

Biology 224

Human Anatomy and Physiology - II

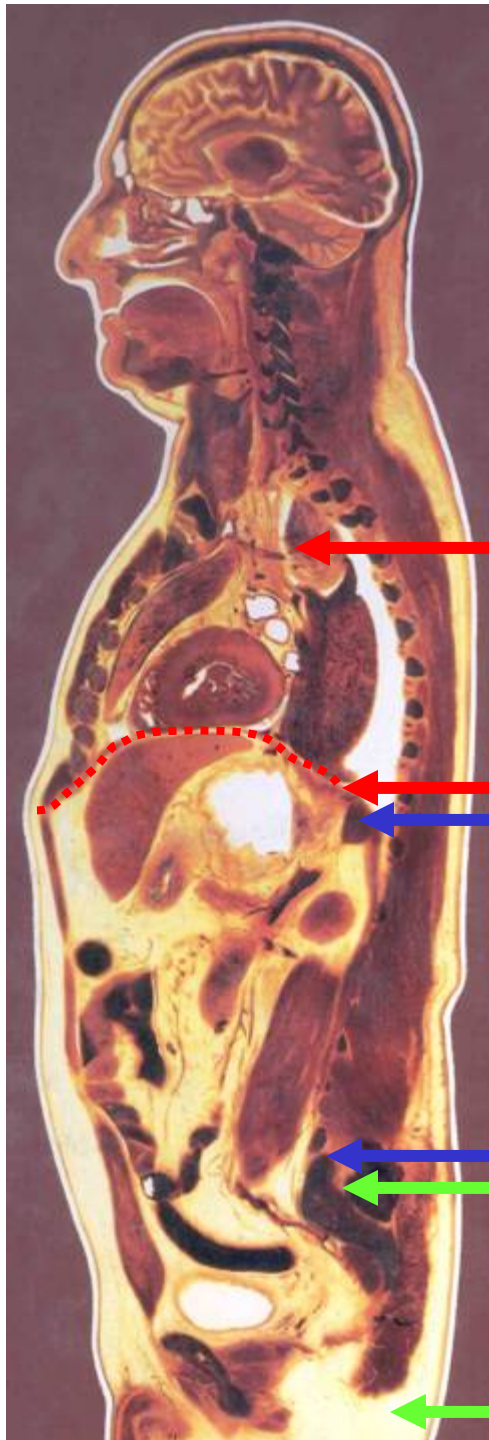
Week 1; Lecture 2; Wednesday

Dr. Stuart S. Sumida

Organizational Overview of Thorax, Abdomen, Pelvis

Introduction to Blood

Organizational Overview of Thorax, Abdomen, Pelvis



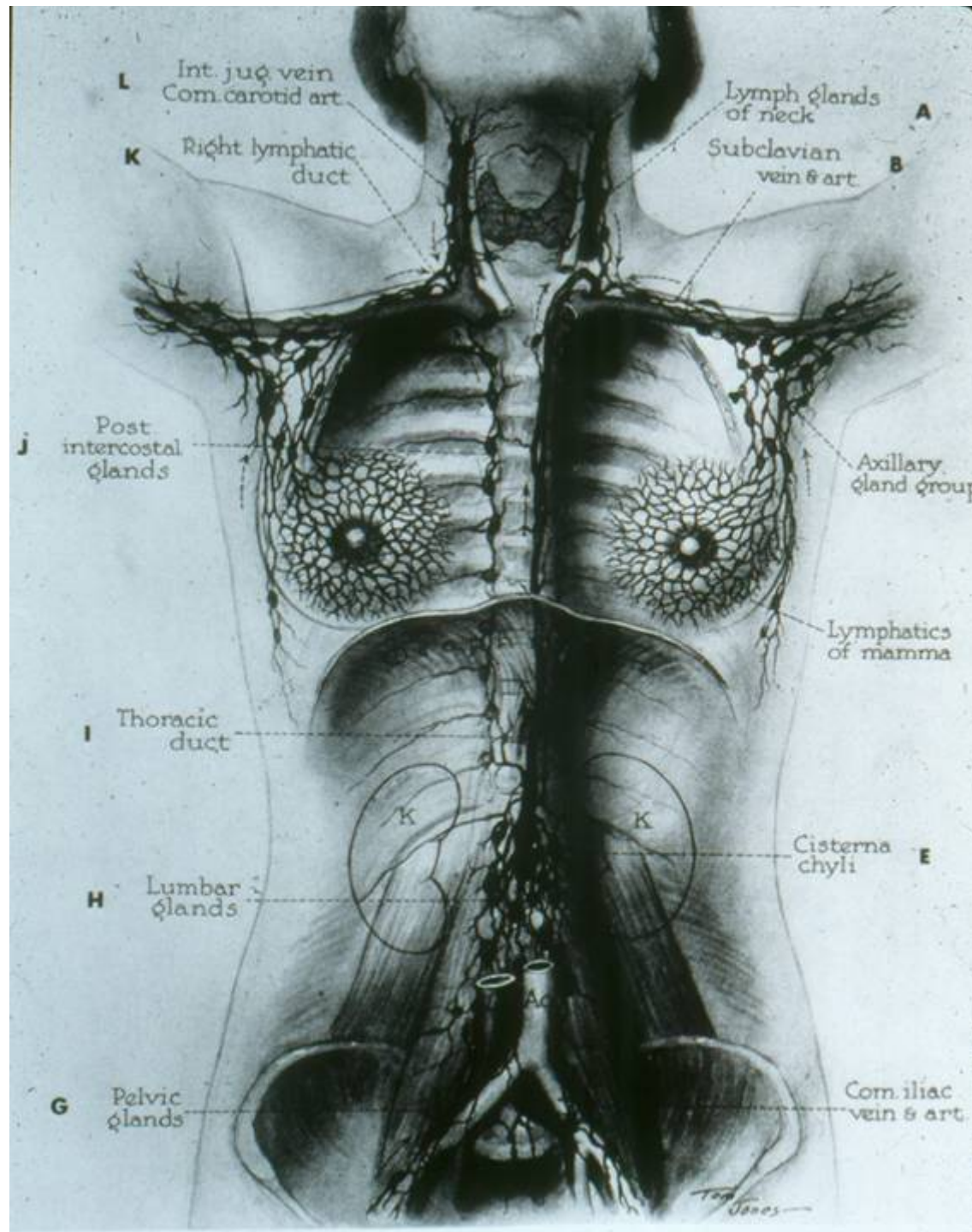
Thorax

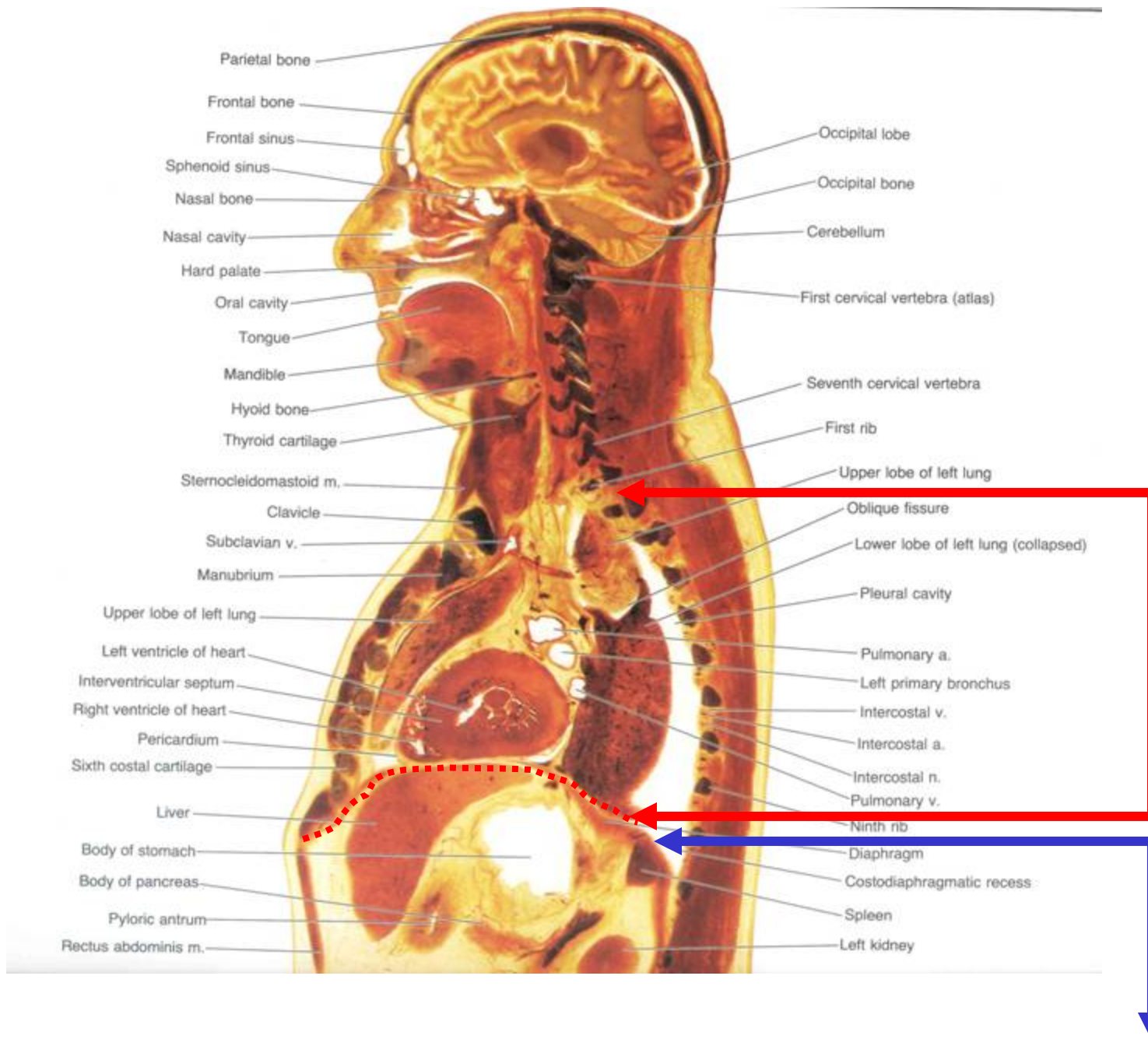
Abdomen

Pelvis/Perineum

Abdomen and Thorax separated by
DIAPHRAGM.

