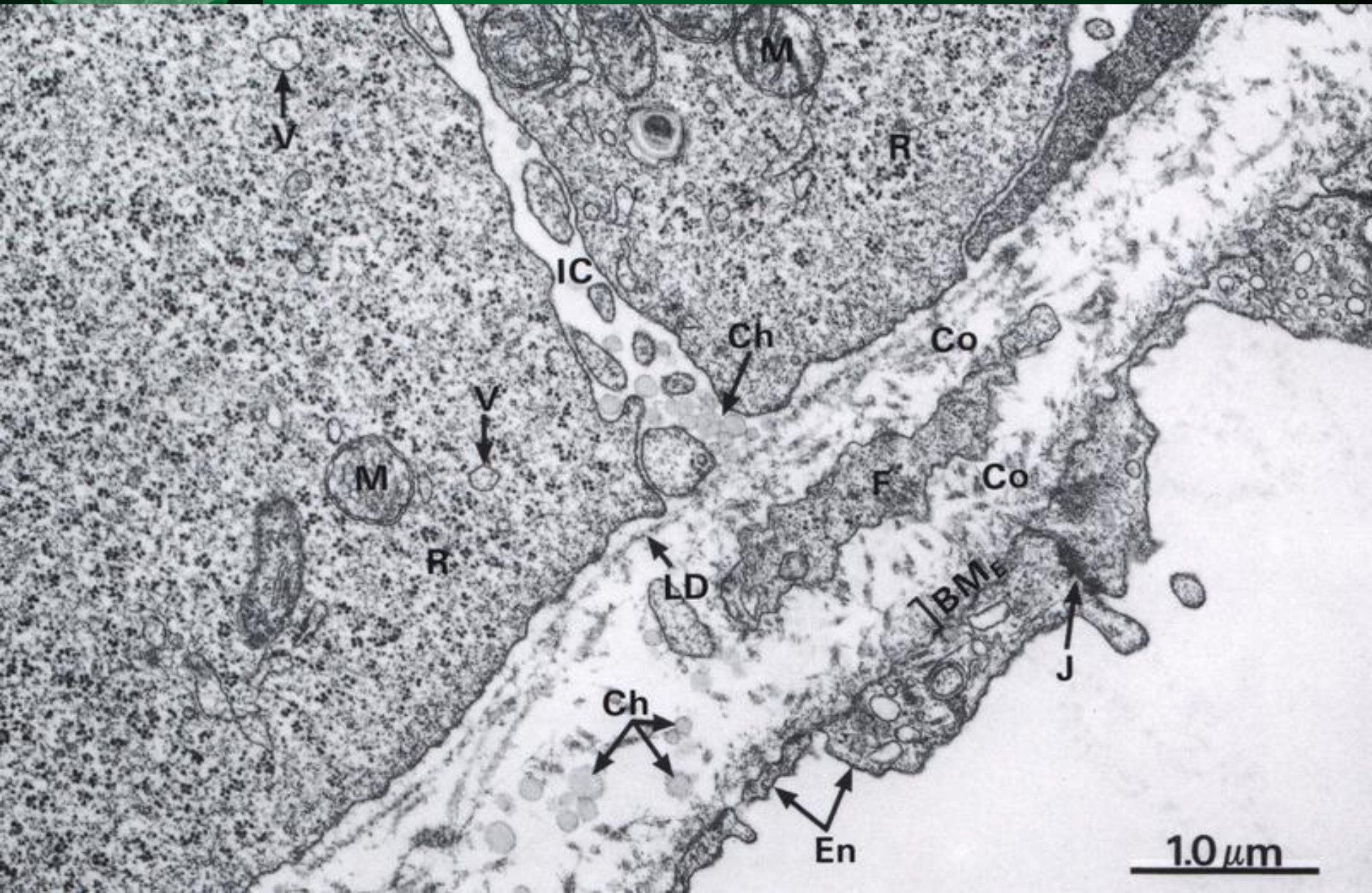


Cells of small intestine mucosa

- ✓ enterocytes - resorption
 - microvilli, interdigitations, lipid droplets
- ✓ goblet cells – mucus production
- ✓ Paneth cells – lysozym production
- ✓ endocrine cells (DNES) - 12 types
 - cholecystokinin, sekretin
- ✓ M-cells - over noduli lymph. aggregati (Peyer's plates)
- ✓ undifferentiated cells





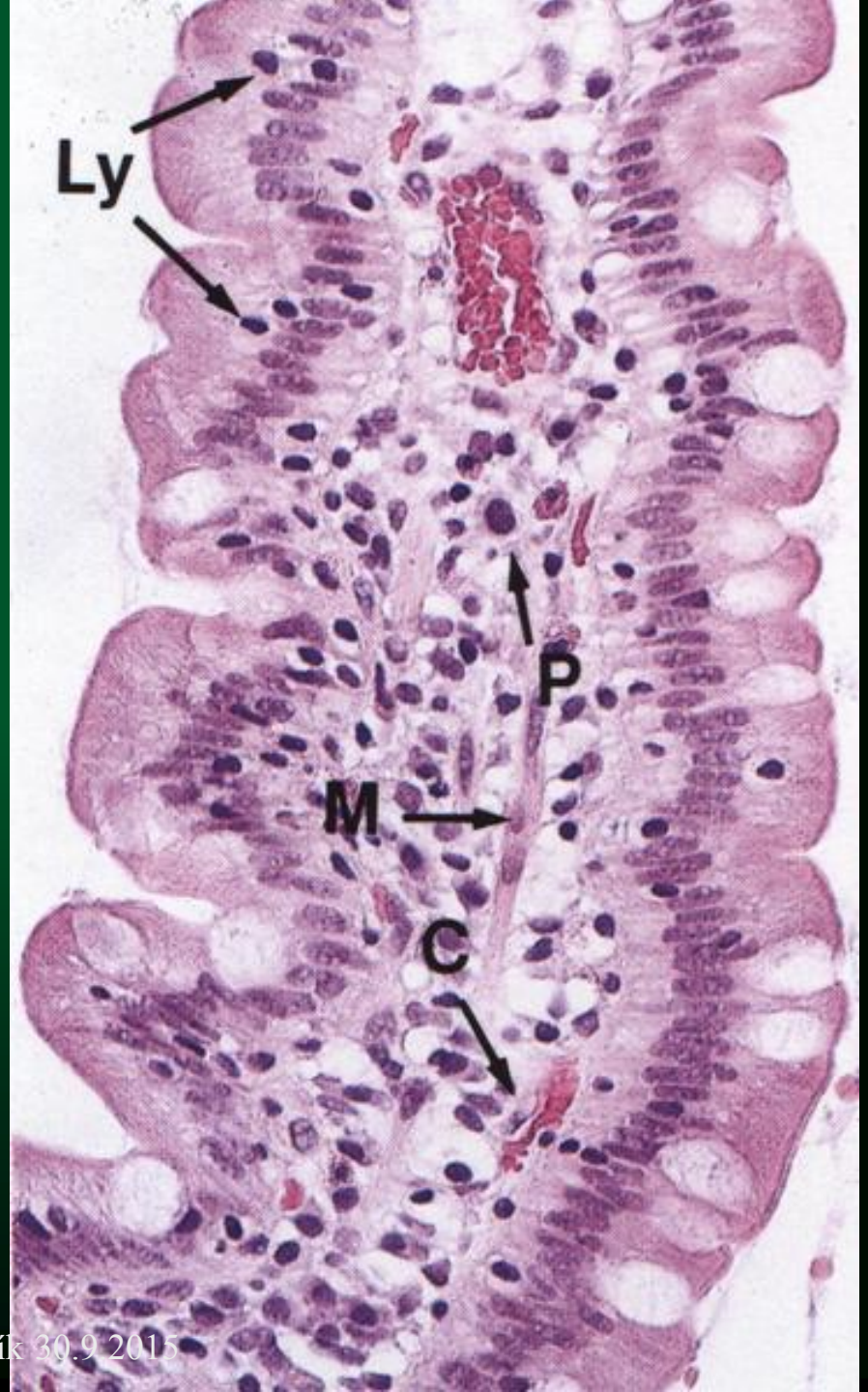


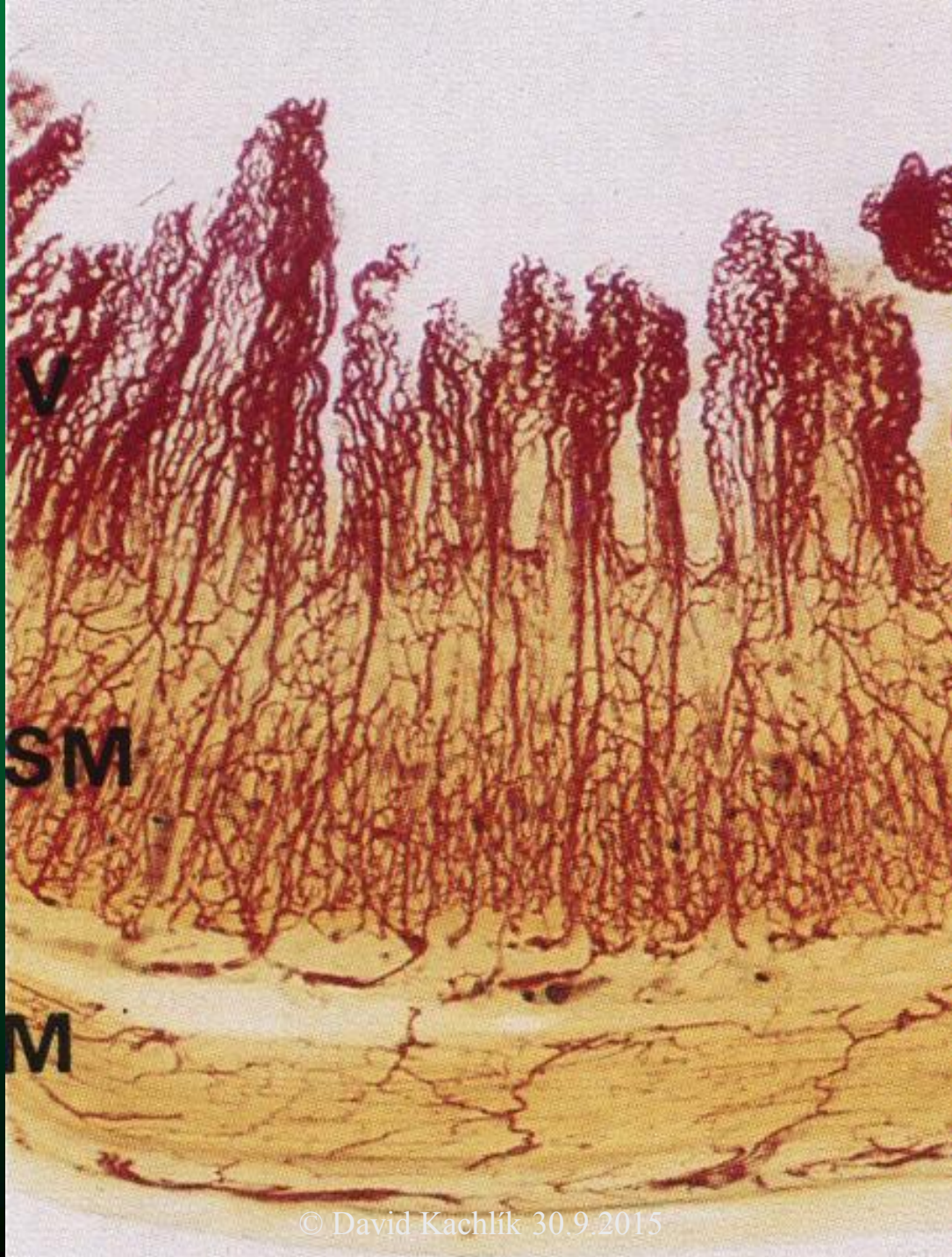


Villi intestinales

- ✓ digit- to leaf-formed elements
- ✓ about 10times surface enlargement
- ✓ surface – enterocytes, goblet cells
- ✓ smooth muscle „skeleton“
- ✓ capillary network
- ✓ lymphoid (=lacteal) inhte centre









Other layers of small intestine wall

✓ tela submucosa

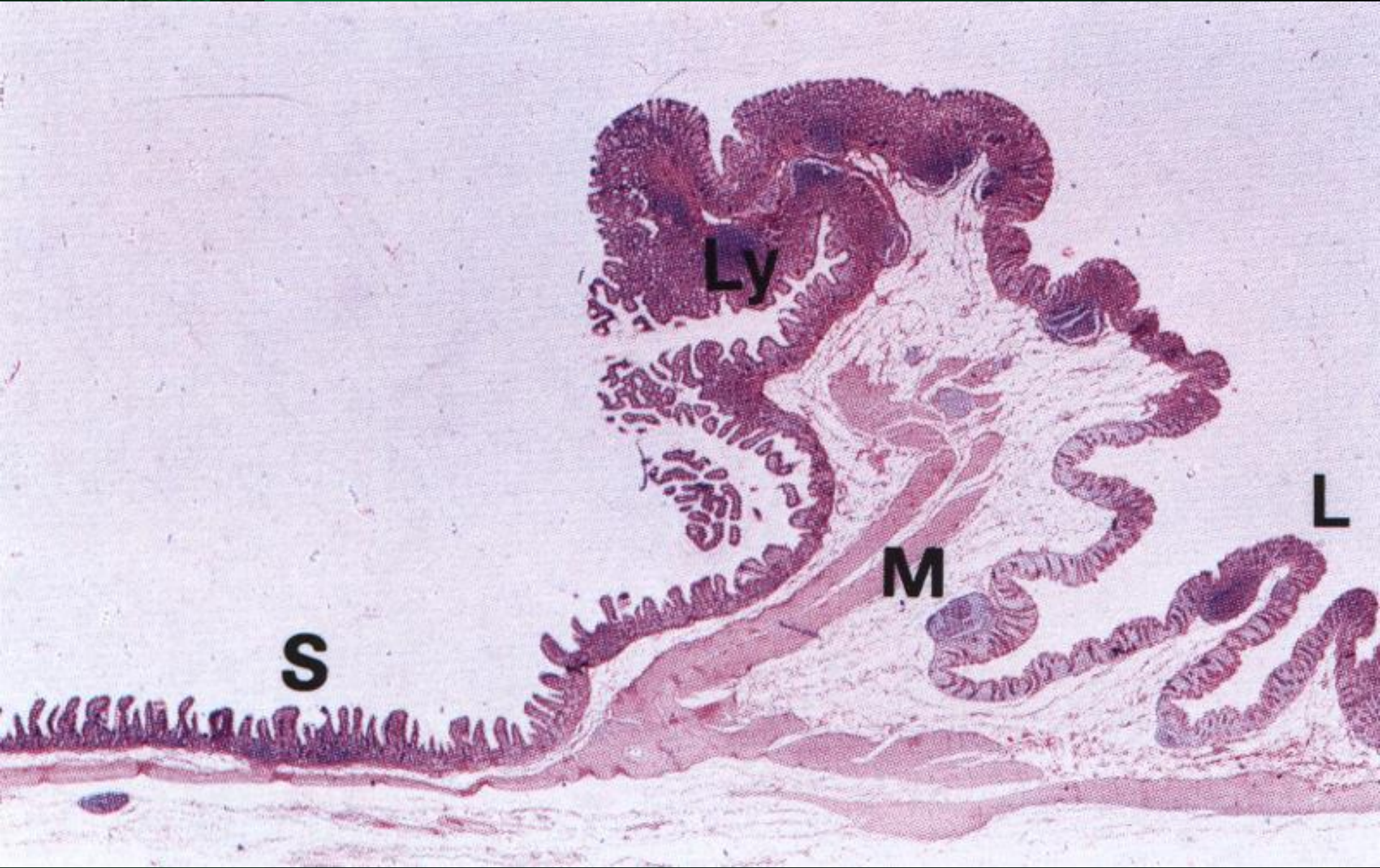
– **duodenum** – glandulae duodenales Brunneri