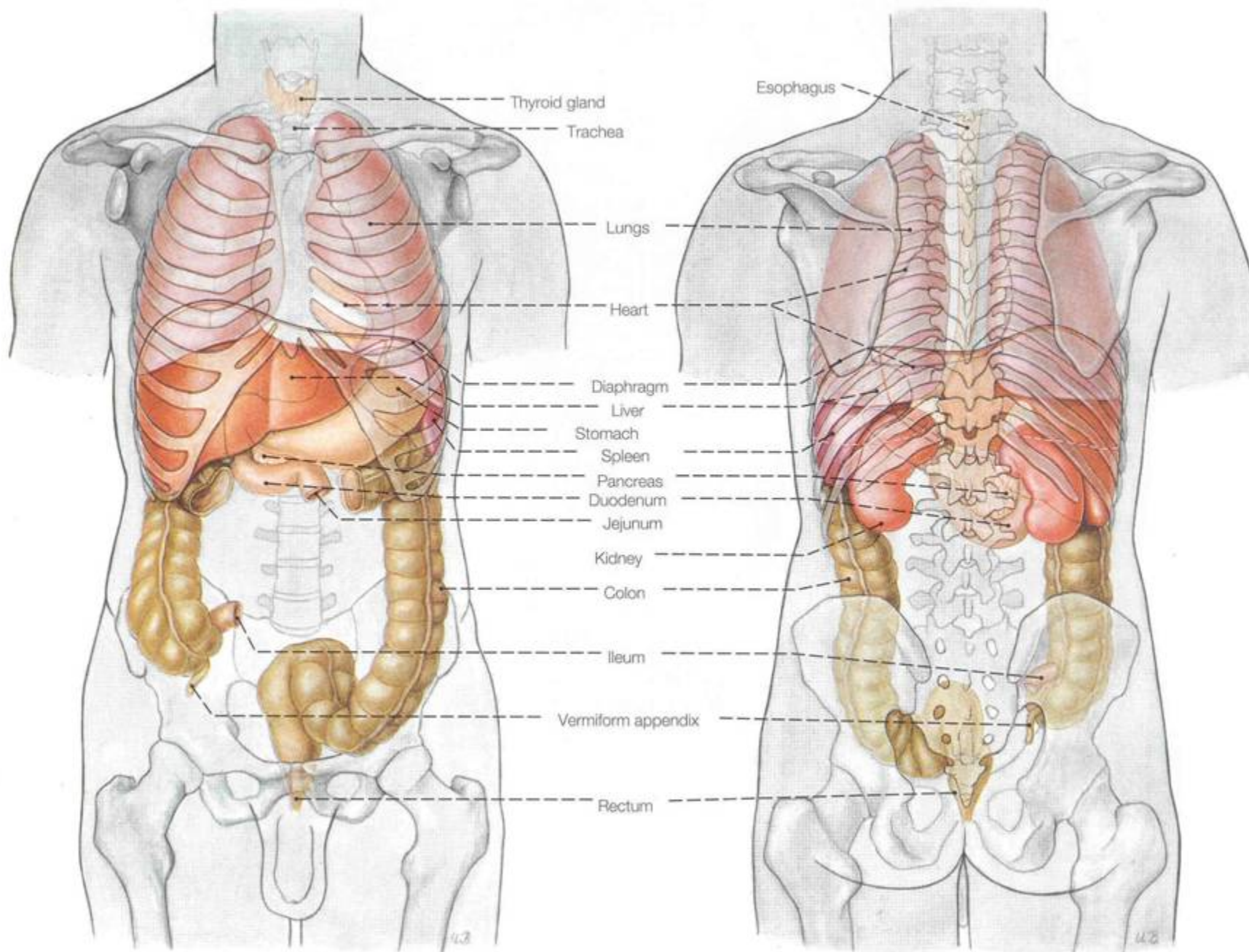
Thorax and Pelvic region not
separated by a defined partition.