- tuboalveolar mucinous
- alkaline secretion

– **ileum** – noduli lymphoidei aggregati („*agmina Peyerii*“) = Peyer's plates

- accumulation of lymphoid tissue

✓ other layers correspond to the standard form of the tube

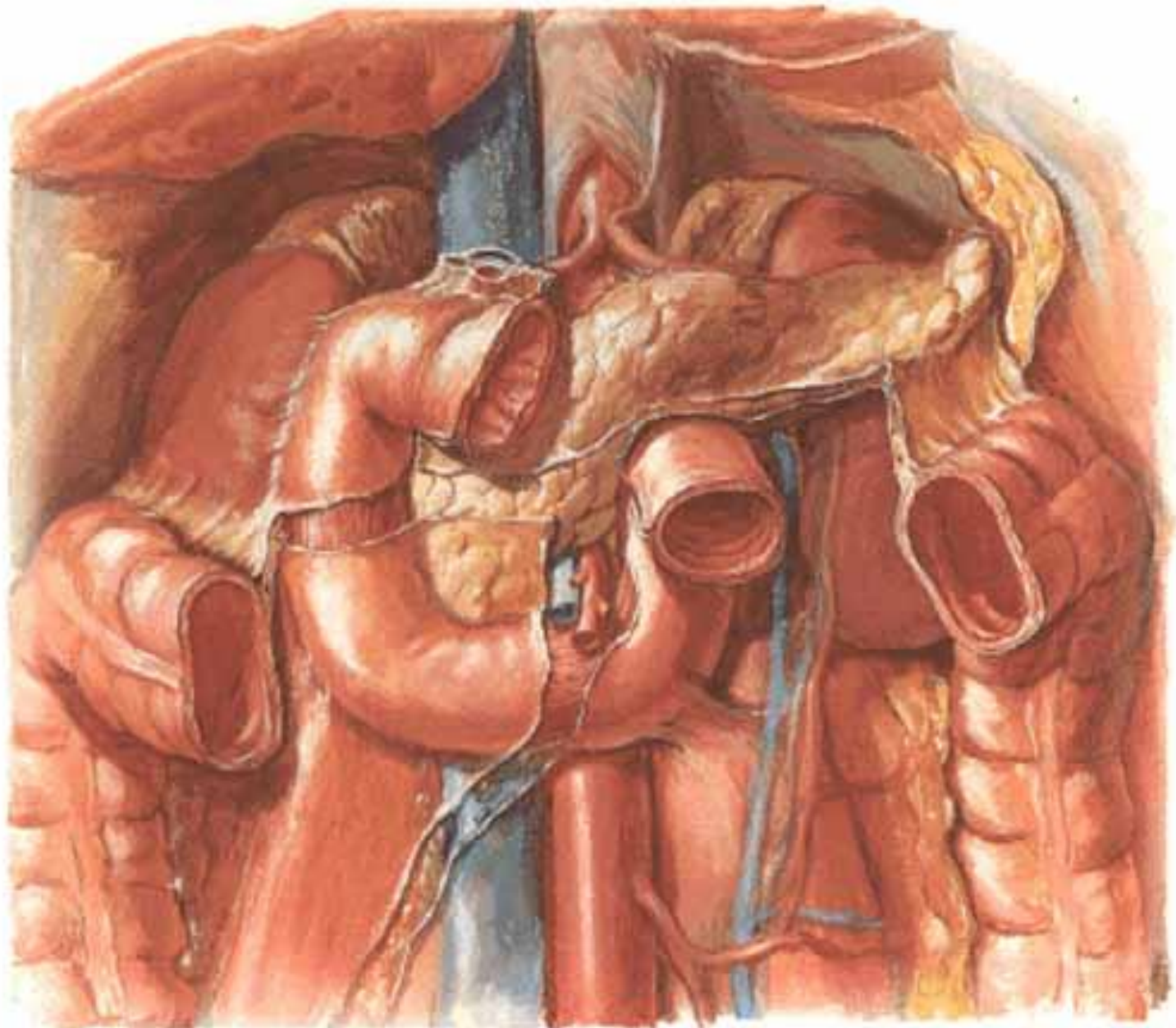




Duodenum

- ✓ pars superior
 - ampulla=bulbus
- ✓ flexura duodeni sup.
- ✓ pars descendens
- ✓ flexura duodeni inf.
- ✓ pars horizontalis/inferior
- ✓ pars ascendens
- ✓ flexura duodenojejunalis

secondary retroperitoneally /except ampulla/

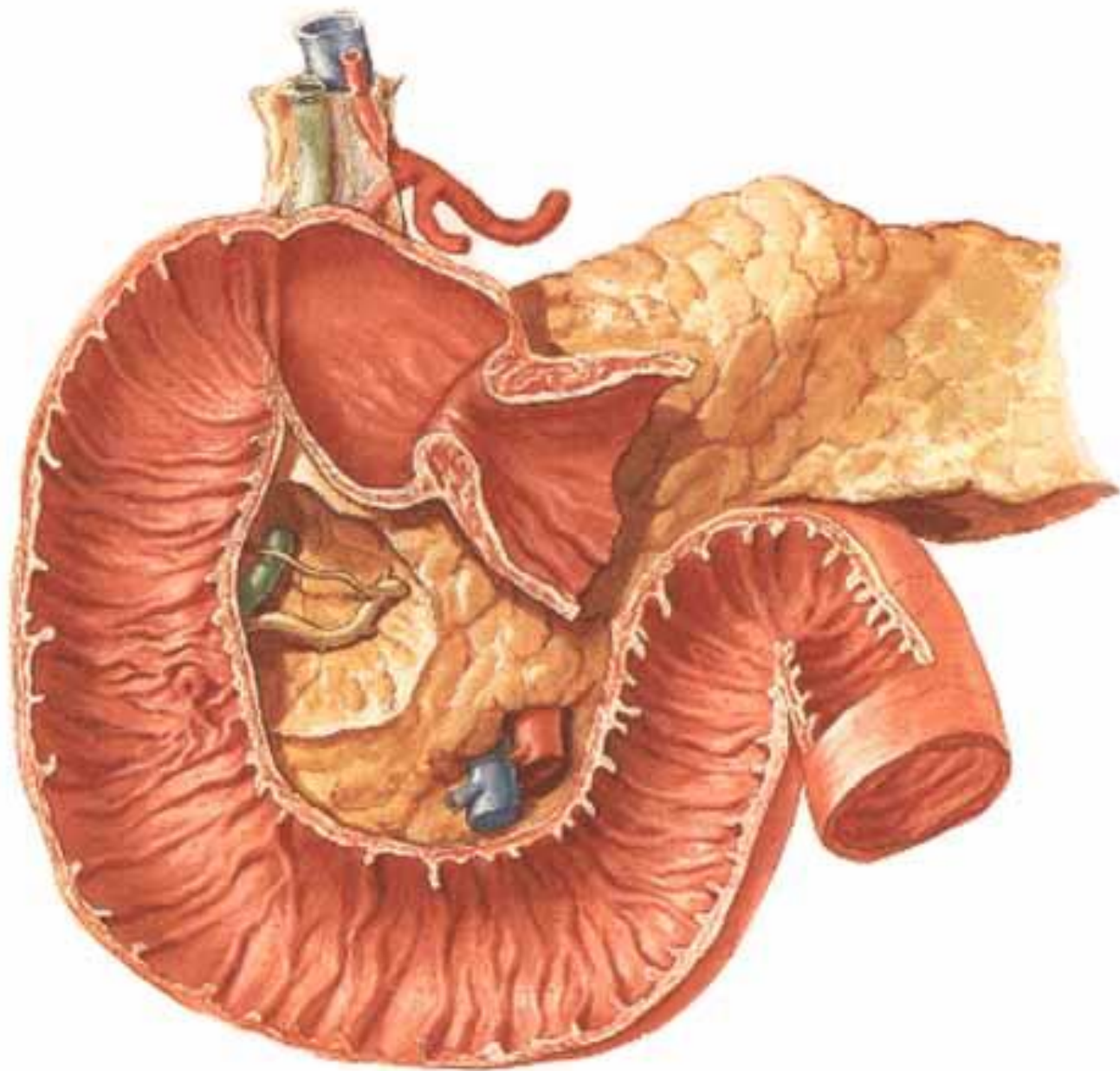




Duodenum

- ✓ structure: plica longitudinalis
 - papilla d. major *Vateri*
 - papilla d. minor *Santorini*
- ✓ fixation: lig. + m. suspensorius *Treitz* d.
- ✓ position: duodenal window L2

- ✓ plicae ciculares *Kerckringi* – highest of the intestine
- ✓ glandulae duodenales *Brunneri*
 - *submucosal*

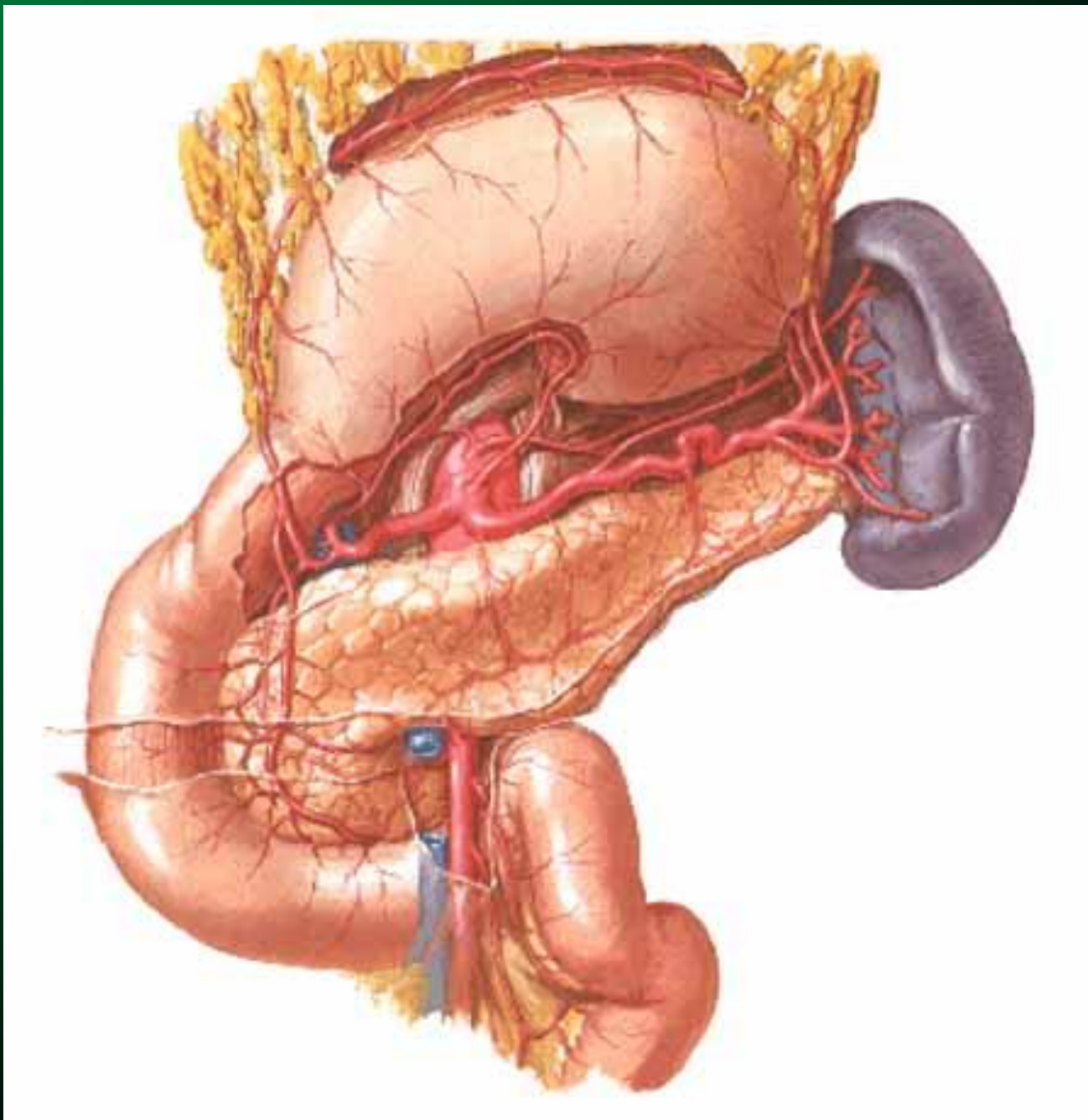




Duodenum – *blood supply*

- ✓ **truncus coelicacus** → a. hepatica communis → a. gastroduodenalis → a. pancreaticoduodenalis sup. post. + sup. ant. + aa. retroduodenales
- ✓ **a. mesenterica sup.** → a. pancreaticoduodenalis inf. → ramus ant. + r. post.

Veins: vv. pancreaticoduodenales → v. mesenterica sup. → v. portae





Duodenum – *Lymph and Nerves*

Lymph: n.l. pylorici

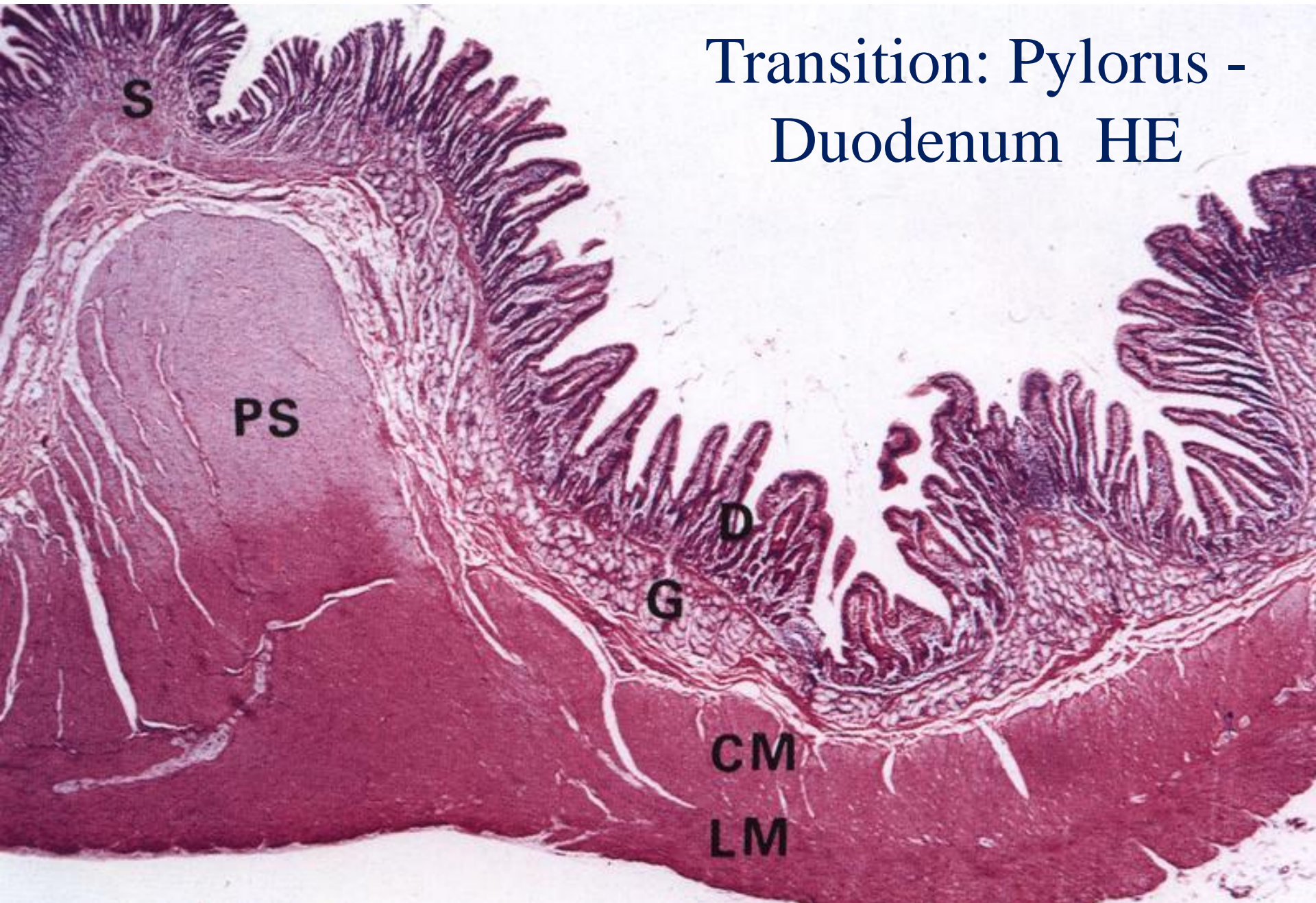
✓ → n.l. hepatici → n.l. coeliaci → n.l. preaortici