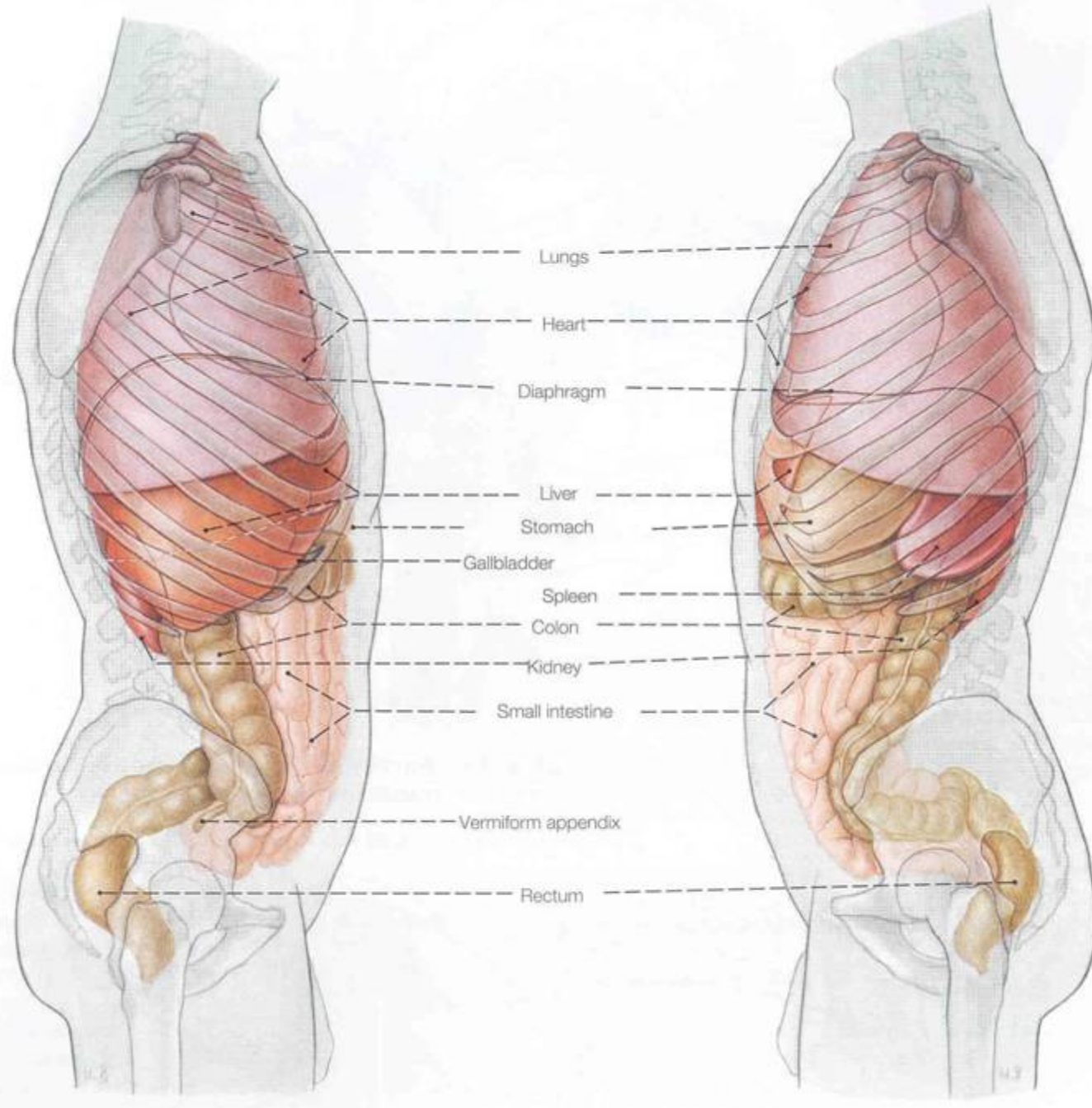
Abdomen

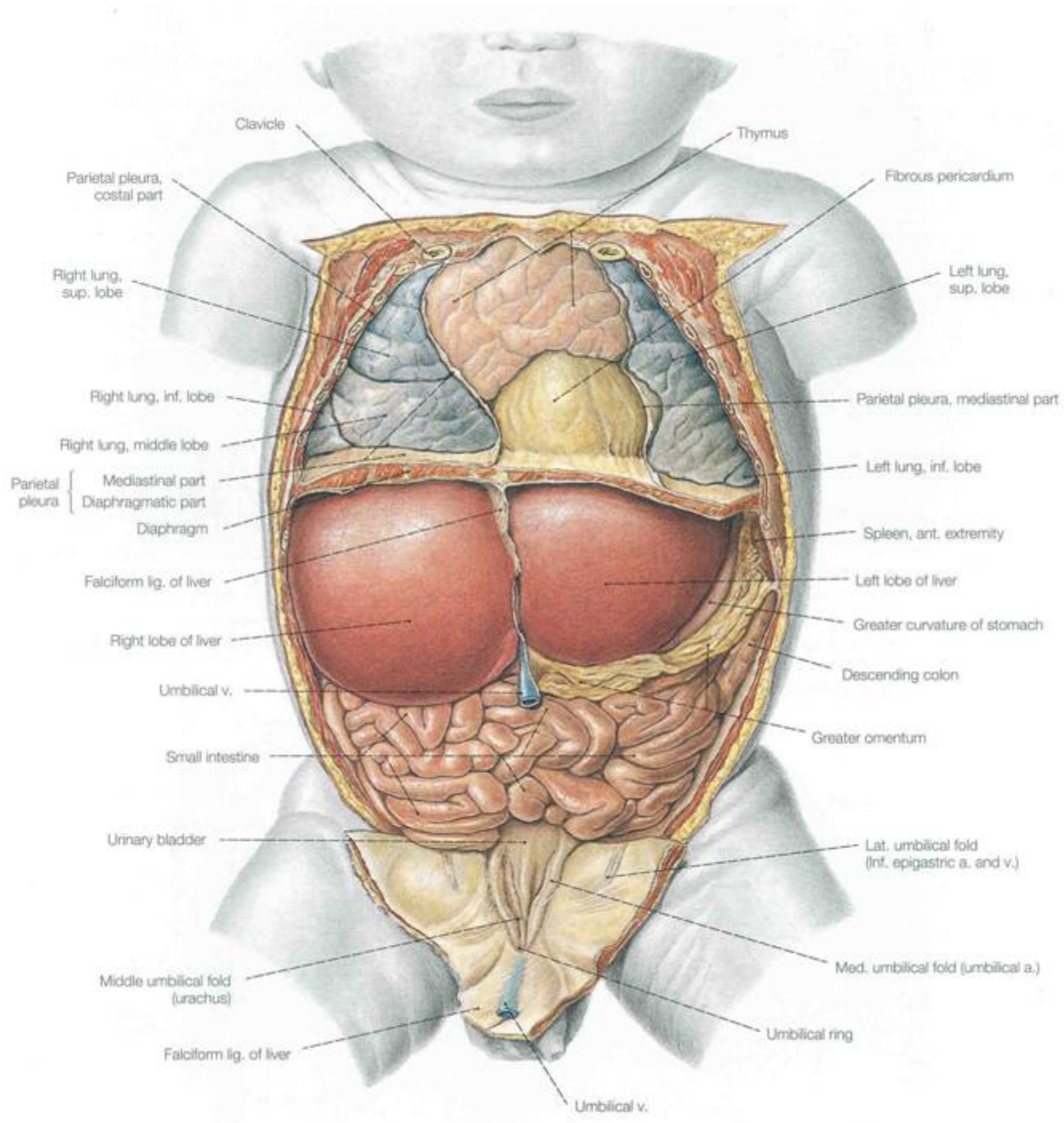
Thorax



De

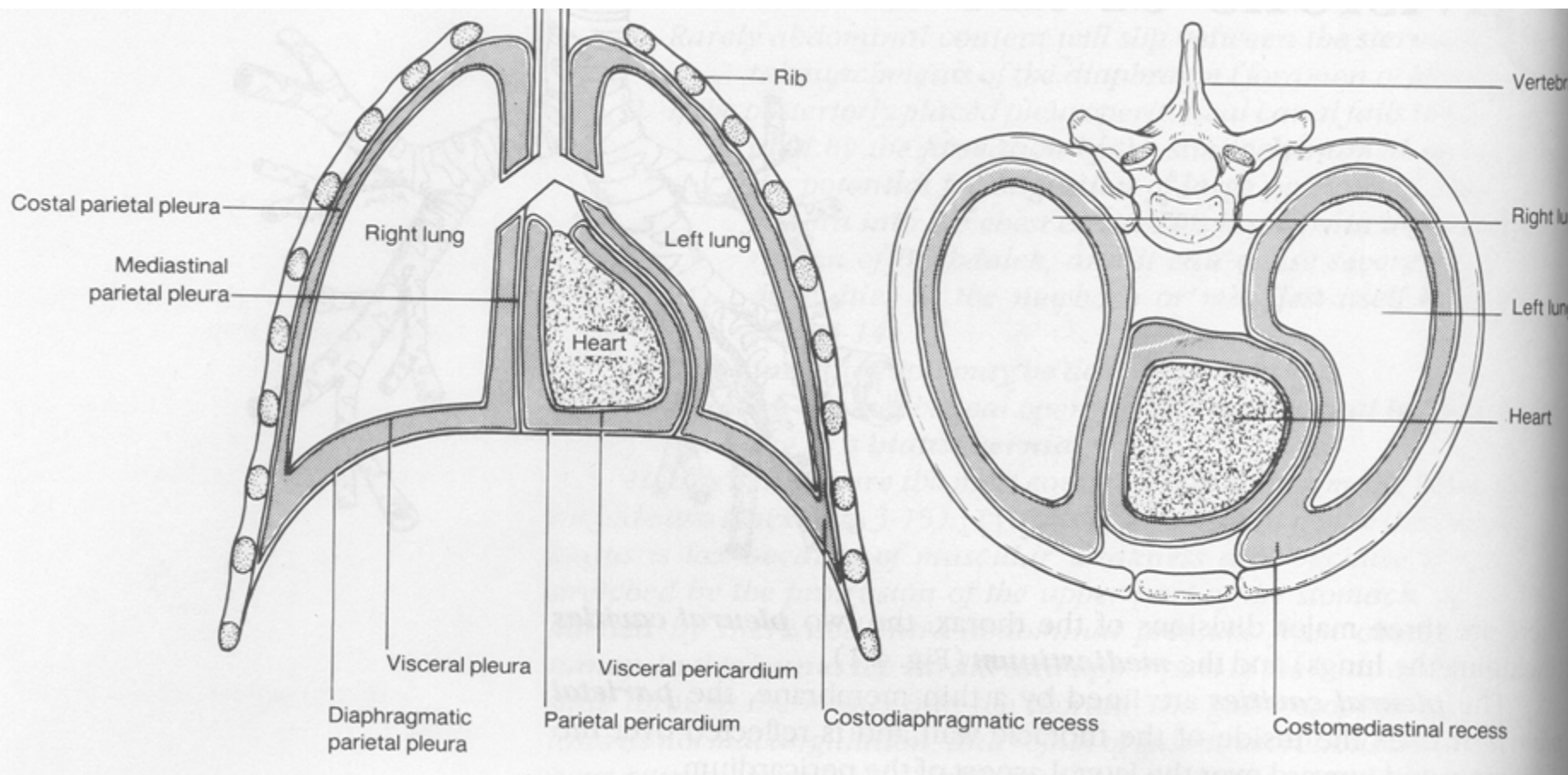
Ba





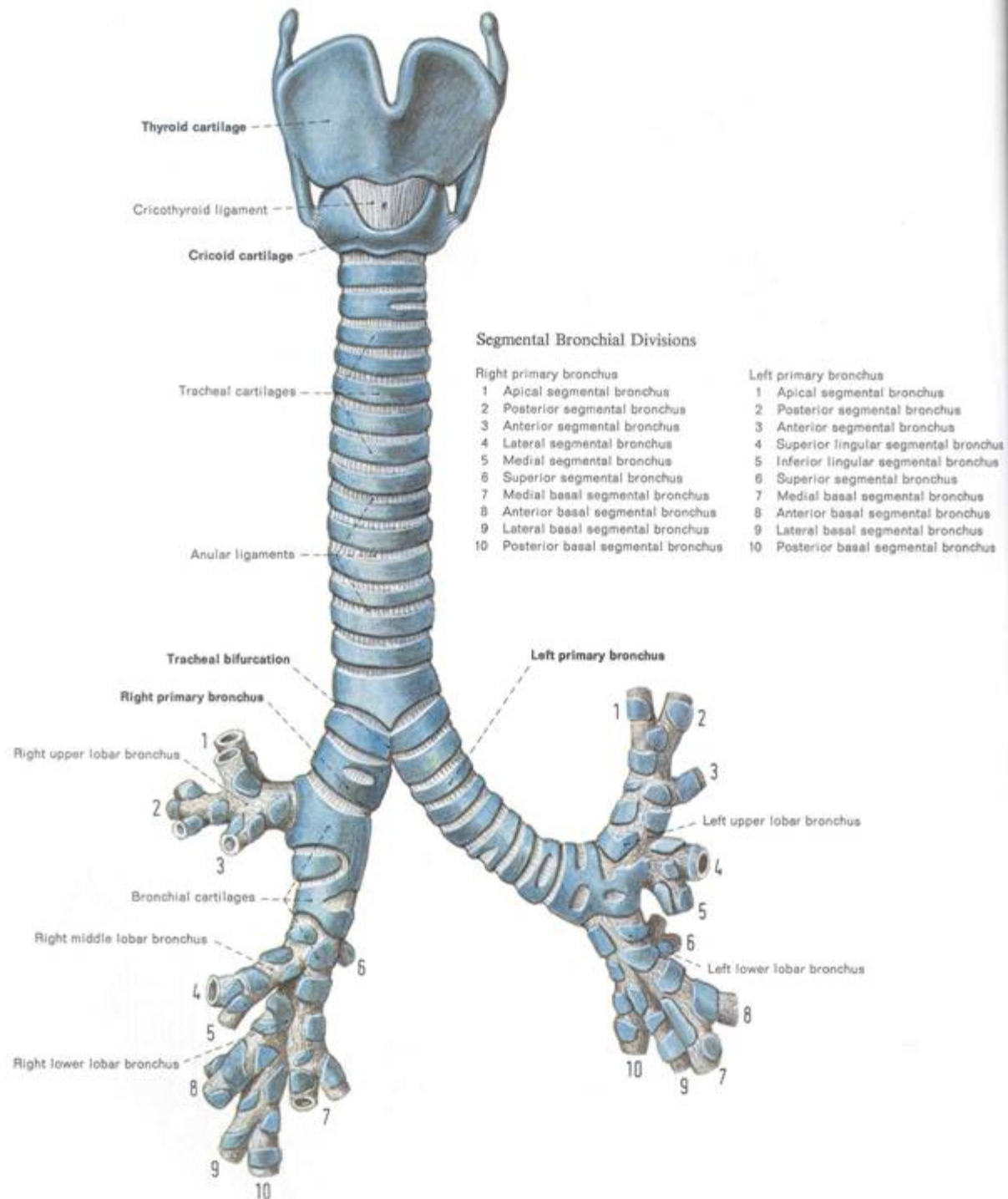
COELOM AND ITS CONTENTS:

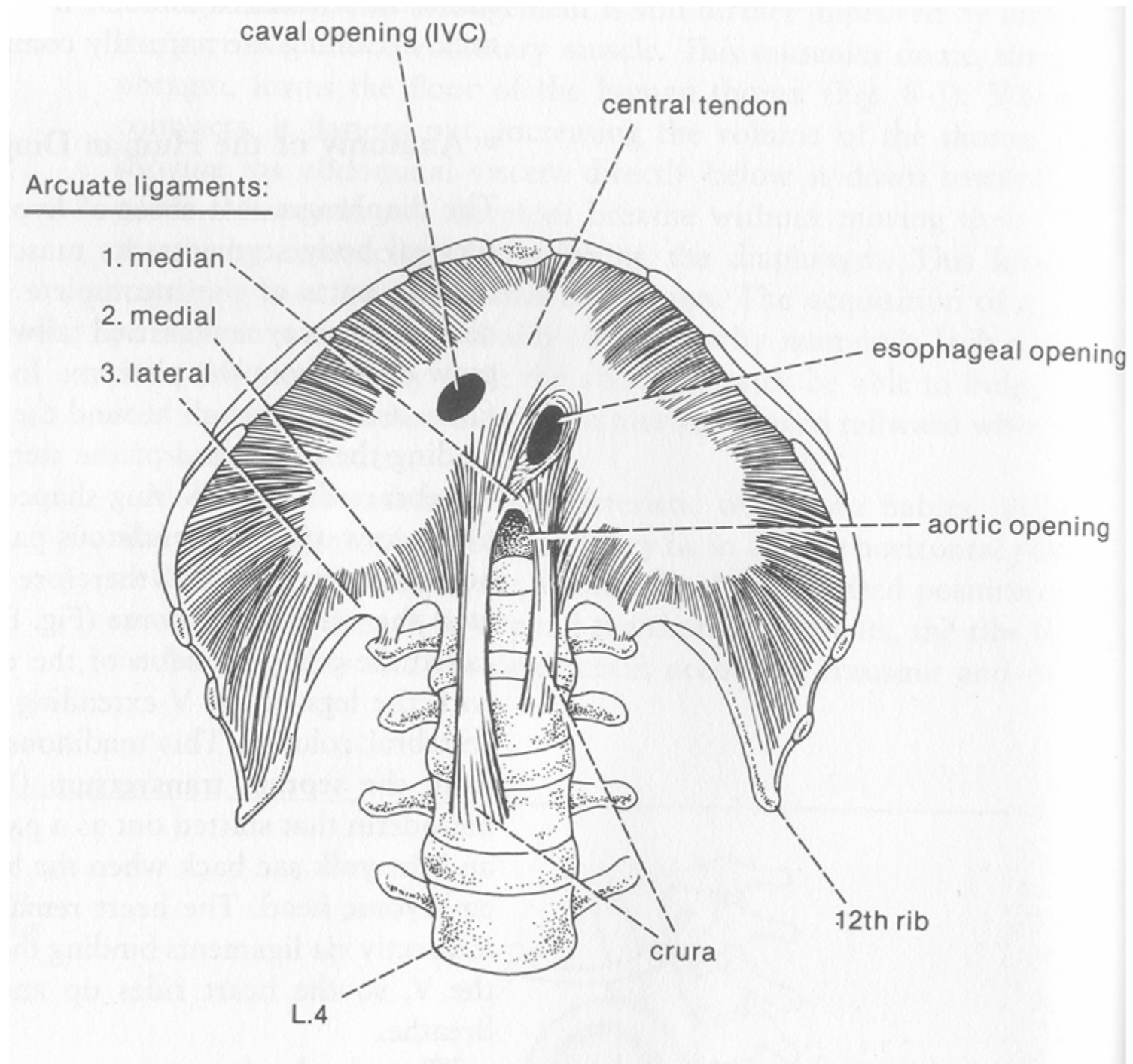
- Filled with coelomic fluid.
- PARIETAL PERITONEUM – mesodermally derived layer coating internal surface of body wall.
- VISCERAL PERITONEUM – mesodermally derived layer coating internal organs.
- MESENTARY – bi-layer of mesodermally derived material that connects to dorsal or ventral midline to suspend gut internally.
- PARIETAL PLEURA – serial homolog of parietal peritoneum in thorax.
- VISCERAL PERITONEUM – serial homolog of visceral peritoneum in thorax.

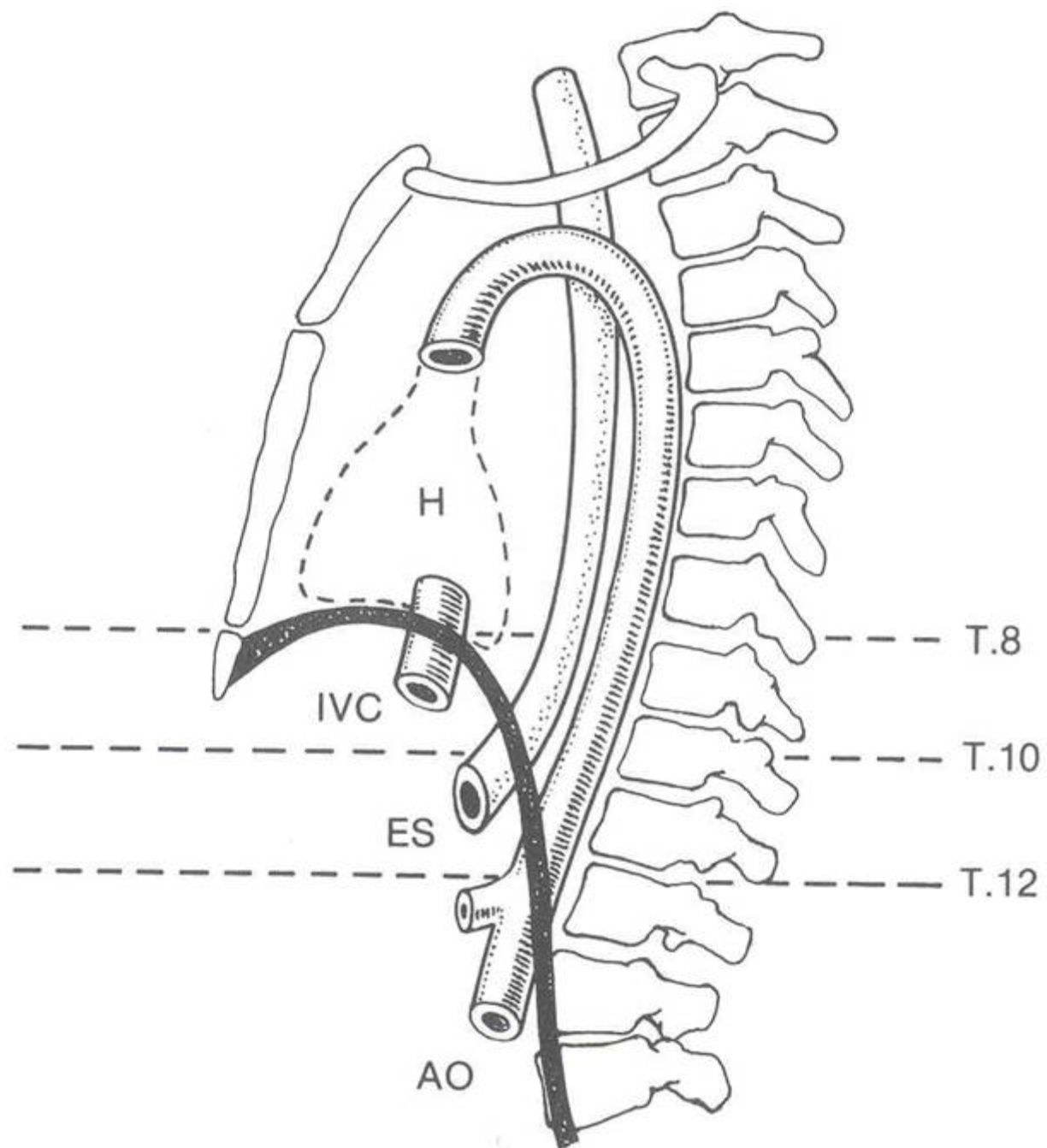


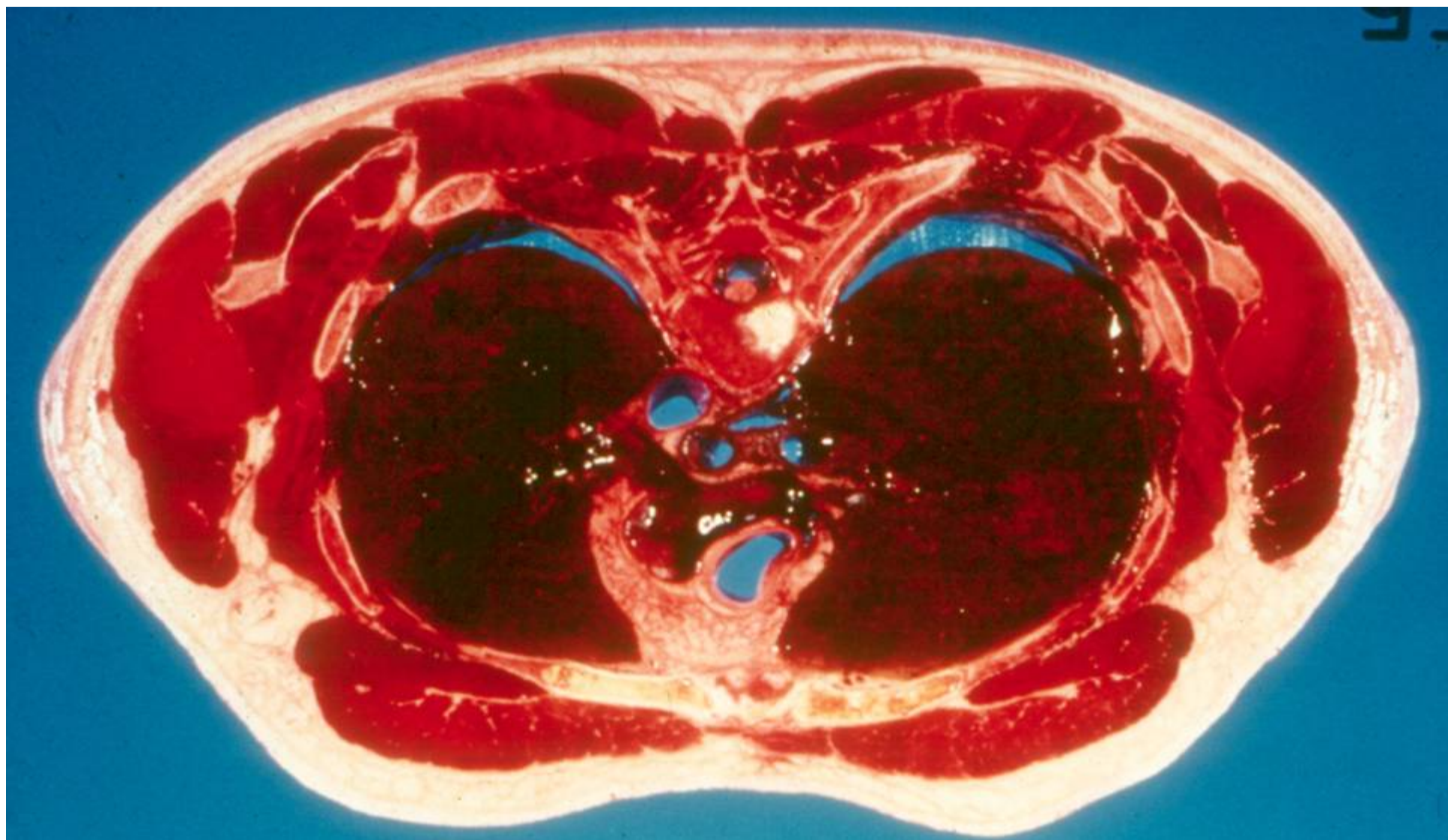
NECK and THORAX and MAJOR COMPONENTS OF RESPIRATORY SYSTEM

- Lungs
- Bronchi
- Trachea
- Pharynx
- Nasal Pharynx
- Oral Pharynx
- Common Pharynx









COMPONENTS OF EMBRYONIC FOREGUT

Including and up to:

- Stomach
 - Duodenum (first bend of small intestine)
 - Liver
 - Gall bladder
 - Pancreas
-
- Sympathetic Innervation: Greater splanchnic nerve (T5-T9)