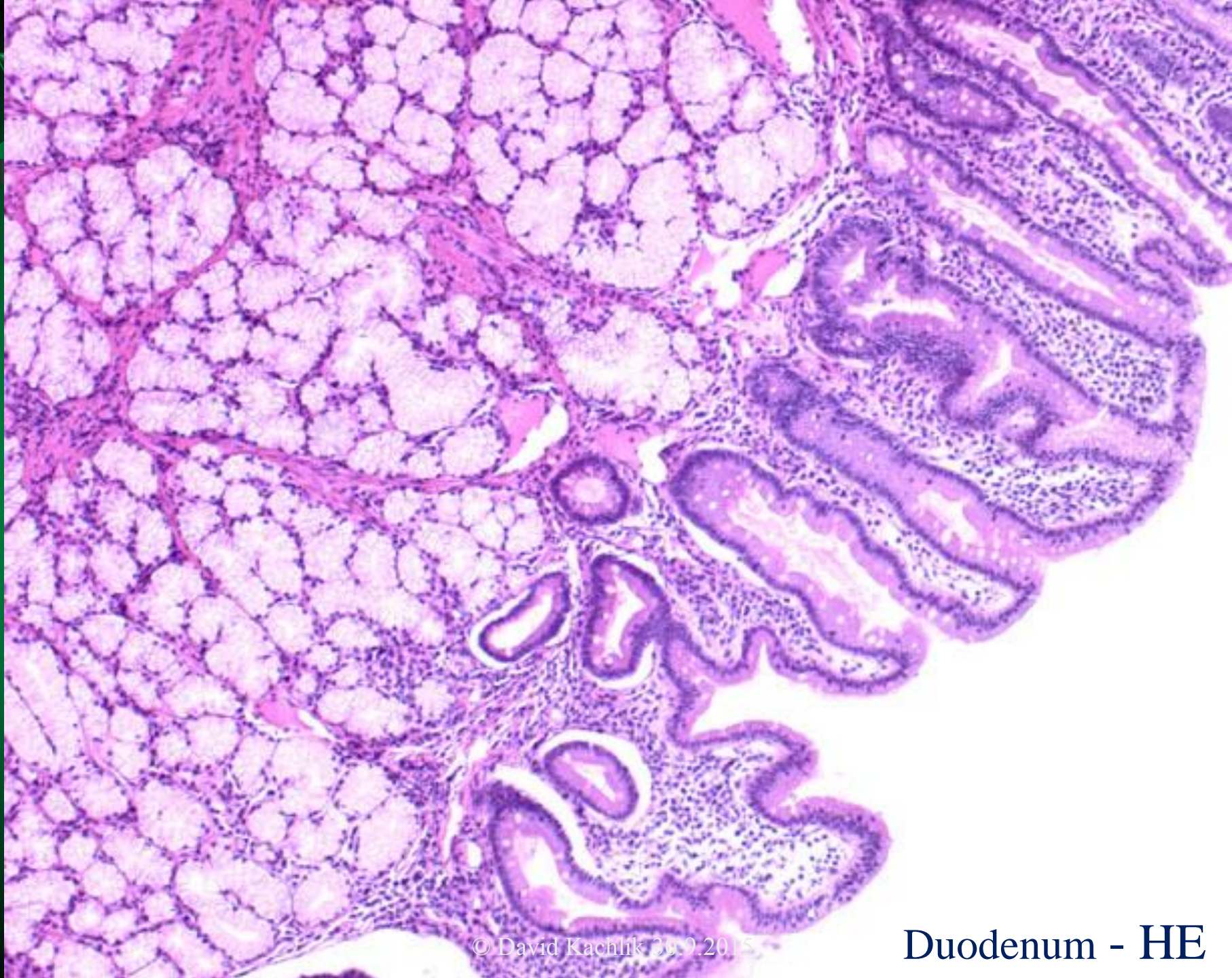
✓ → *down directly to* n.l. preaortici

Nerves: *parasympathetic* – n. X

sympathetic – nn. splanchnici major+minor →
ggl. coeliacum + mesentericum sup.

Transition: Pylorus - Duodenum HE





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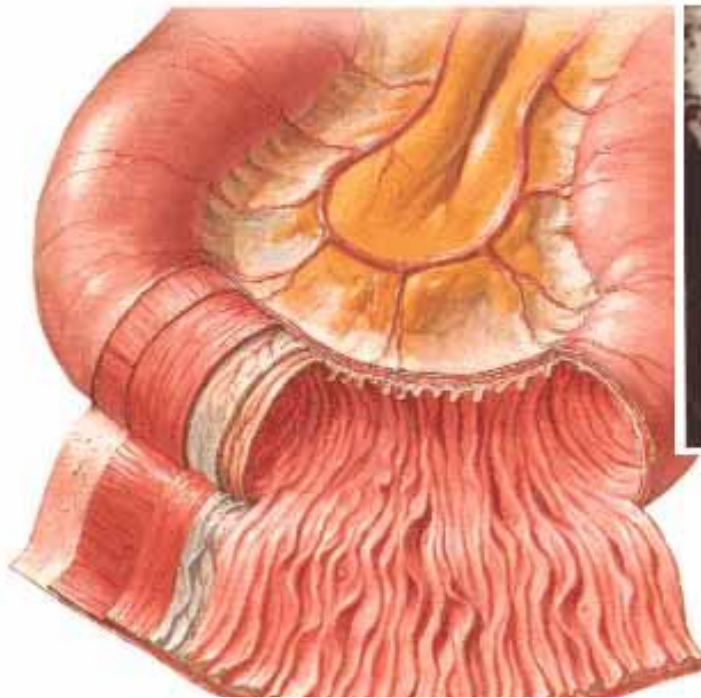
Duodenum - HE



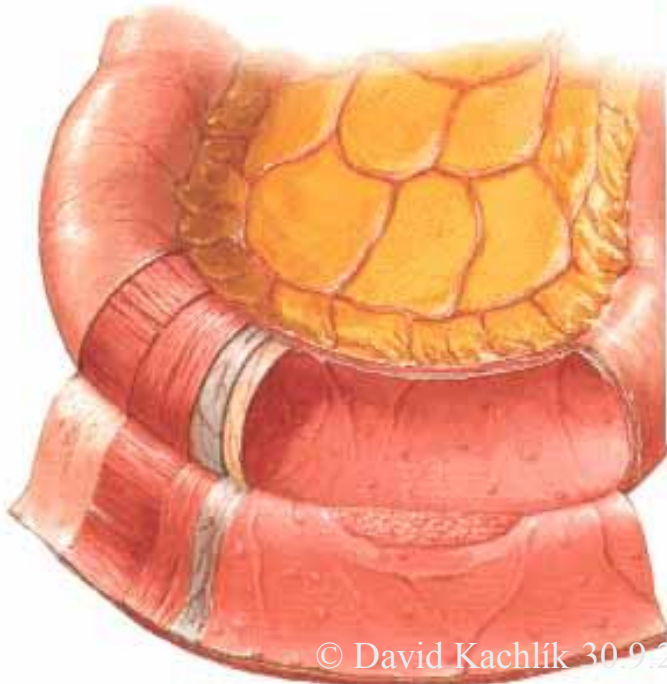
Jejunum et ileum

6 differences: content, width, folds, lymphoid tissue, vessels density and arrangement

- ✓ wholly intraperitoneally, radix mesenterii
- ✓ ostium ileale *Bauhini* s. *Tulpi* (former valva ileocaecalis !) – labrum sup. + inf.
- ✓ diverticulum ilei *Meckeli* (2%) – remnant of ductus omphaloentericus



Jejunum

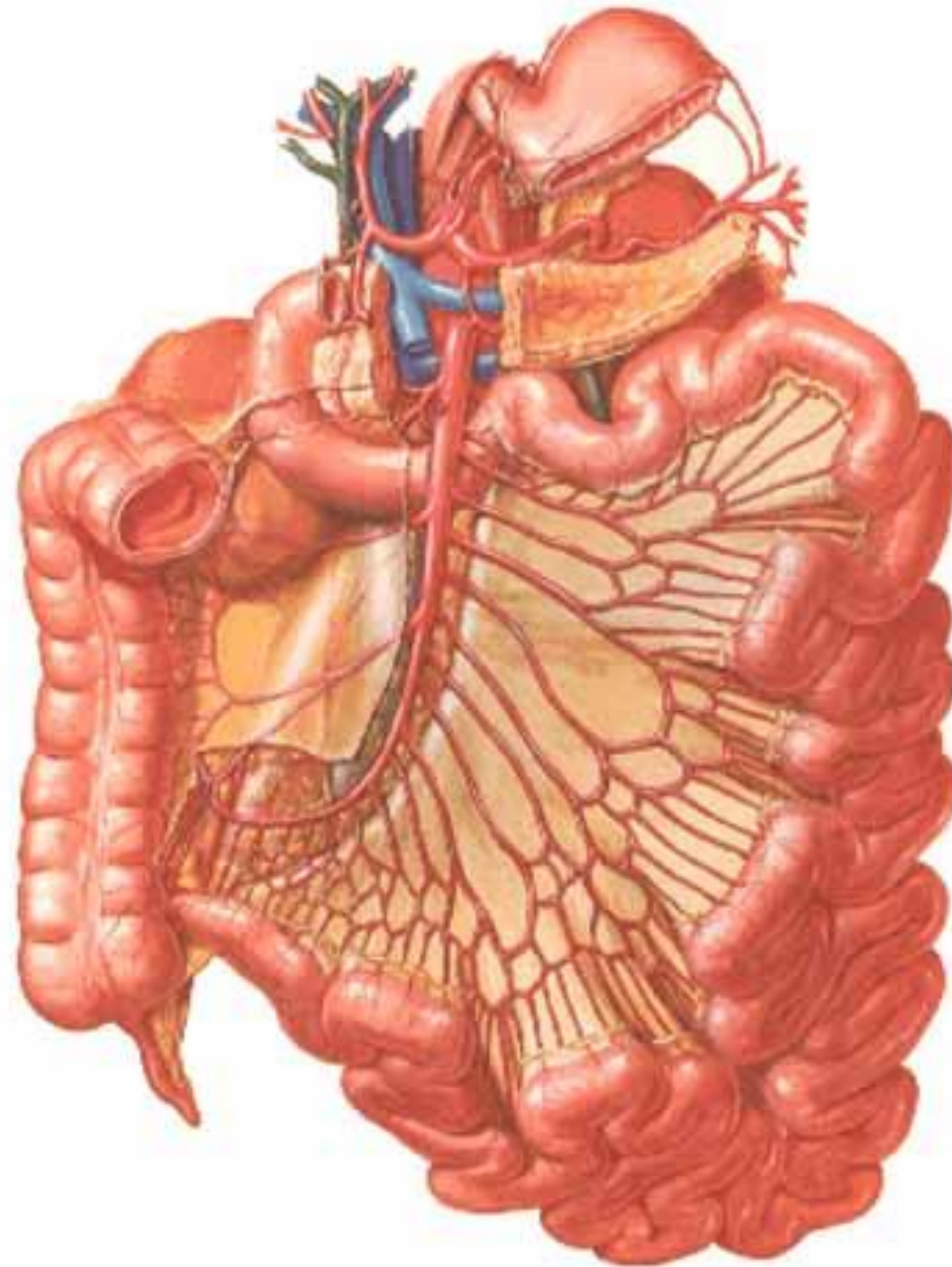


Ileum



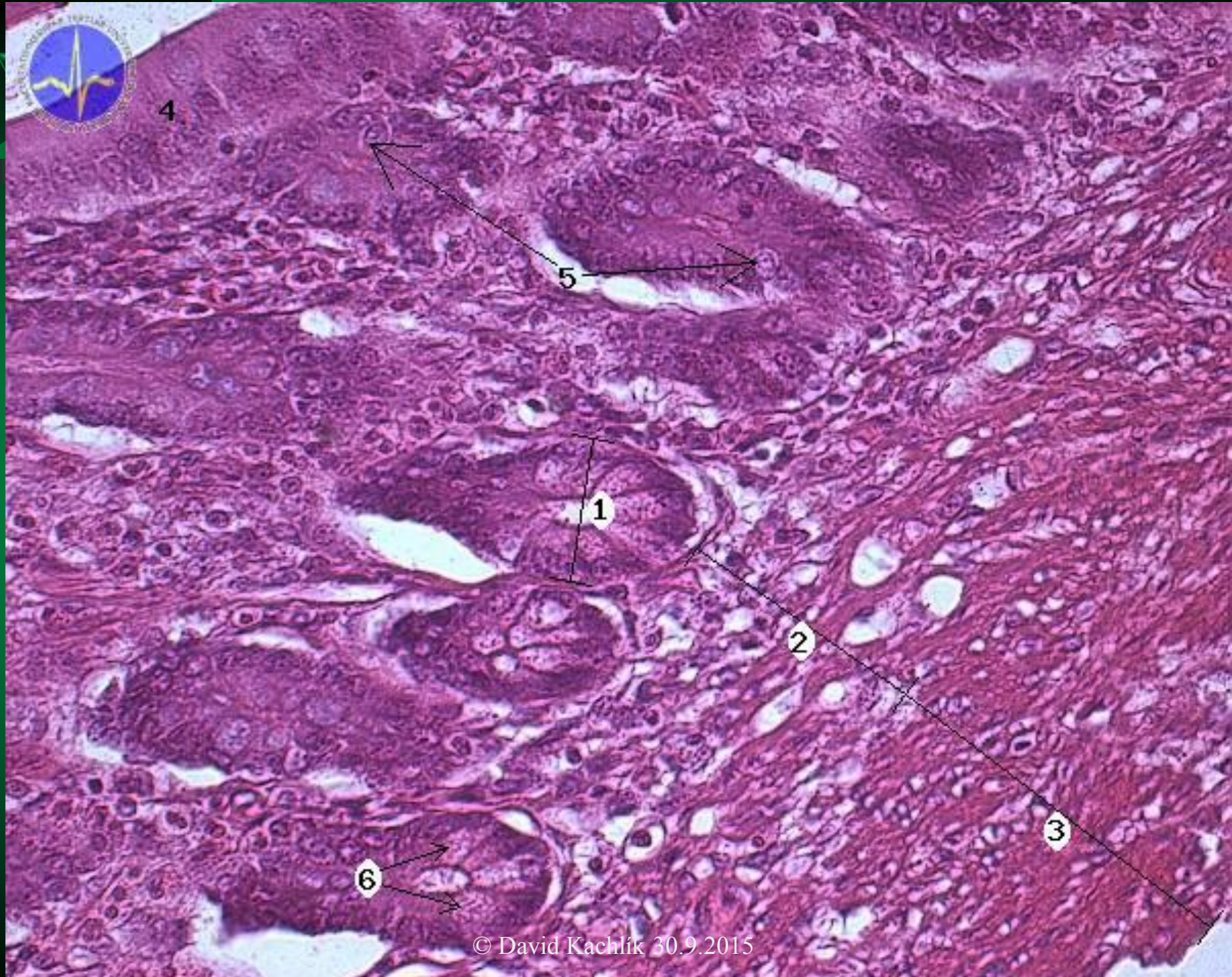
Jejunum + ileum - *supply*

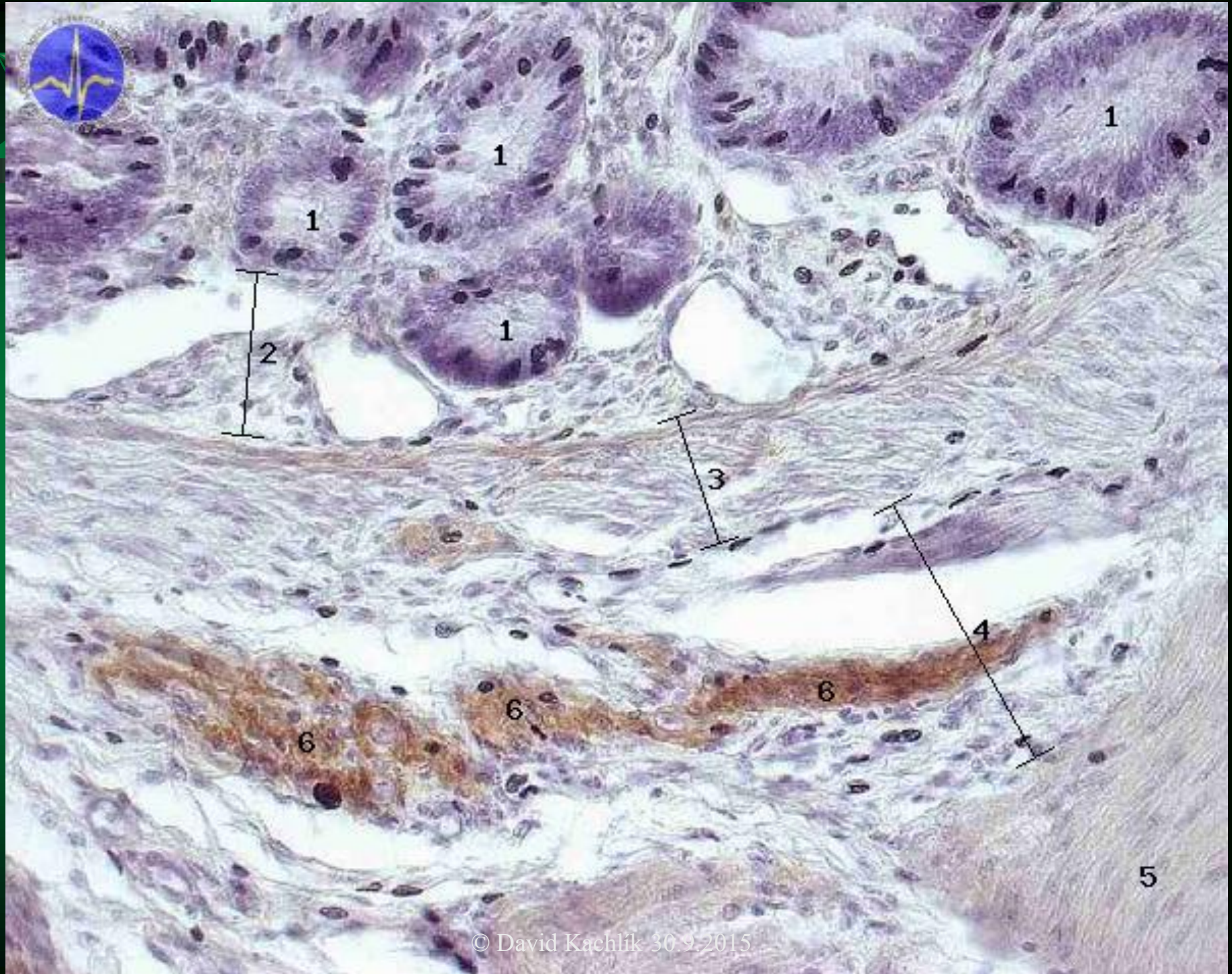
- ▼ arteries: **a. mesenterica sup.** → aa. jejunales + ileales + aa. ileocolica → arkády (*parallel Dwight's artery* → arteriolae rectae)
- ▼ Veins: correspon to arteries
- ▼ Lymph: 3 rows of n.l.mesenterici sup.
- ▼ Nerves: n. X + sympathetic



Small intestine - HE










Small intestine - *diseases*

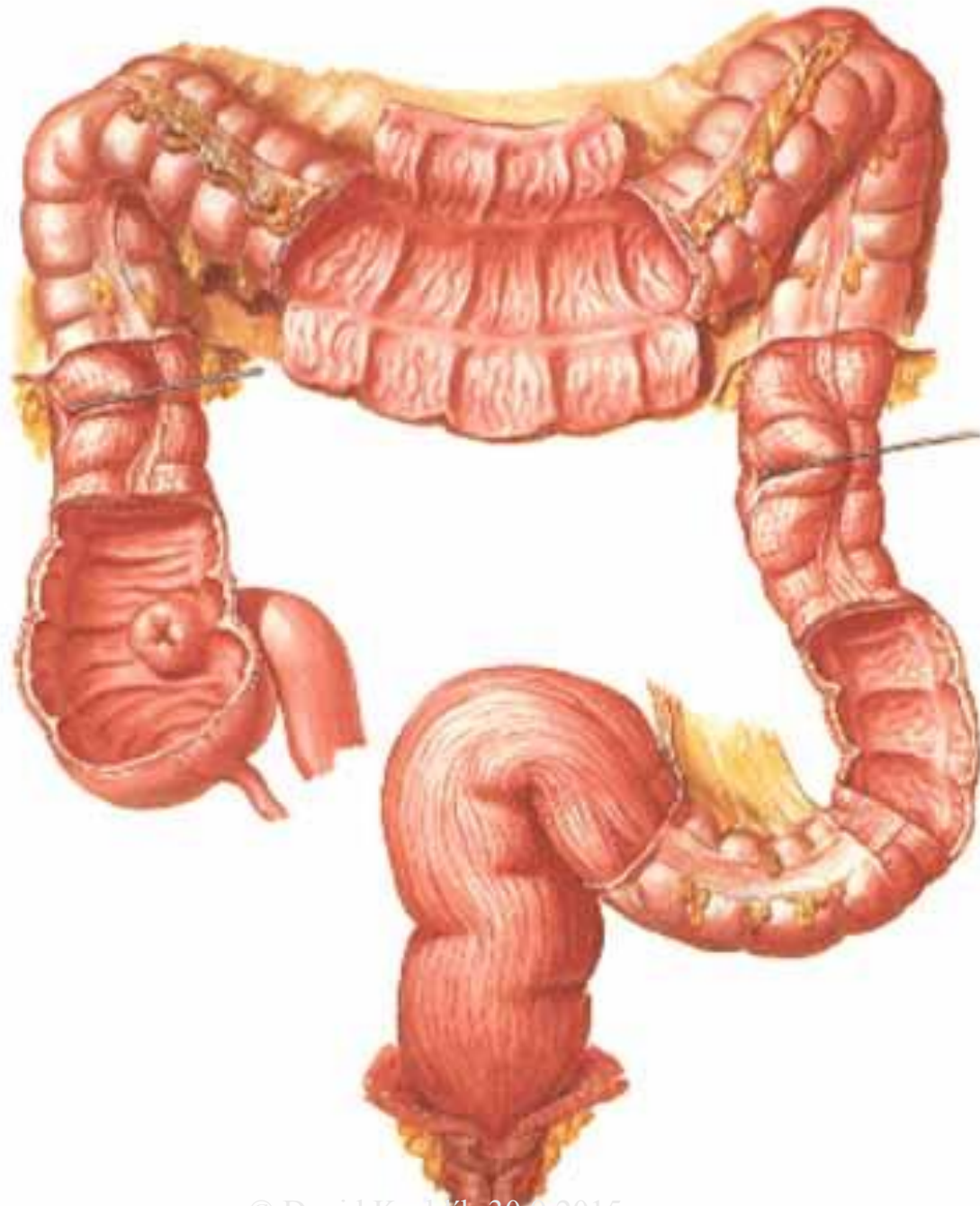
- ✓ *duodenal ulcer*
- ✓ *inflammation – morbus Crohn, colitis ulcerosa*
- ✓ *tumors – very rare – carcinoid*
- ✓ *coeliakia*



Large intestine = **Intestinum crassum**

- ✓ caecum + appendix vermiformis
- ✓ colon ascendens, transversum, descendens, sigmoideum
- ✓ rectum
- ✓ canalis analis

- ✓ flexurae coli dx.+ sin.





Large intestine - *arteries*

✓ a. mesenterica sup.

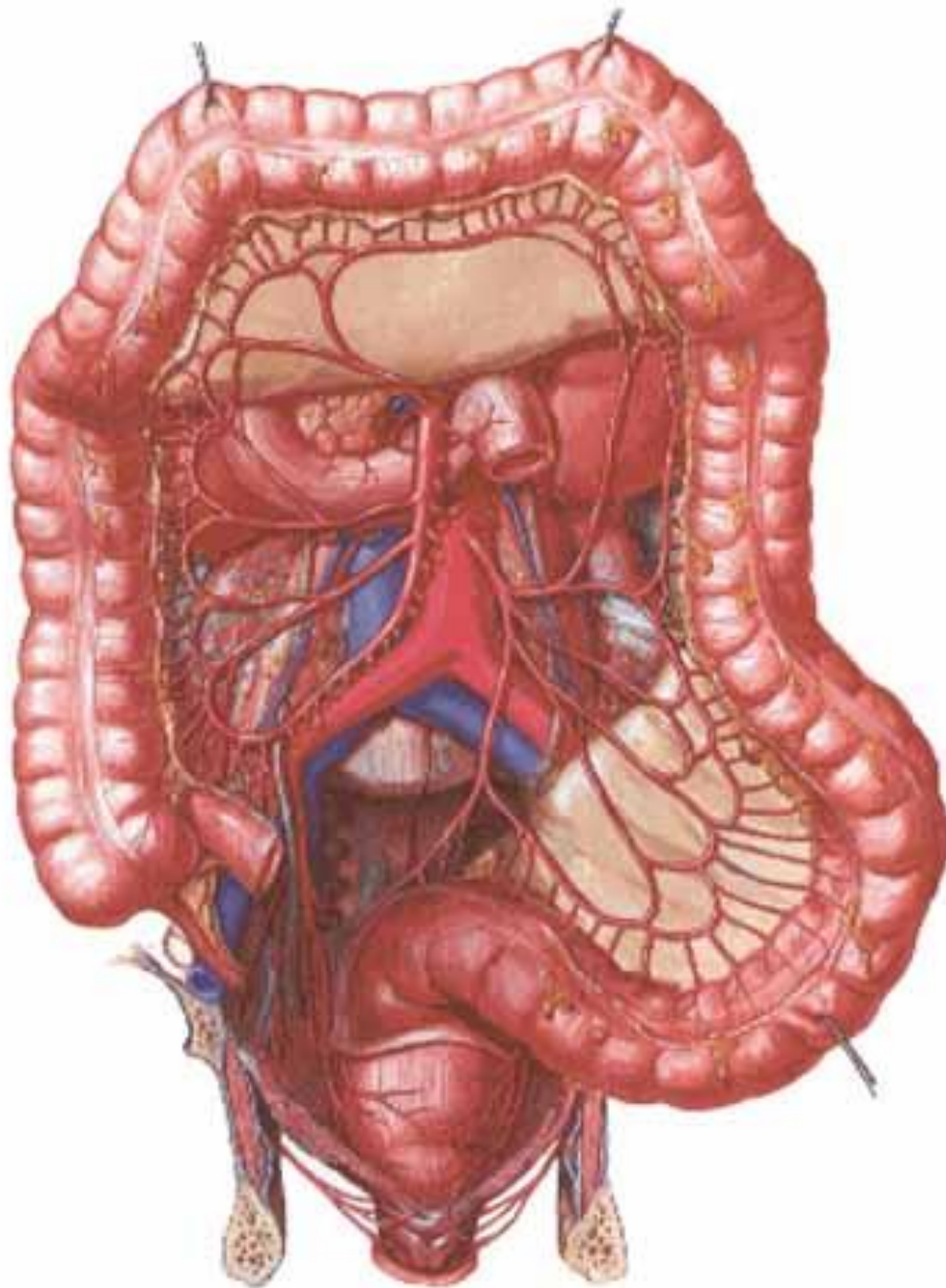
- → a. ileocolica → a. ceacalis ant. + post., a. appendicularis
- → a. colica dx. (colon ascendens)
- → a. colica media (colon transversum)

✓ a. mesenterica inf.

- → a. colica sin. (pro colon descendens)
- → aa. sigmoideae (3-4)

arteria marginalis *Drummondi*

anastomosis magna *Halleri* = arcus *Riolani*





Large intestine – *other supply*

- ✓ Veins: correspond to arteries → v. portae
- ✓ Lymph: 3 rows of n.l. colici → n.l. preaortici
- ✓ Nerves:
 - parasympathetic: n. X down to flexura coli sin. (= *Cannon-Böhme's*), then sacral parasympathetic (S2-4)
 - sympathetic: z ggl. coeliacum, mesentericum sup. + inf.