 - Parasympathetic Innervation: Vagus Nerve (X)
 - Arterial Supply: Celiac Artery and its branches
 - Venous Drainage: Splenic Vein and its tributaries.

celiac trunk

L. gastric a.

splenic a.

R. & L. hepatic arteries

short gastric arteries

common
hepatic artery

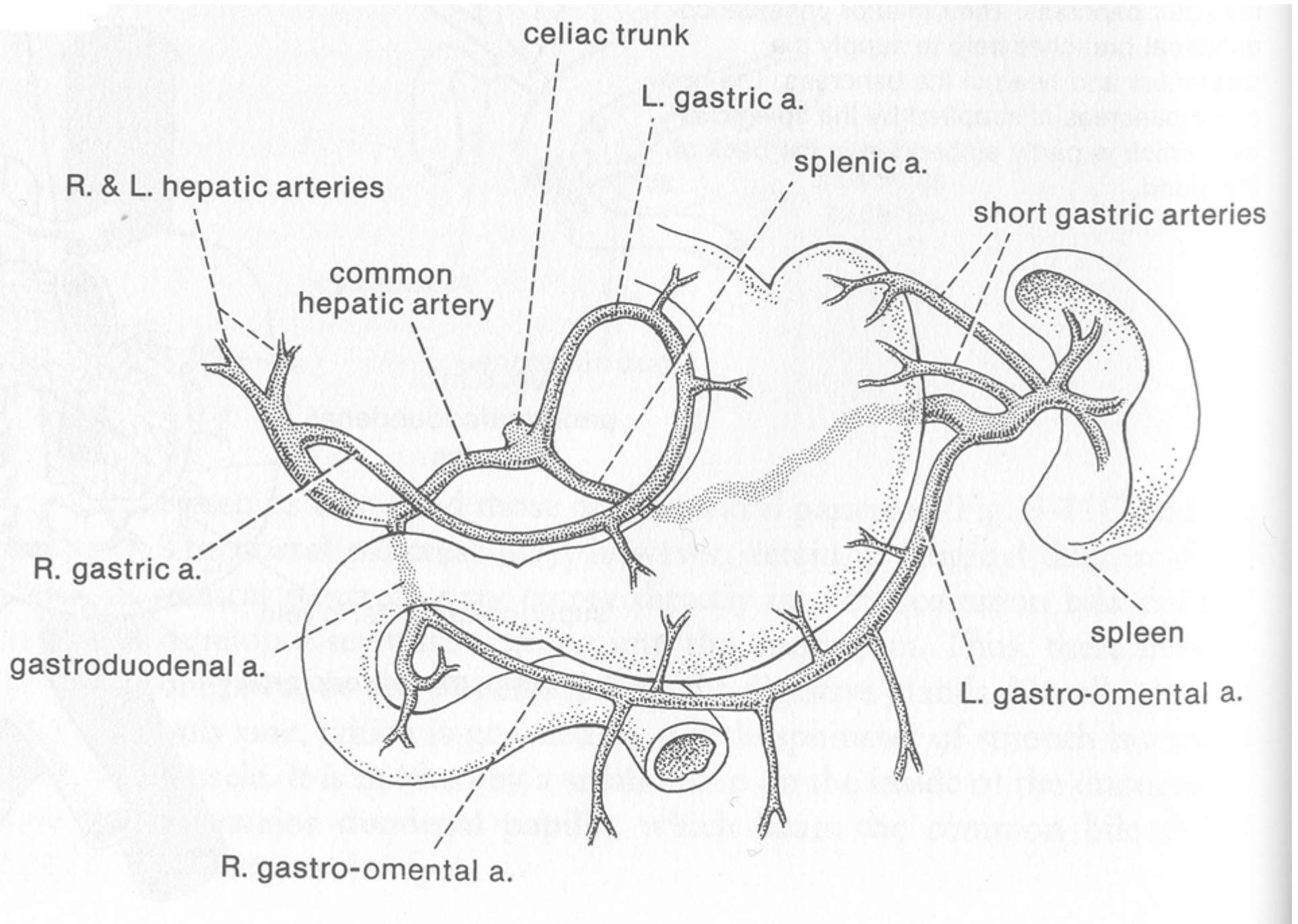
R. gastric a.

gastroduodenal a.

spleen

L. gastro-omental a.

R. gastro-omental a.



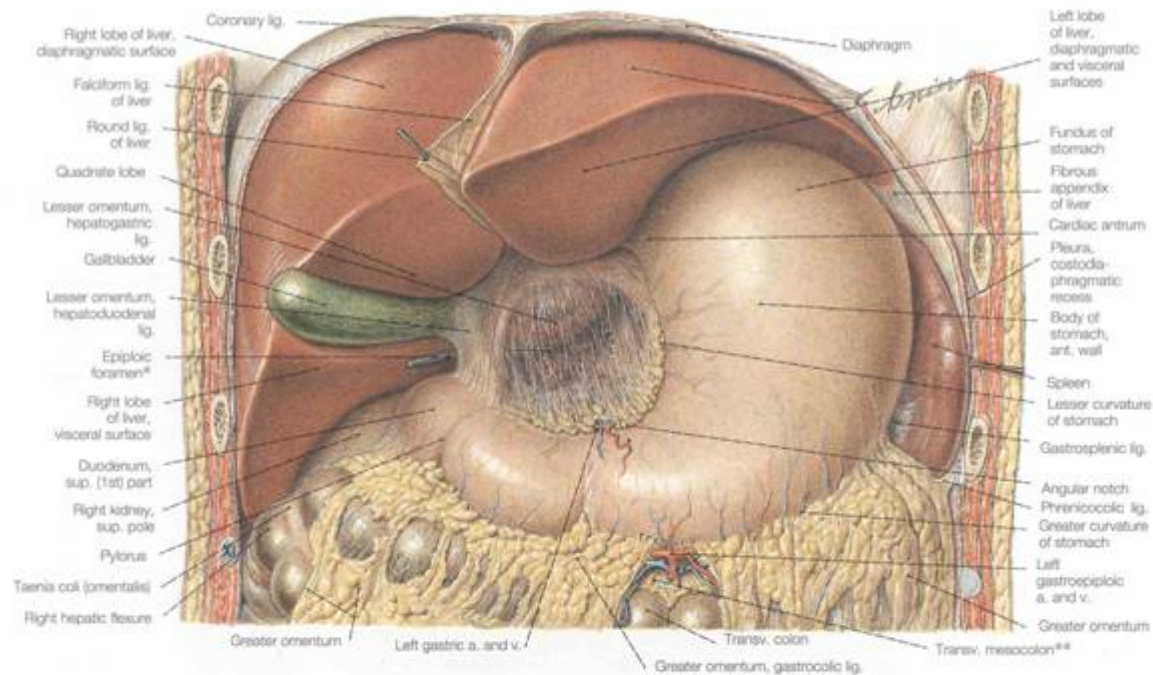
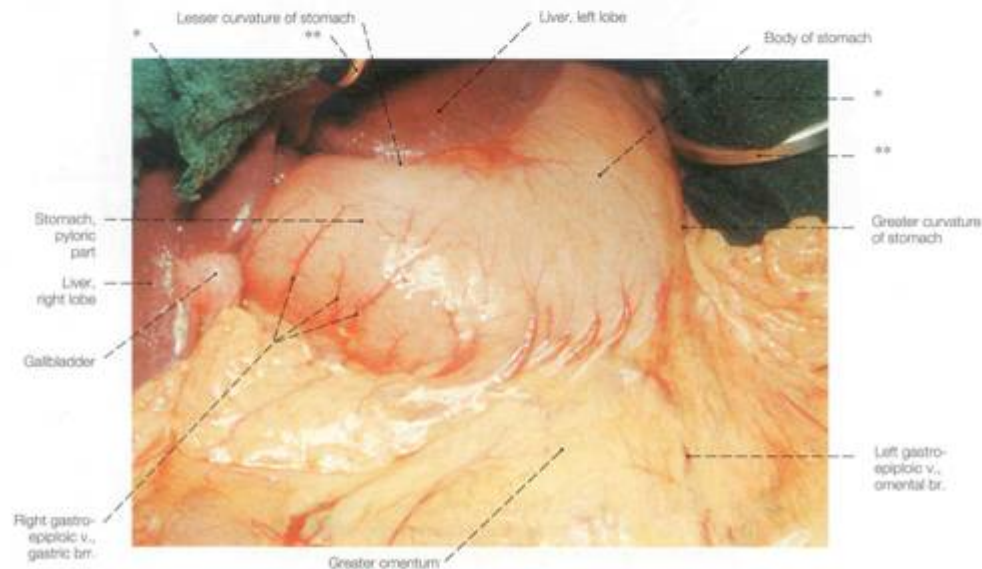