Mucosa of large intestine

- ✓ *plicae semilunares*
- ✓ *no villi*
- ✓ *deeper Lieberkühn's crypt*
 - enterocytes – less of microvilli
 - goblet cells are numerous
 - *Paneth cells are missing*
 - endocrine cells (DNES) are present



Other layers of large intestine wall

- ▼ tunica muscularis externa
 - inner circular - haustrations
 - outer longitudinal – reduced to *taenie coli*
 - mesenterica
 - omentalis
 - libera
 - *besides appendix and rectum !*



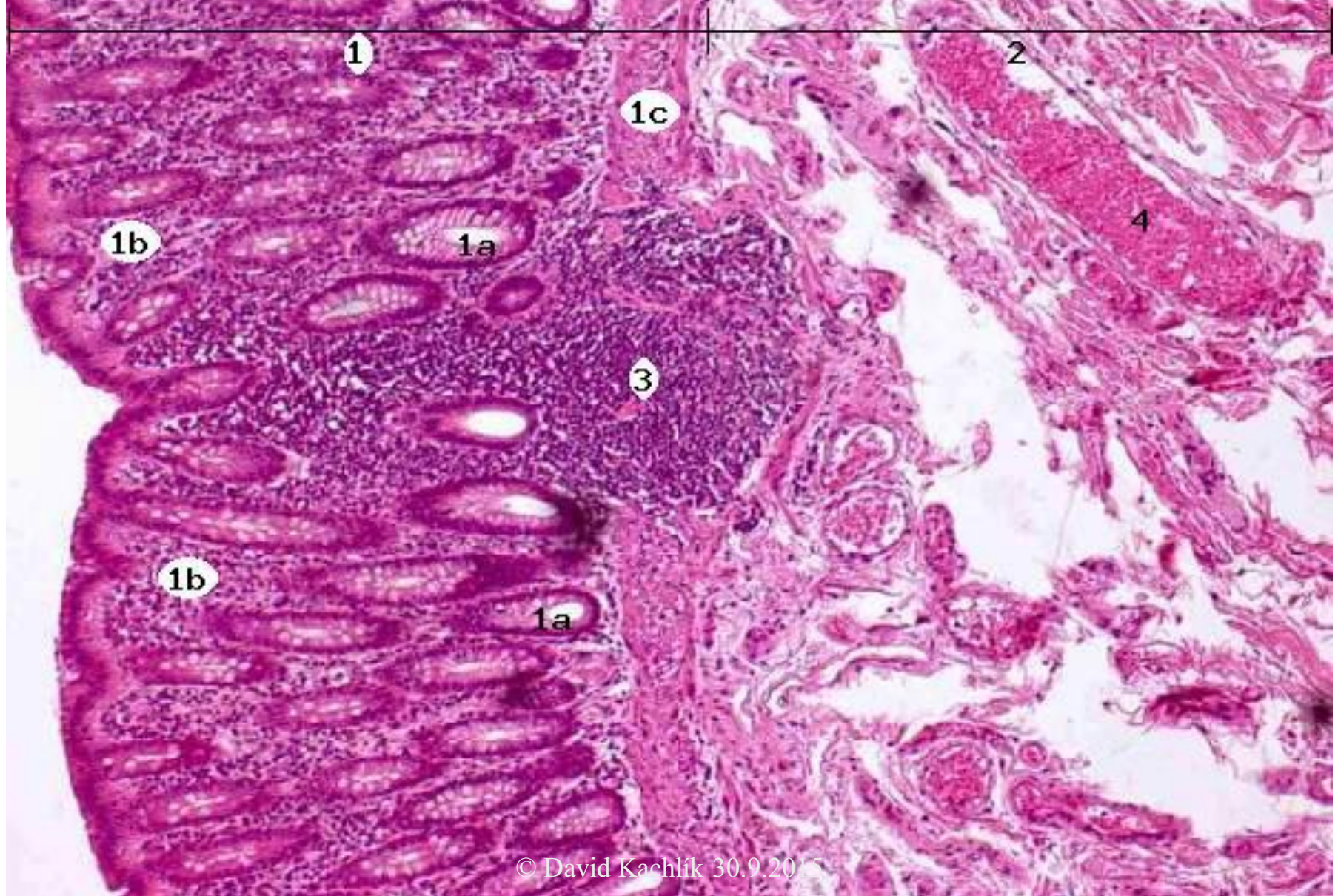
Large intestine - tunica serosa

Fixation and relation to peritoneum

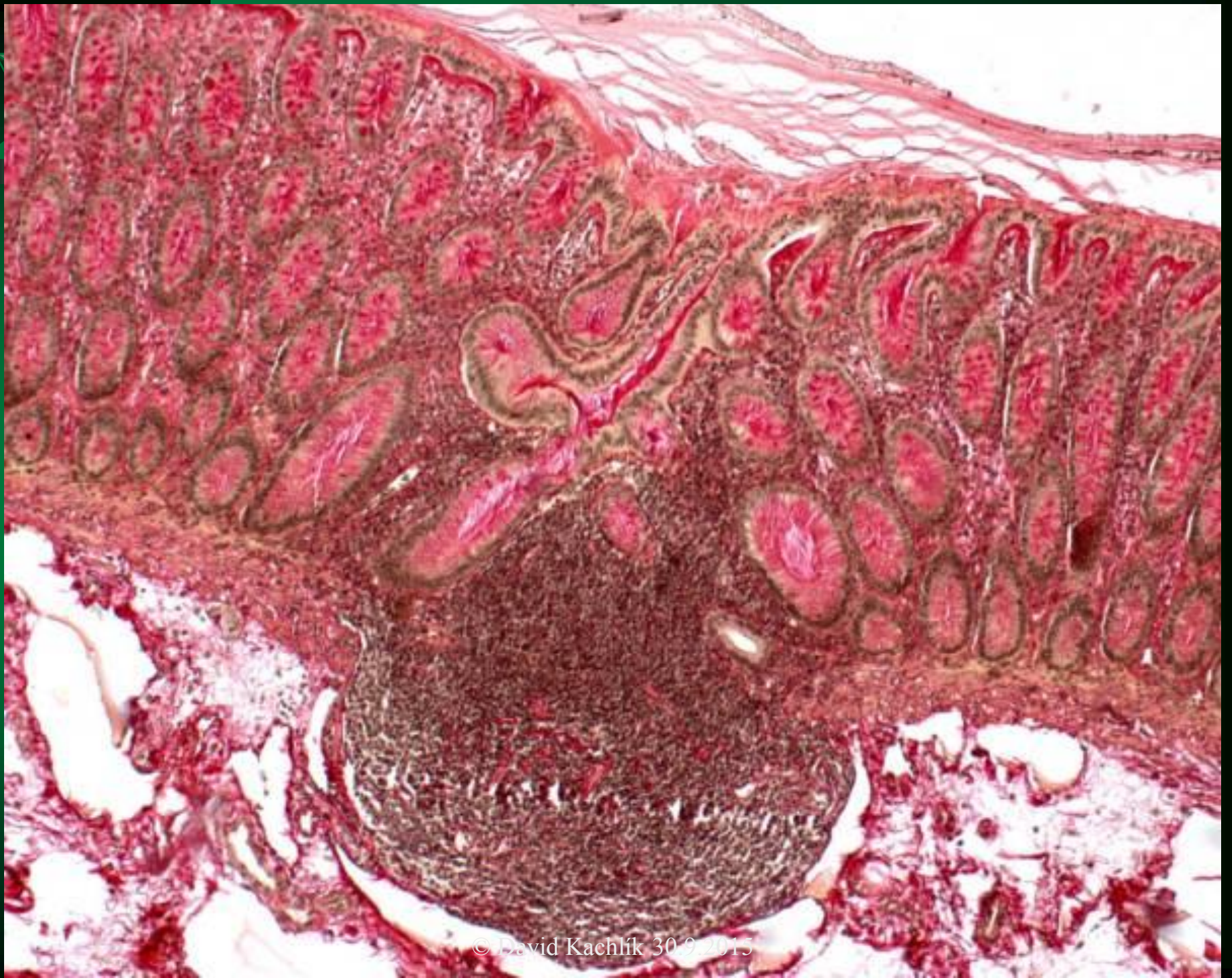
- ✓ intraperitoneal: appendix, colon transversum + sigmoideum - *having their meso-*
- ✓ mesoperitoneal: colon ascendens + descendens – *half-grown with the posterior wall*
- ✓ rectum – partially intraperitoneal + subperitoneal
- ✓ caecum – variability – *see picture*
- ✓ appendices omentales
 - adipose tissue
 - unclear function

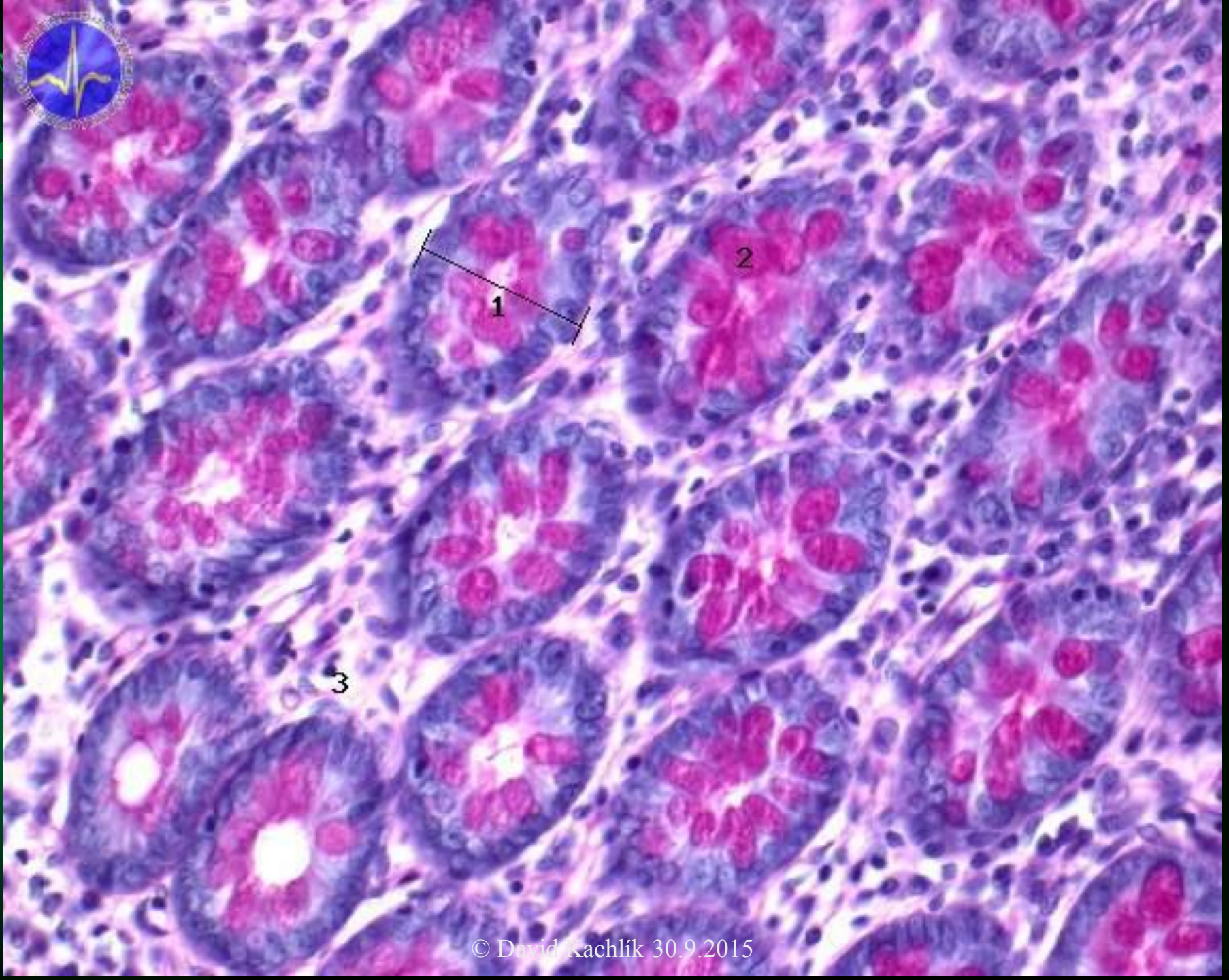


Large intestine - HE





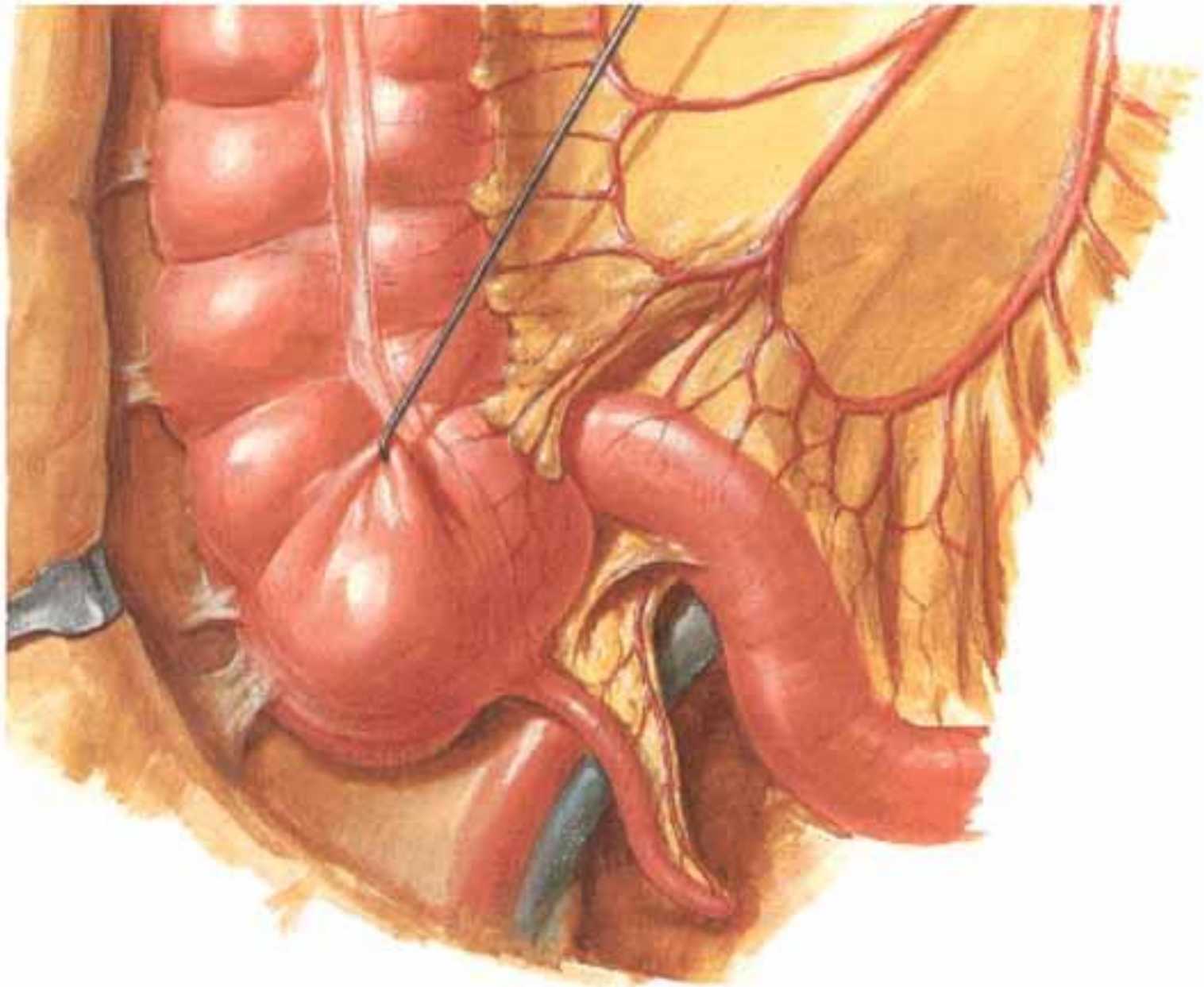


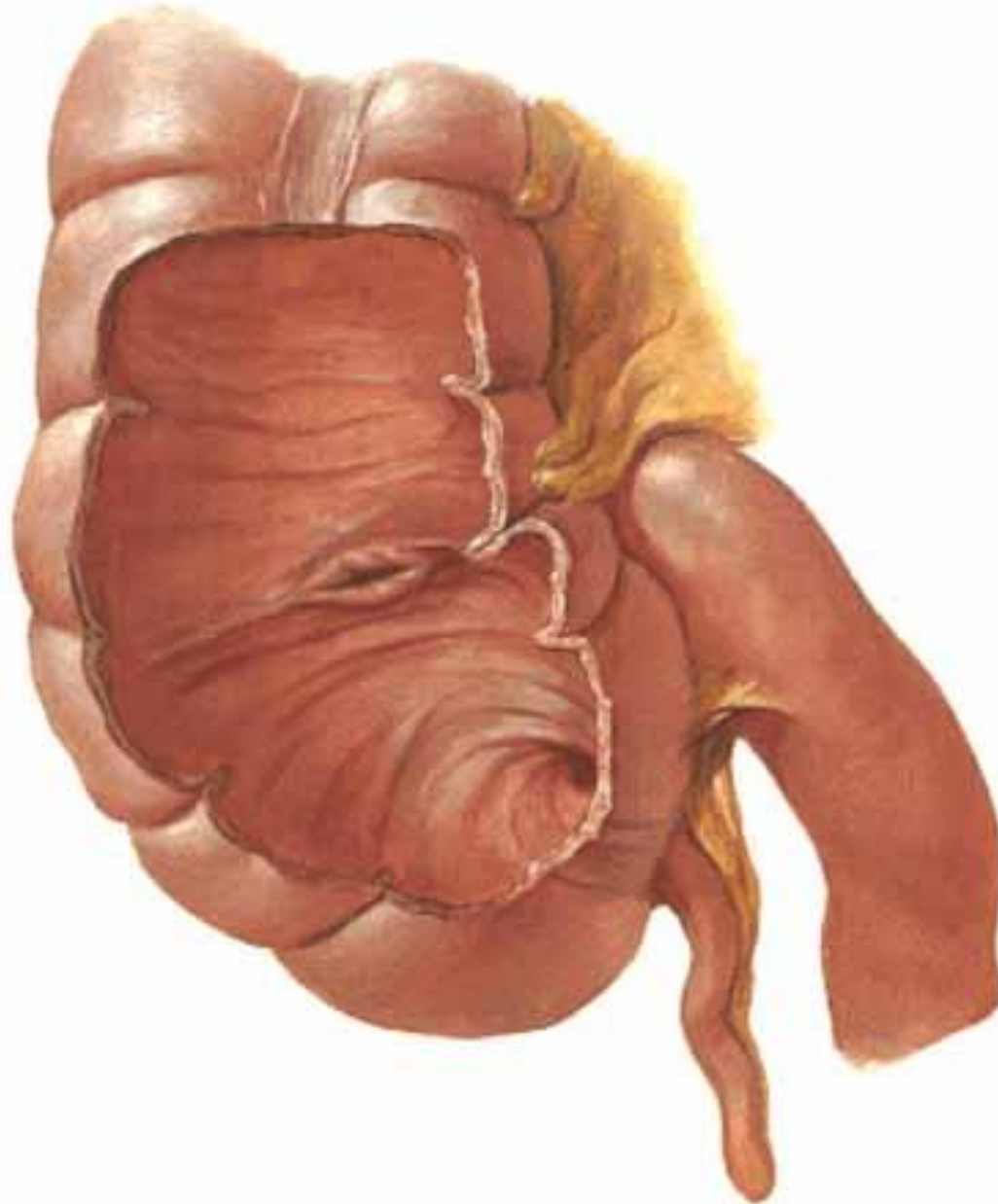


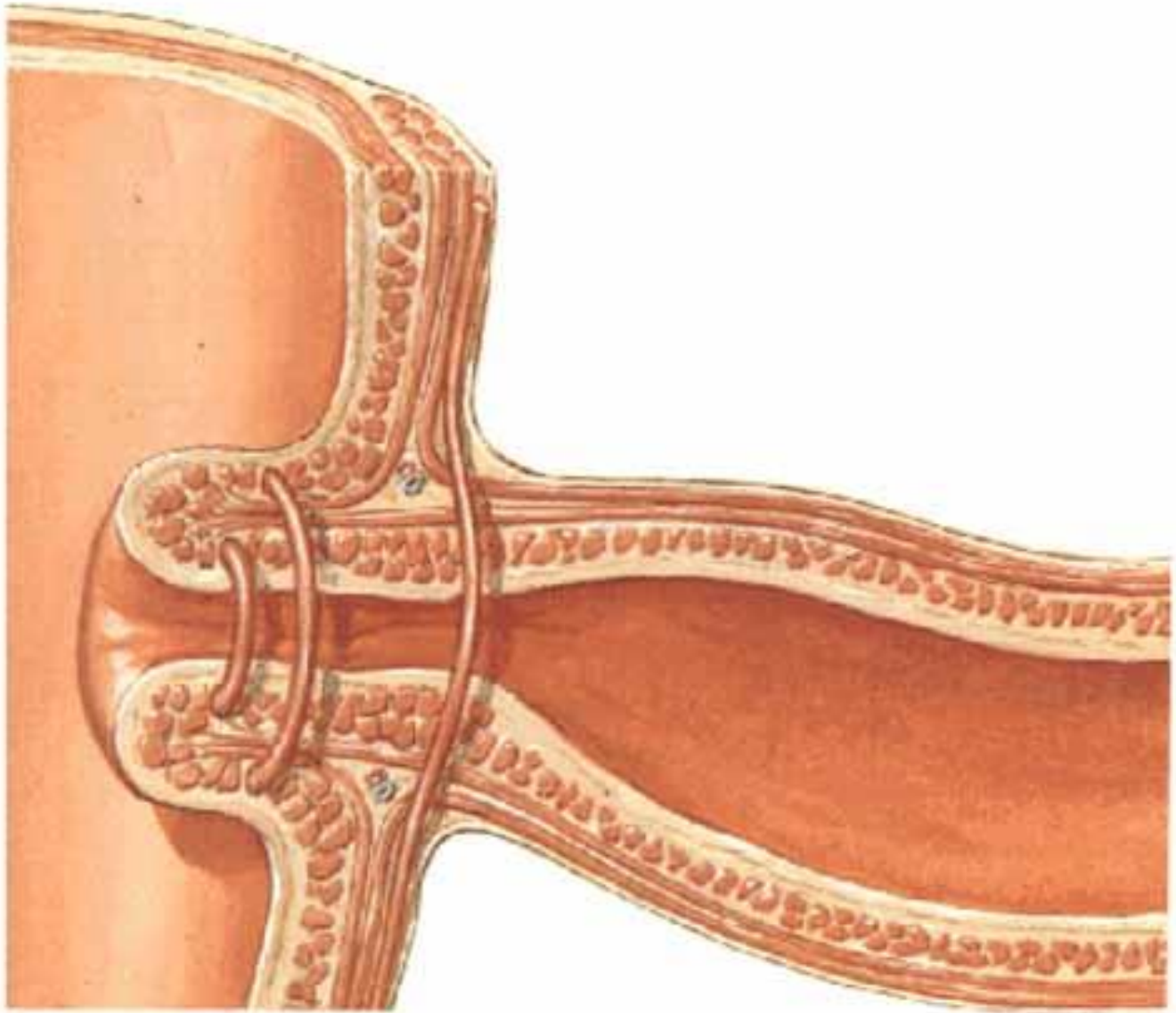


Caecum

- ✓ papilla et ostium ileale *Bauhini s. Tulpi* (frenulum, labrum)
- ✓ intraperitoneally, often no mesocaecum
- appendix vermiformis:** 2-30 cm, mesoappendix, ostium, lig. appendiculoovaricum *Cladoi*
- ✓ 6 positions: positio pelvina, retro-, pre-, sub-, latero- et ileocaecalis /most frequent positio retrocaecalis/
- ✓ projection: *McBurney's* (on *Monro's* line) and *Lanz's* point (on linea interspinosa)









Ileocecal Region

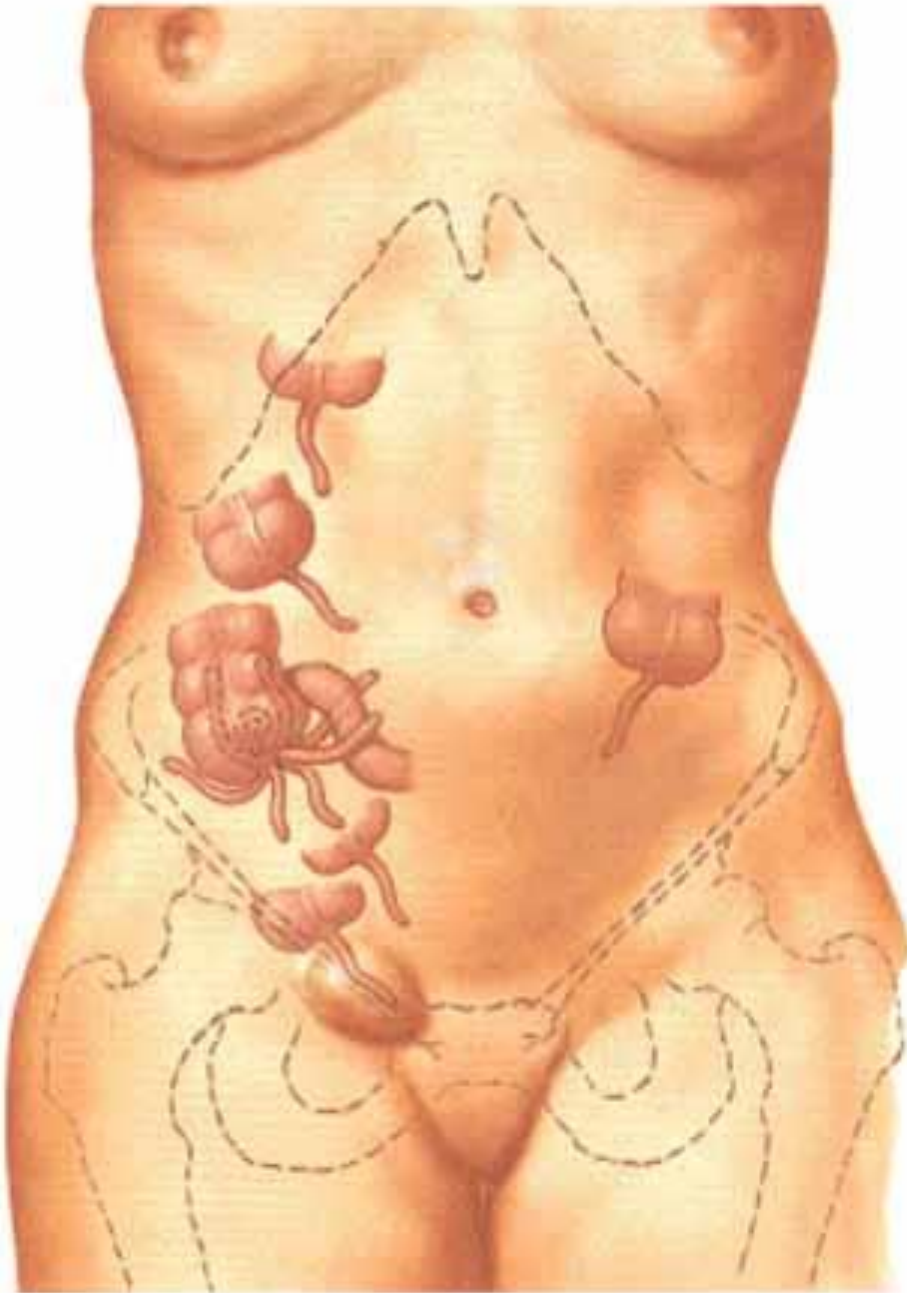
Variations in Posterior Peritoneal Attachment





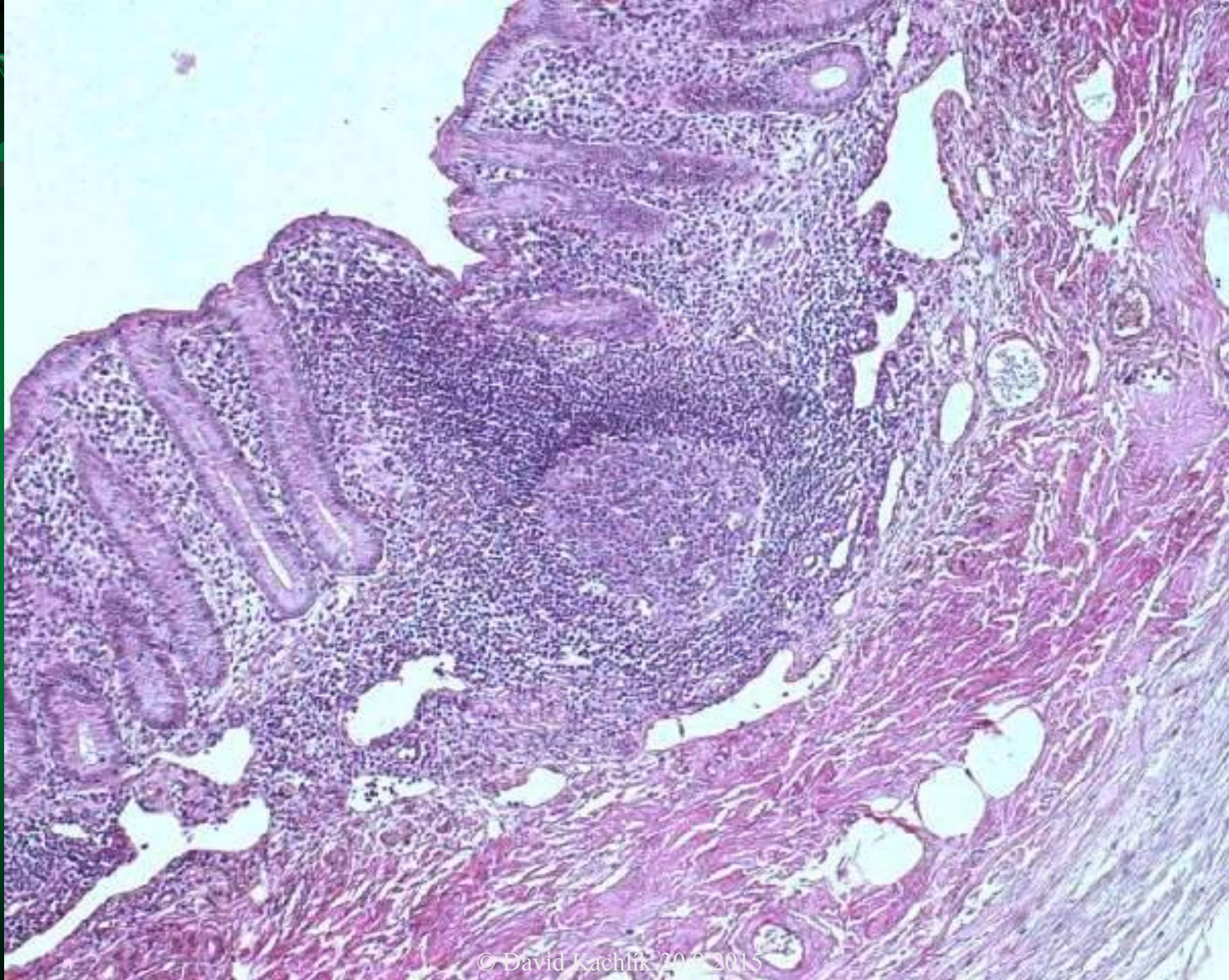
Appendix vermiformis caeci

- ✓ Paneth cells are present
- ✓ lamina propria mucosae
 - fulfilled with lymphatic tissue = noduli lymphoidei aggregati („tonsilla abdominalis“)
- ✓ longitudinal musculature forms no taenia
 - circular one strongly reduced
- ✓ *Amyand's hernia* – appendix in sac of inguinal hernia
 - Claudius Amyand, 1735 – physician to George II.