Fig. 969 Position of the viscera in the upper abdomen, ventral view. Parts of the diaphragm and the anterior thoracic and abdominal walls have been removed.

This part of the abdominal cavity is also known as the "glandular abdomen."

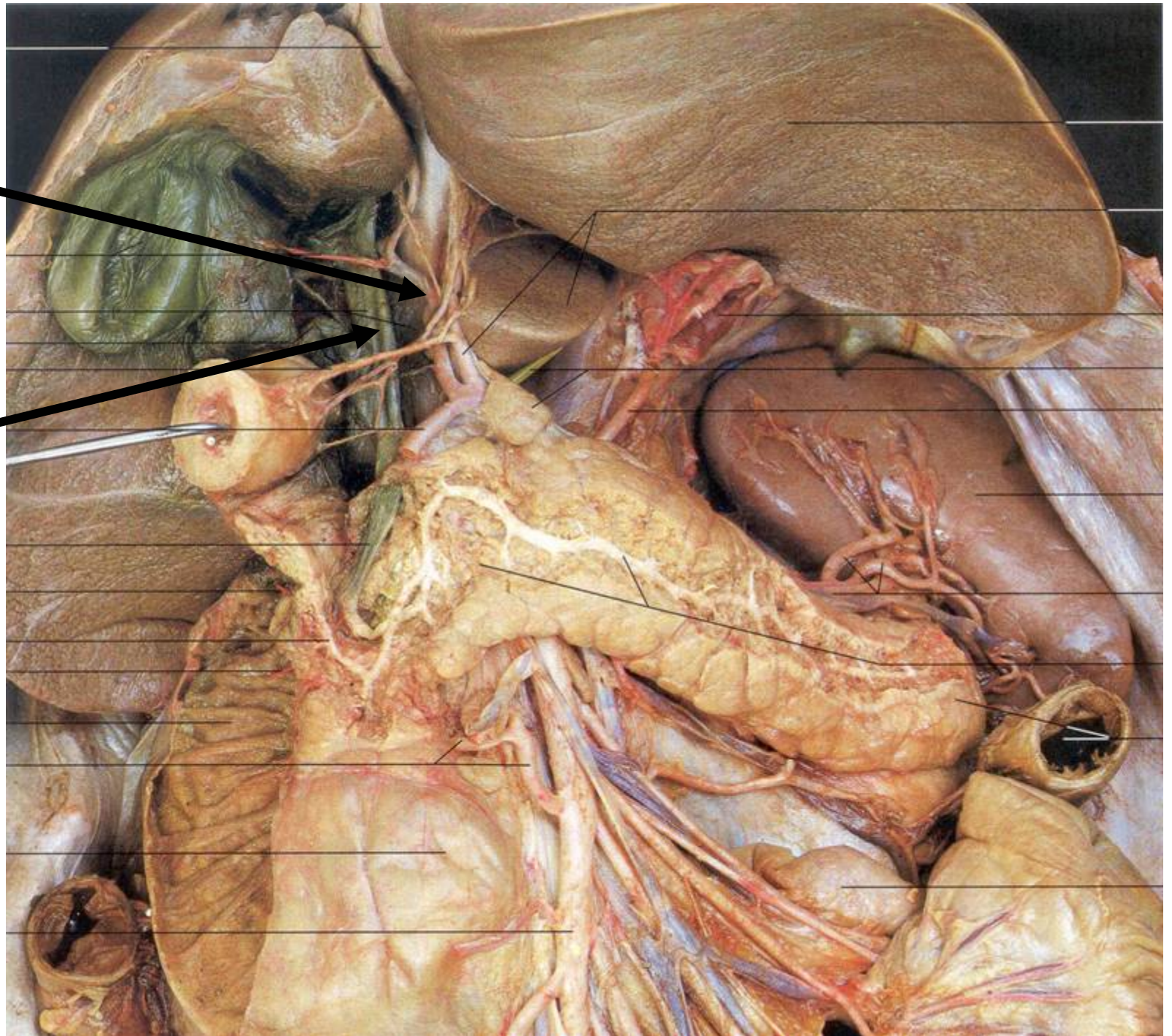
* Also: Foramen of WINSLOW

** Omental bursa partially opened



Hepatic
Portal Vein

Bile Duct



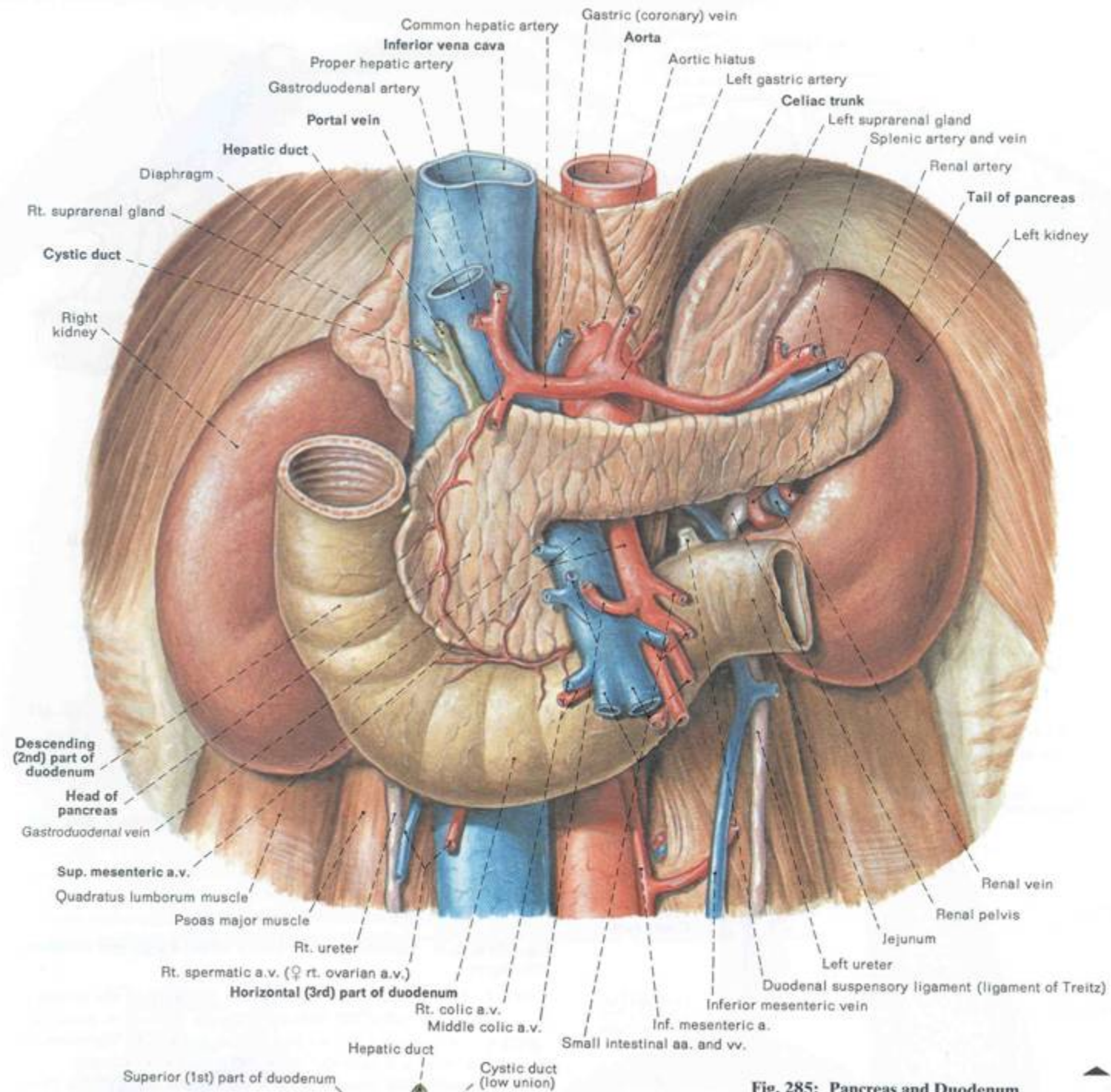
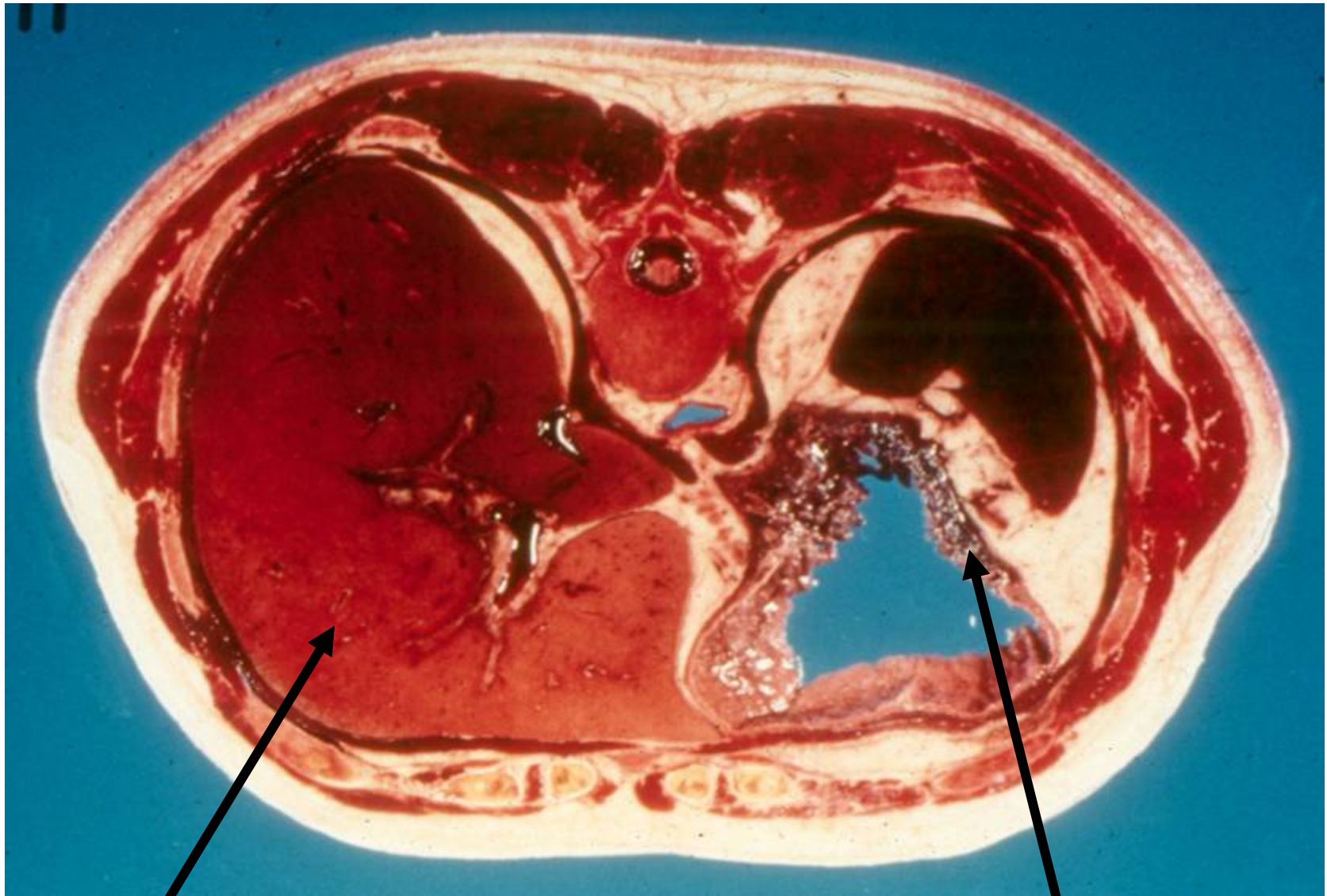