Appendix vermiformis - HE

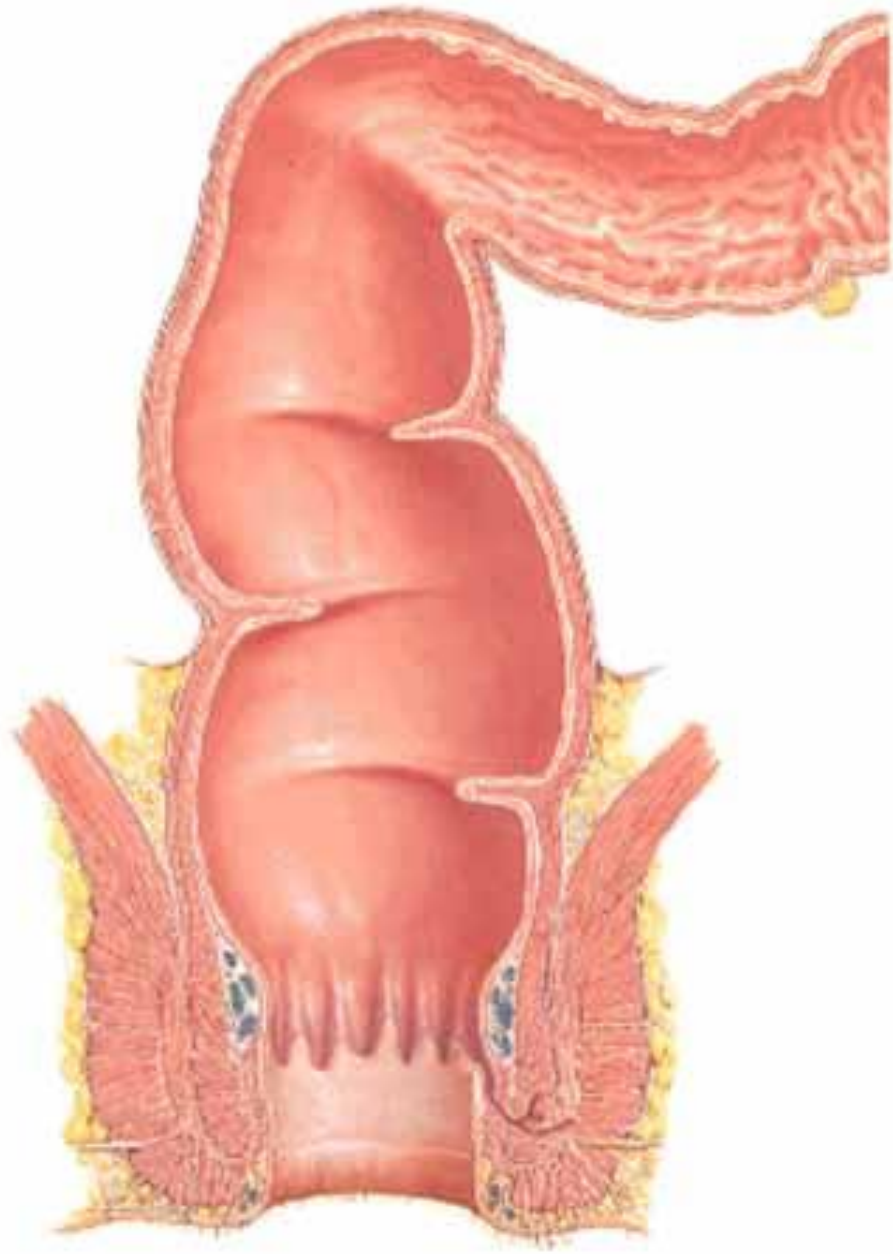


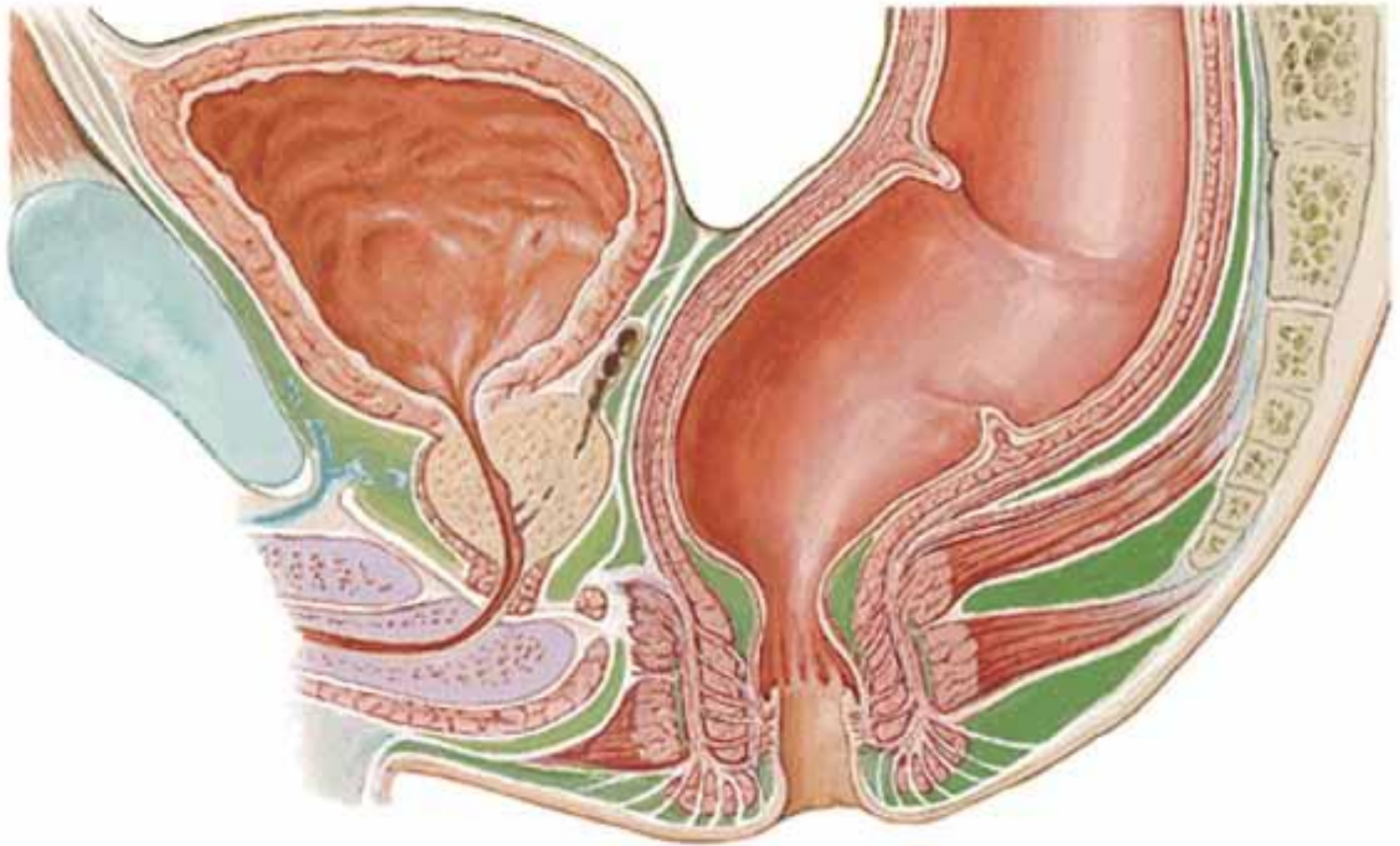




Rectum

- ✓ description: ampulla, flexura sacralis et laterales (superodextra lat., intermedisinistra lat., inferodextra lat.),
- ✓ structure: plicae transversae
 - plica dx. *Kohlrauschi*
 - plicae sin. sup. + inf. *Houstoni* s. *Nelatoni*
- ✓ longitudinal musculature forms no taenia
lig. recti lat.

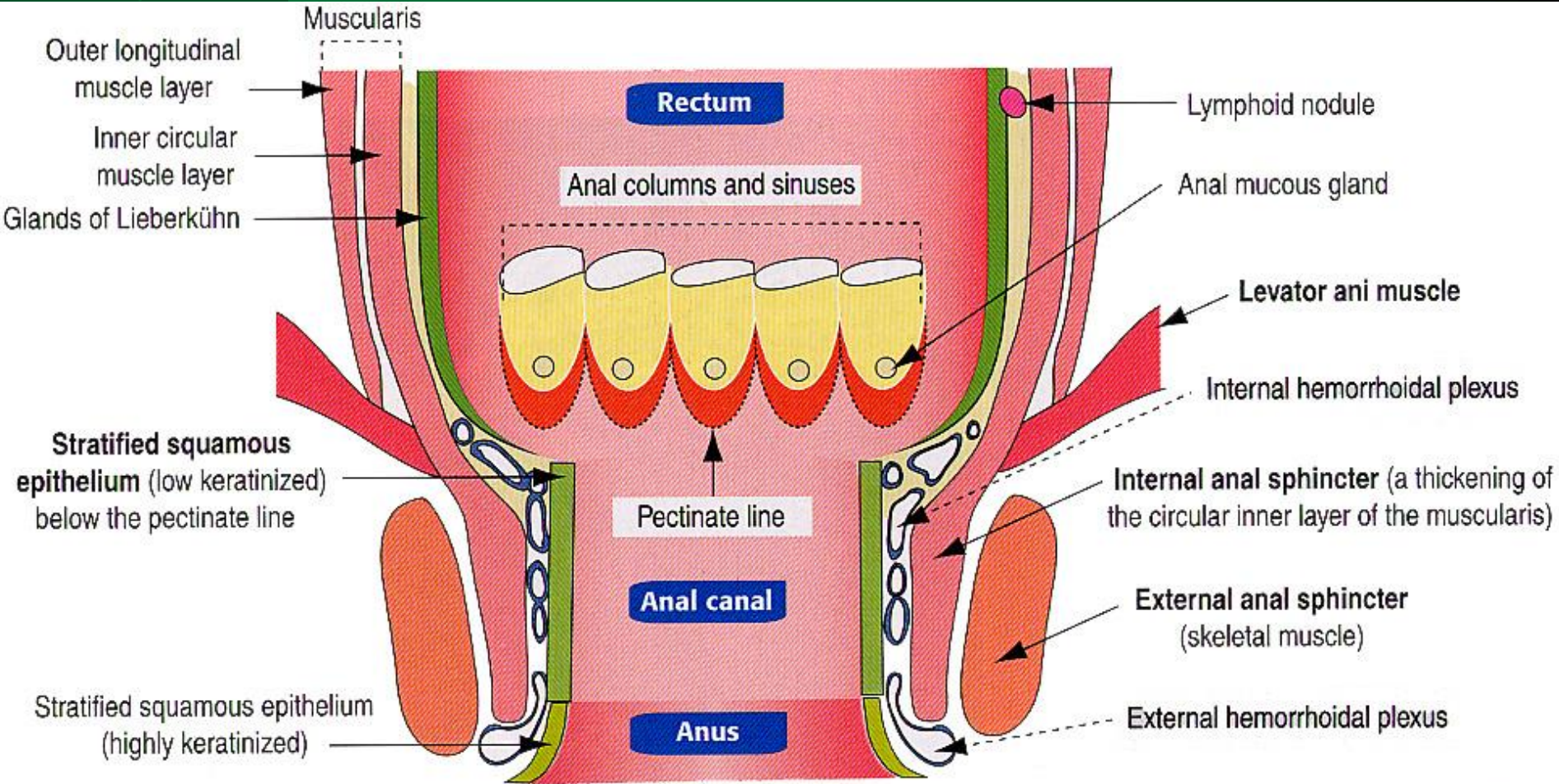


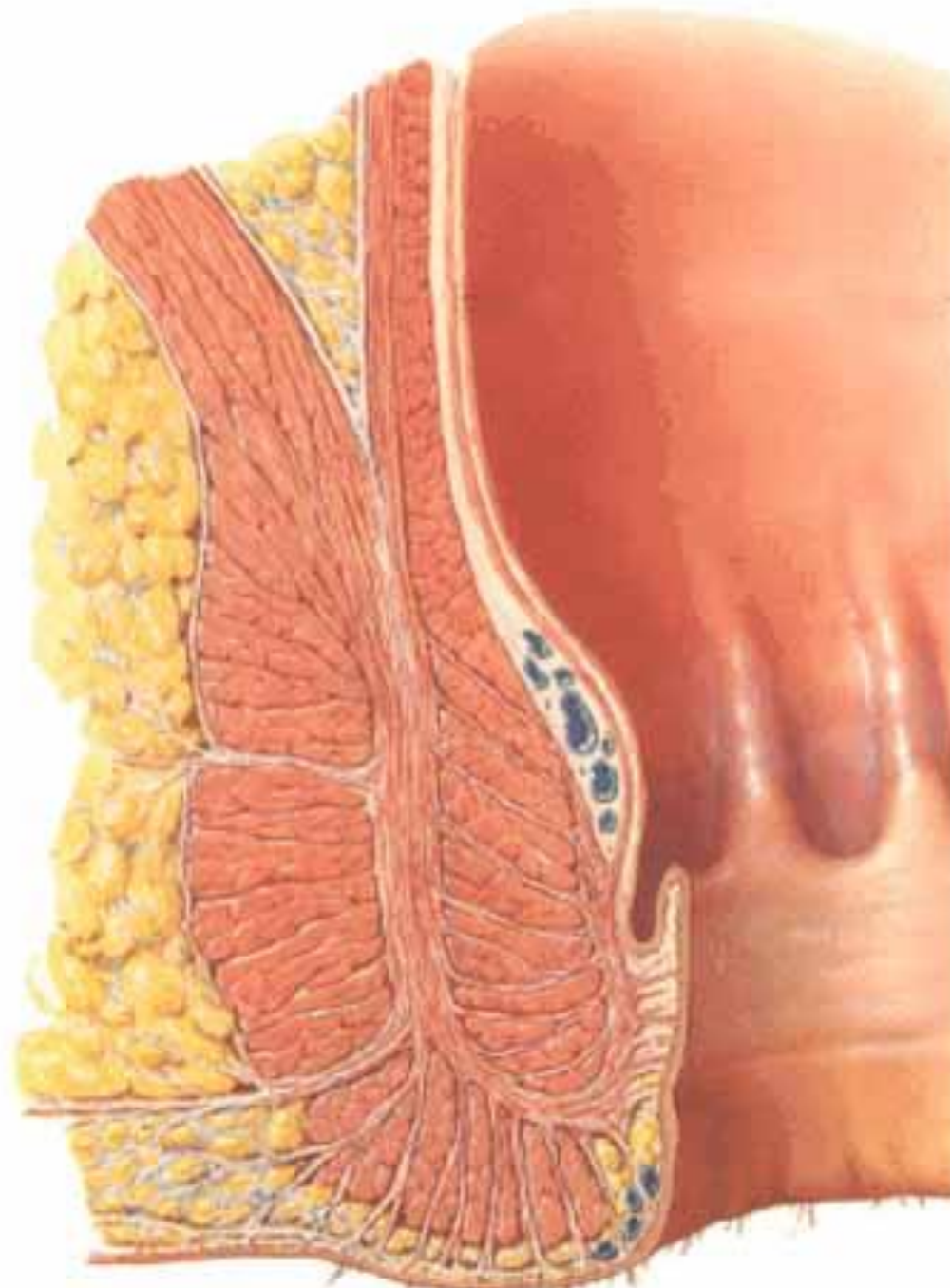




Canalis analis

- ✓ description: flexura anorectalis = perinealis, anus
- ✓ structure: columnae, valvulae, sinus, lineae anocutanea et pectinata, pecten, zona transitionalis
- ✓ muscles: m. sphincter ani ext. et int.
- ✓ peritoneum: on upper $\frac{1}{4}$ only = partially intraperitoneal + subperitoneal organ
- ✓ psition: septum rectovesicale♂/rectovaginale♀, fossa ischioanalis



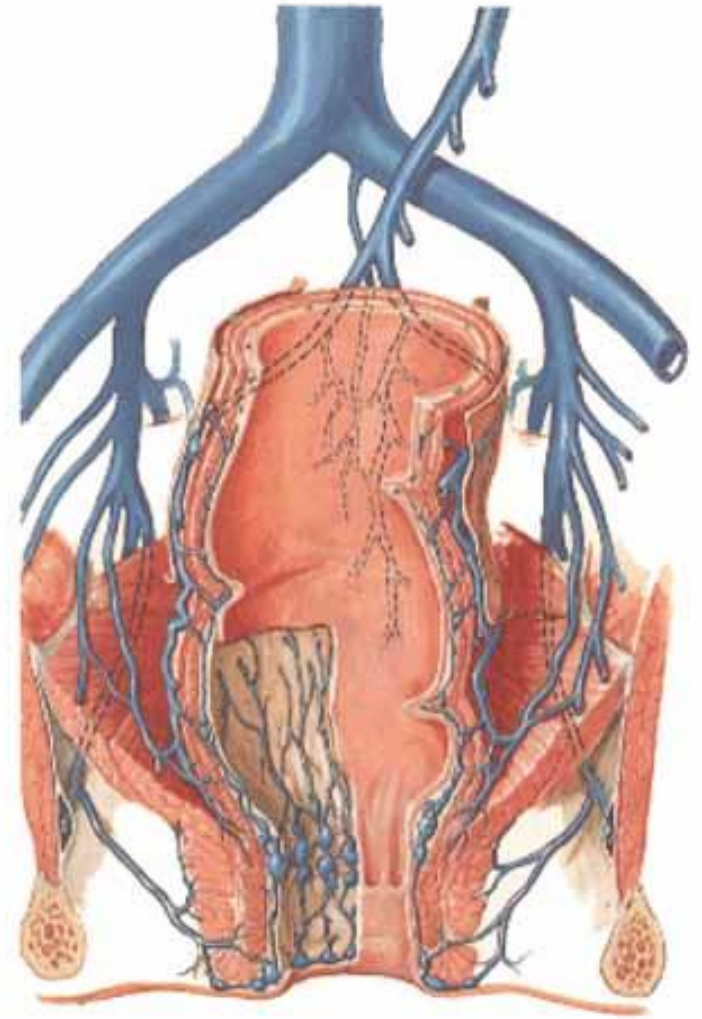
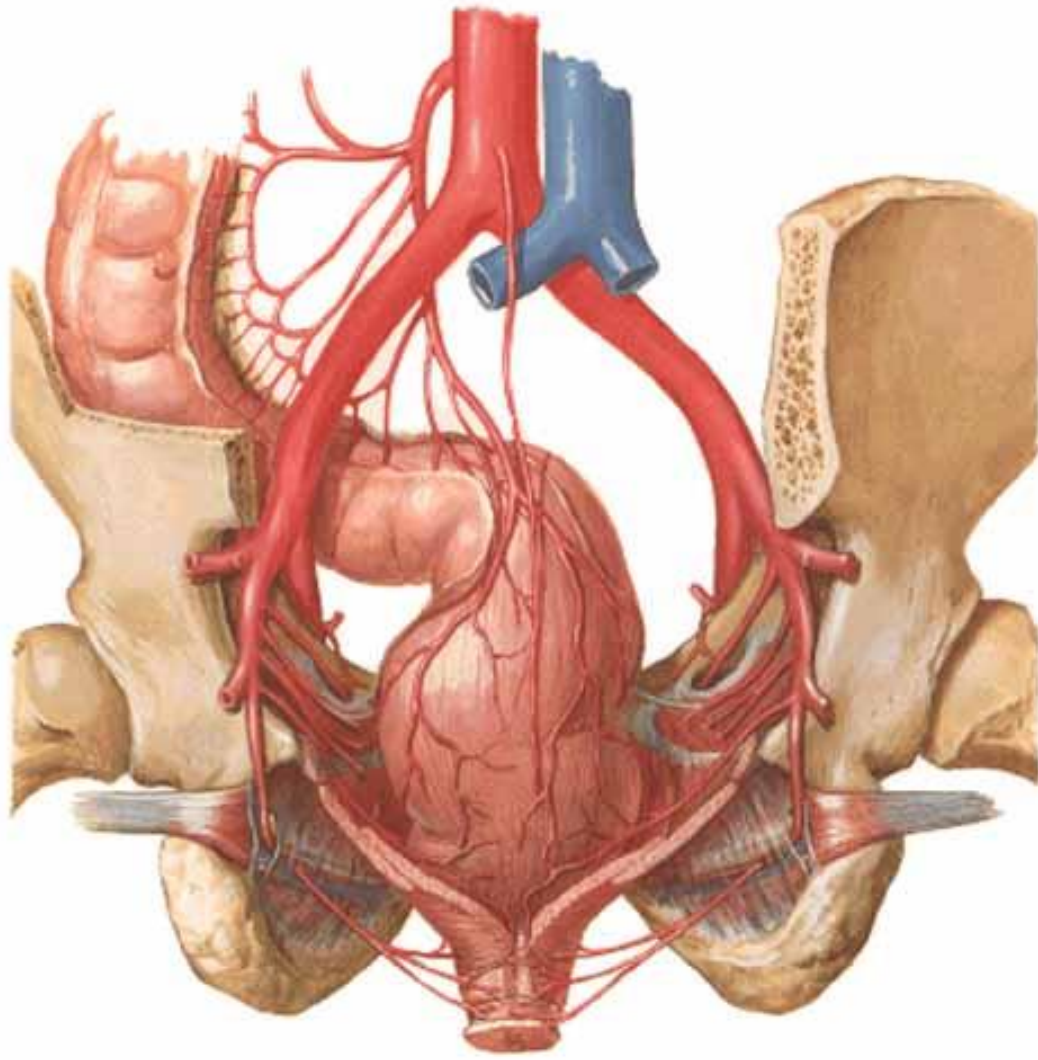




Rectum + canalis analis – *blood vessels*

- ✓ a. mesenterica sup. → a. rectalis sup.
- ✓ a. iliaca int. → a. rectalis media
- ✓ a. iliaca int. → a. pudenda int. → a. rectalis inf.

Veins: plexus venosus rectalis → correspond to arteries → possible portocaval anastomosis





Rectum + canalis analis – *Lymph and Nerves*

- ✓ n.l. mesenterici inf. → n.l. preaortici
- ✓ n.l. iliaci int.
- ✓ n.l. sacrales
- ✓ n.l. inguinales superficiales

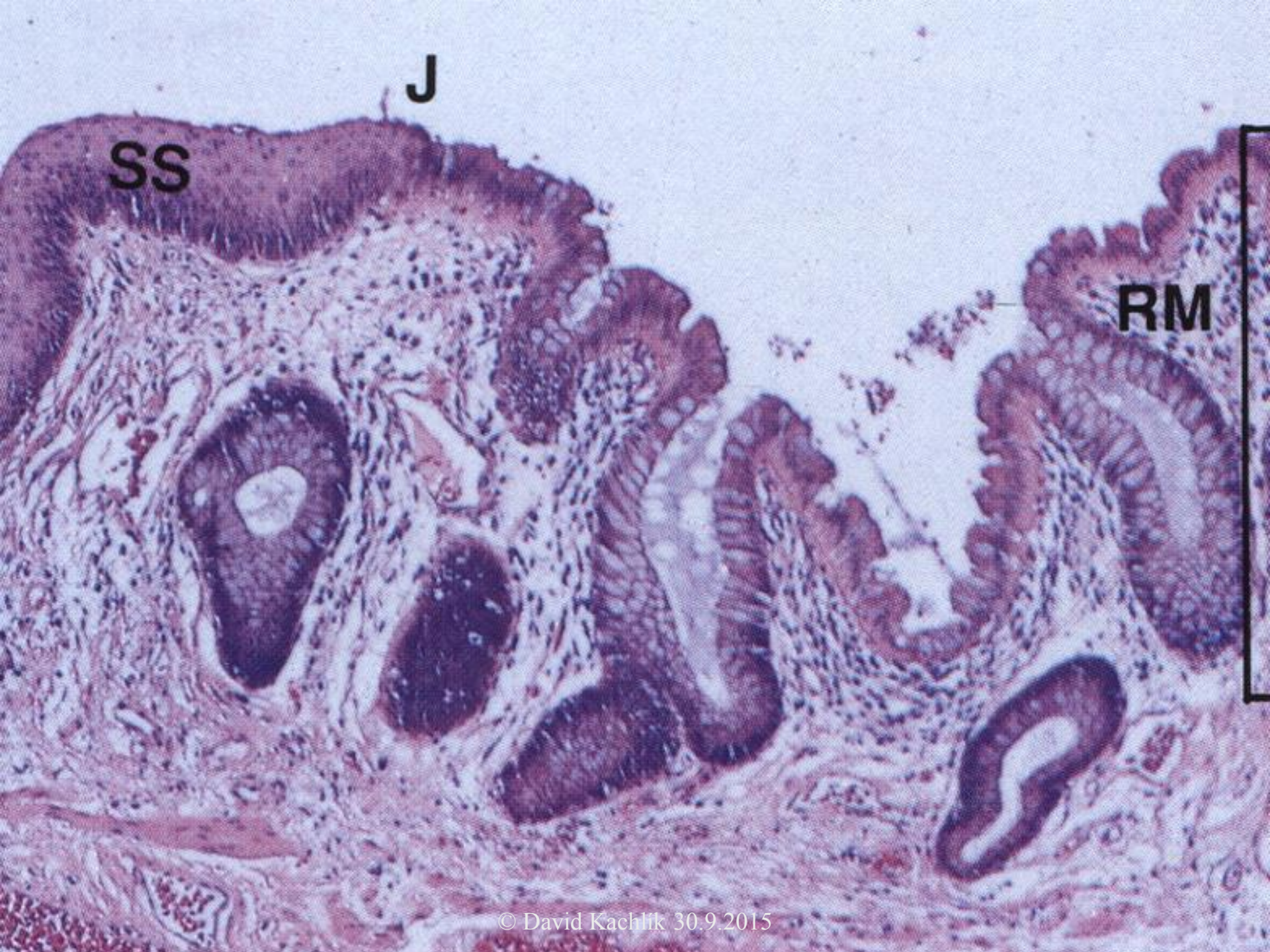
Nerves: - sacral *parasympathetic*

– *sympathetic* by plexus hypogastricus sup. + inf.,
n. pudendus



Canalis analis - *structure*

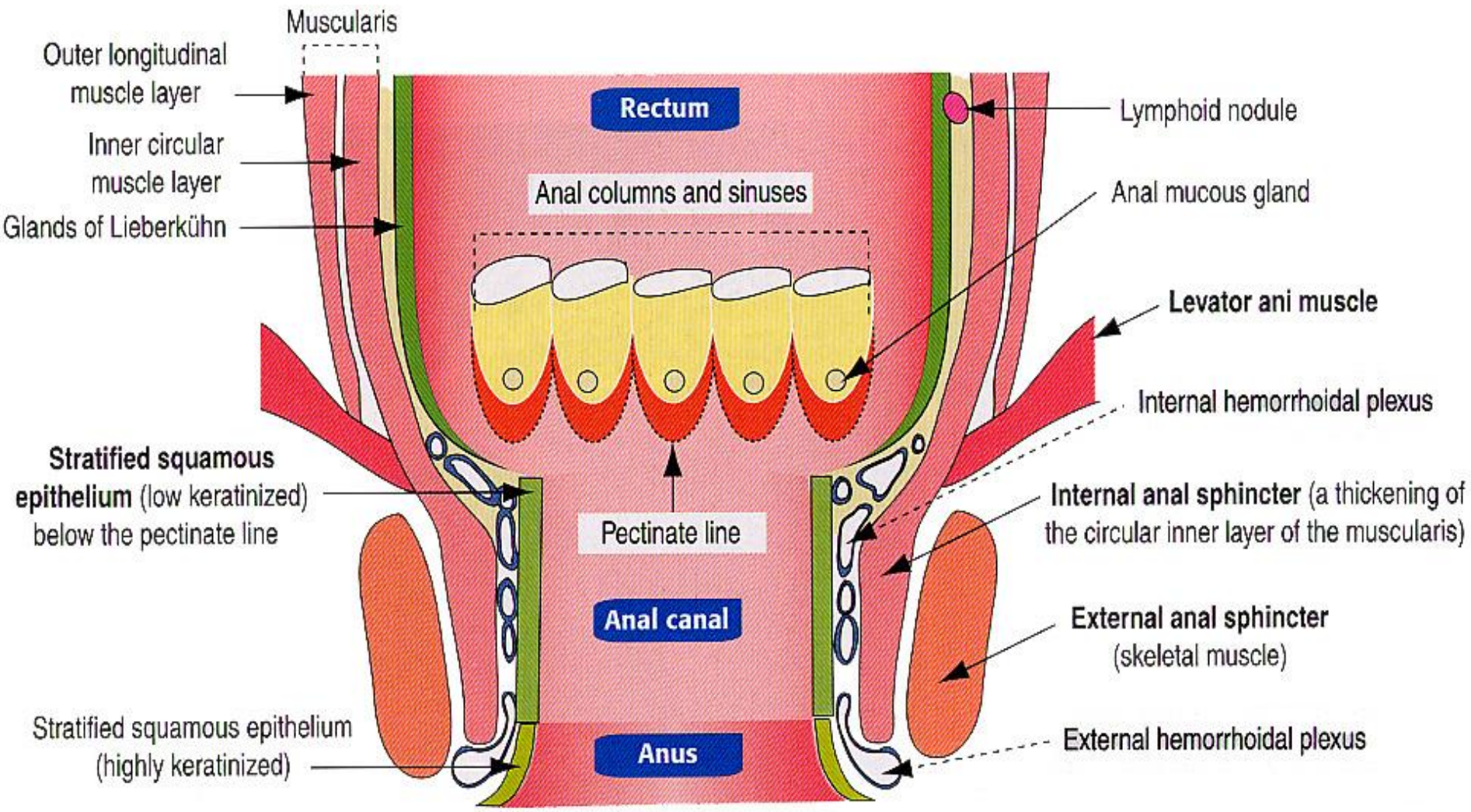
- ✦ *zona haemorrhoidalis - m. sphincter ani int.*
 - *columnae anales (6-10)*
 - change of epithelium – stratified squamous nonkeratinising
 - Anal venous plexus – „cavernous body“ – maintains continence → inner haemorrhoids
- ✦ *zona cutanea – keratinising epithelium*
 - *glandulae circumanales (sweat and apocrine)*



SS

J

RM





Large intestine - *examination*

- ✓ Hemokult – hidden bleeding examination
- ✓ endoscopy – rectoscopy (*rigid*), coloscopy (*flexible*)
- ✓ X-ray- native, contrast - passage, irigography
- ✓ CT



Large intestine - *diseases*

- ✓ *polyps*
- ✓ *tumors – most frequent !!!*
- ✓ *diverticulosis → diverticulitis (Graser's diverticle)*
- ✓ *inflammation – colitis ulcerosa, morbus Crohn*
- ✓ *appendicitis – „the sun may not rise or fall“*
 - *most frequent sudden abdominal accident*
- ✓ *internal / external haemorrhoids*
- ✓ *colostomy – temporary / permanent*