FIG. 285: Pancreas and Duodenum



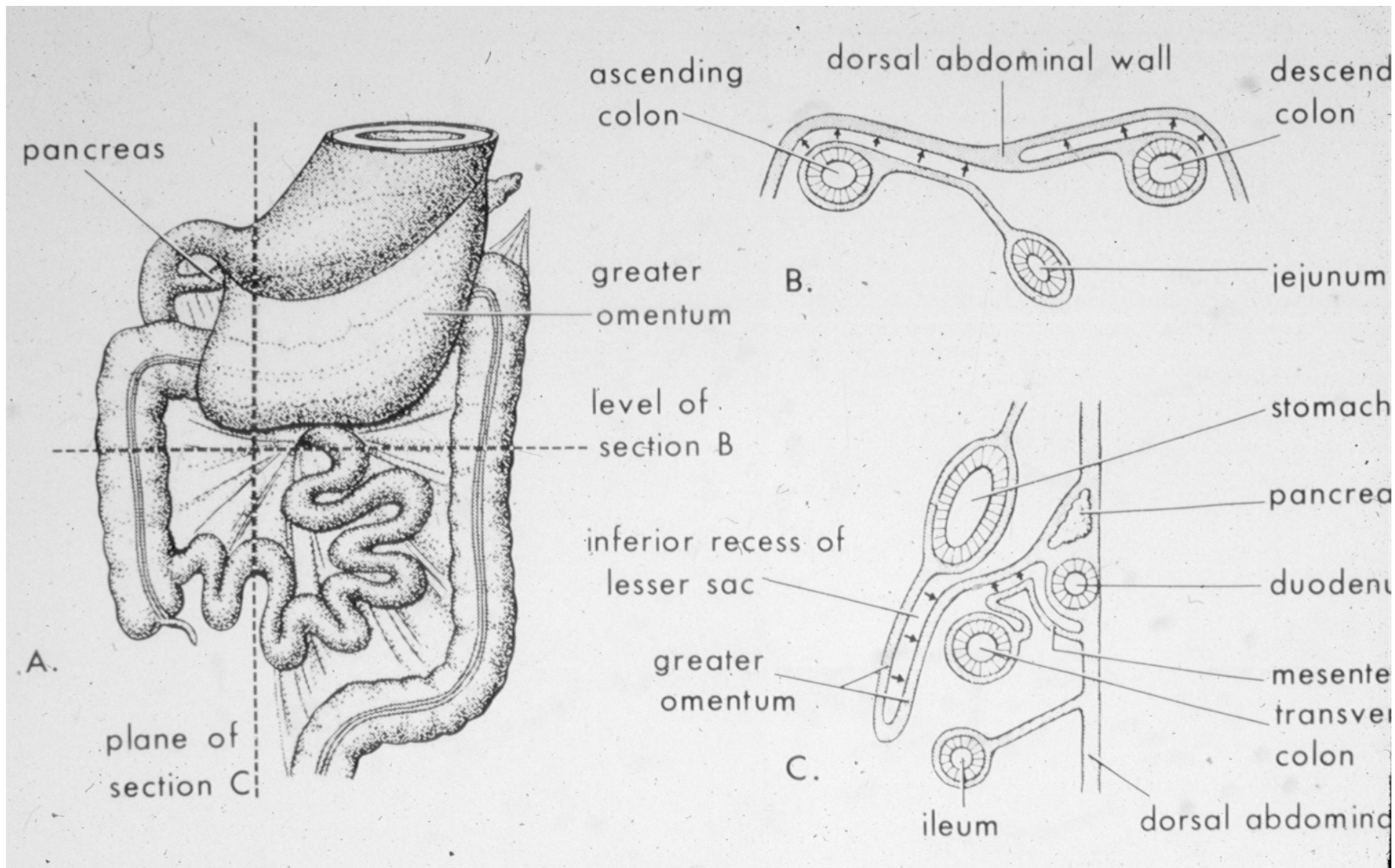
Liver

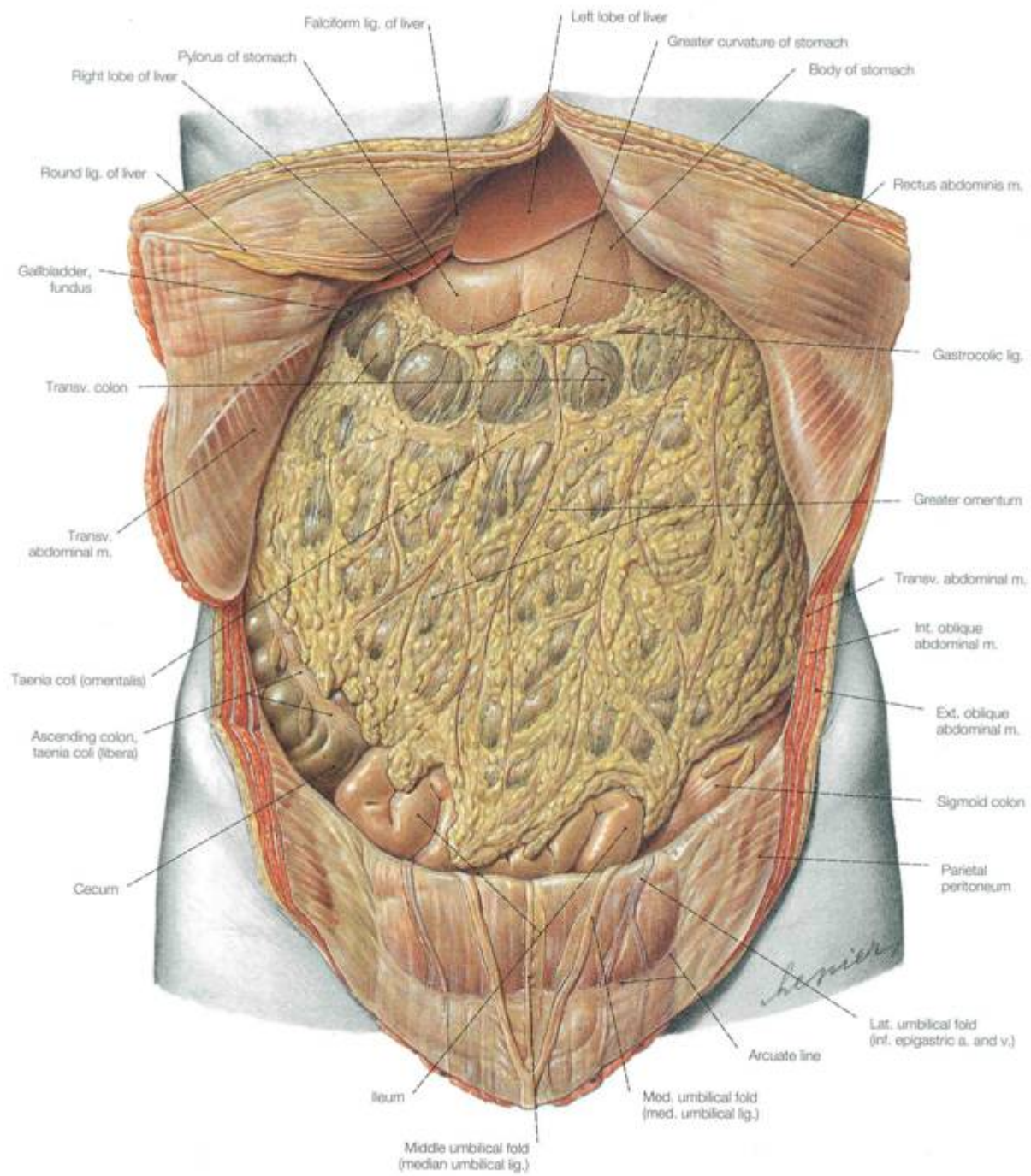
Stomach

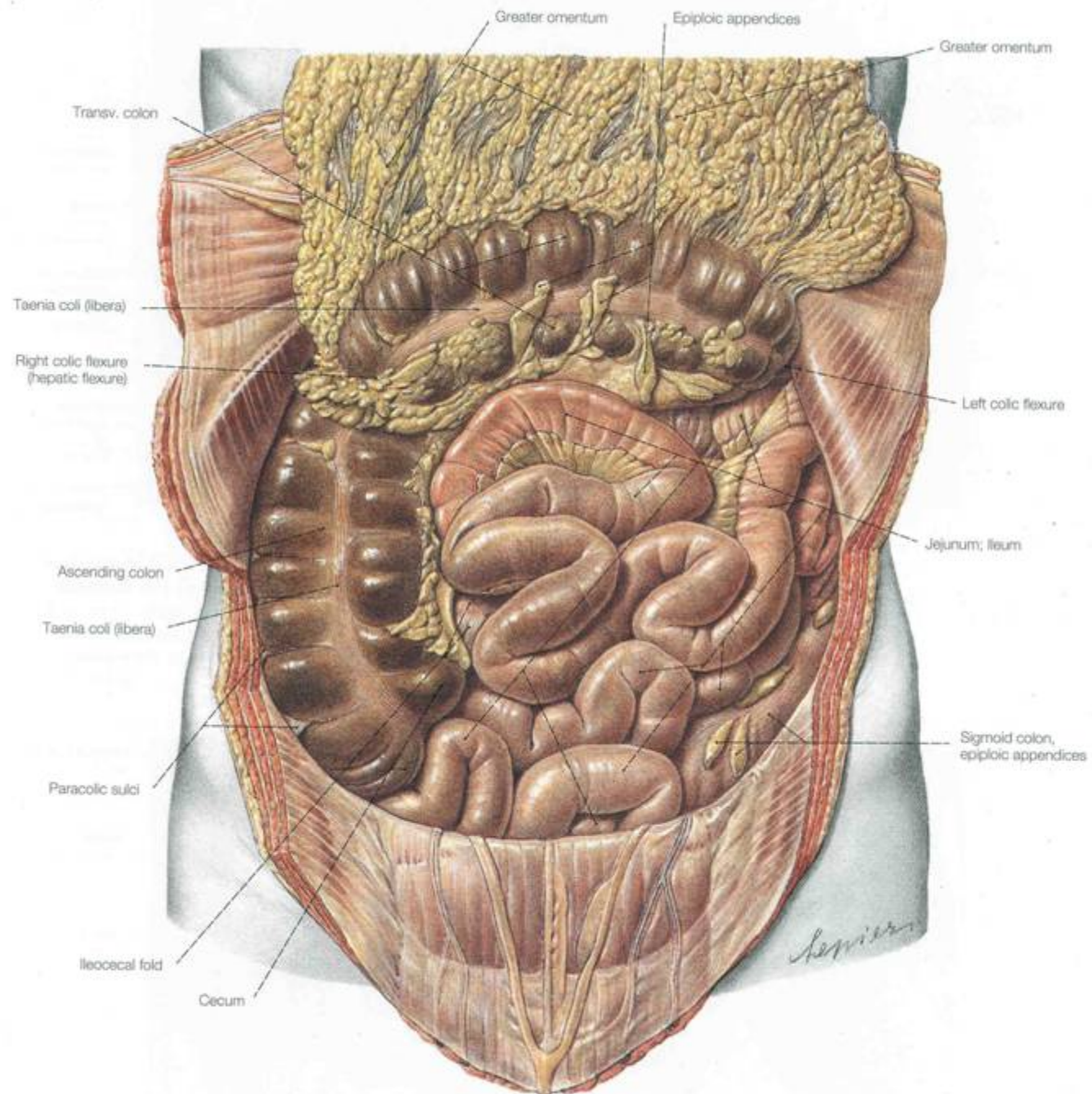
COMPONENTS OF EMBRYONIC MIDGUT

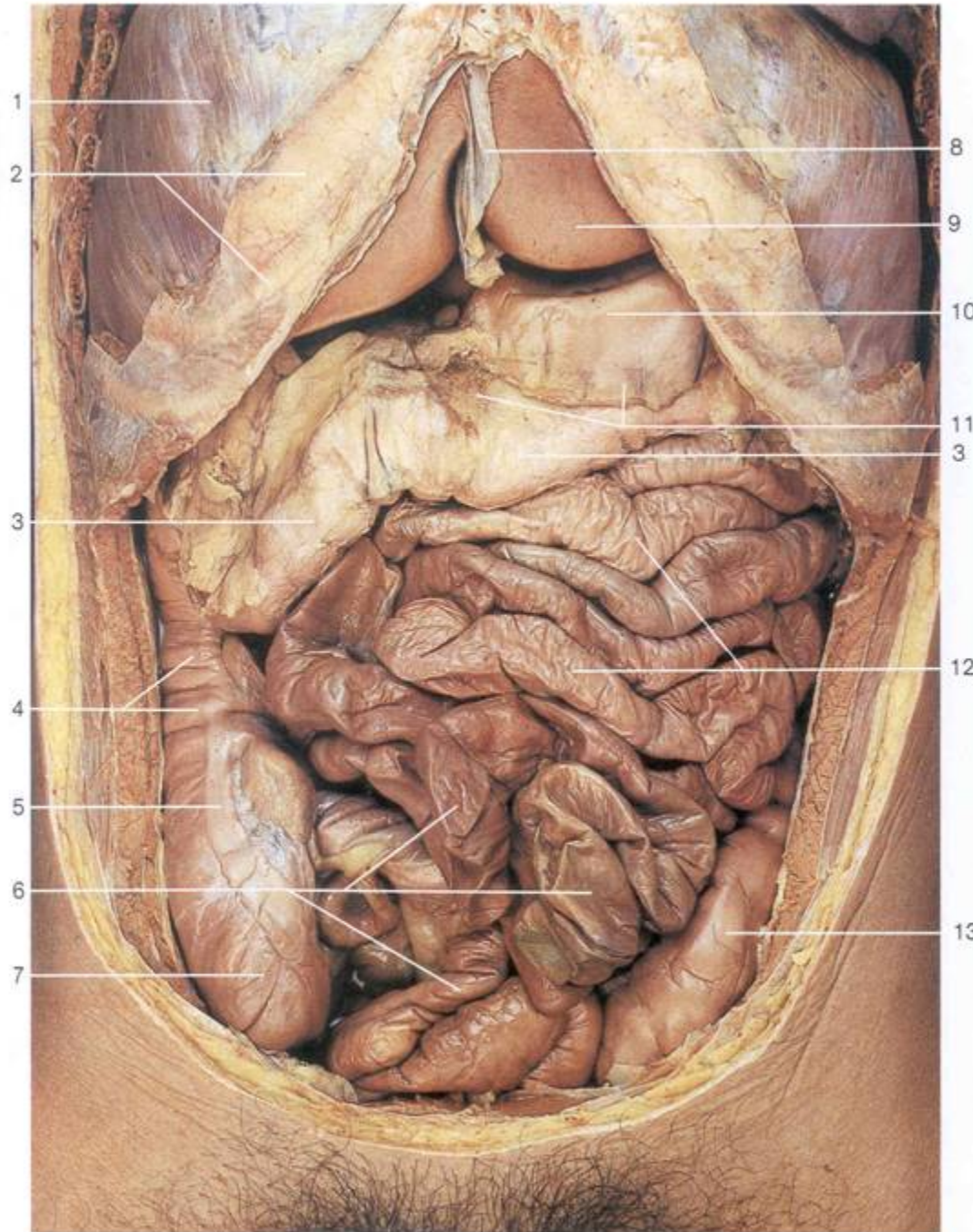
Including and up to:

- Jejunum and Ileum of small intestine
- Appendix
- Ascending Colon
- Transverse Colon (up to **LEFT COLIC FLEXURE**)
- Sympathetic Innervation: Lesser Splanchnic nerve (T10-T11)
- Parasympathetic Innervation: Vagus Nerve (X)
- Arterial Supply: Superior Mesenteric Artery and its branches
- Venous Drainage: Superior Mesenteric Vein and its tributaries.

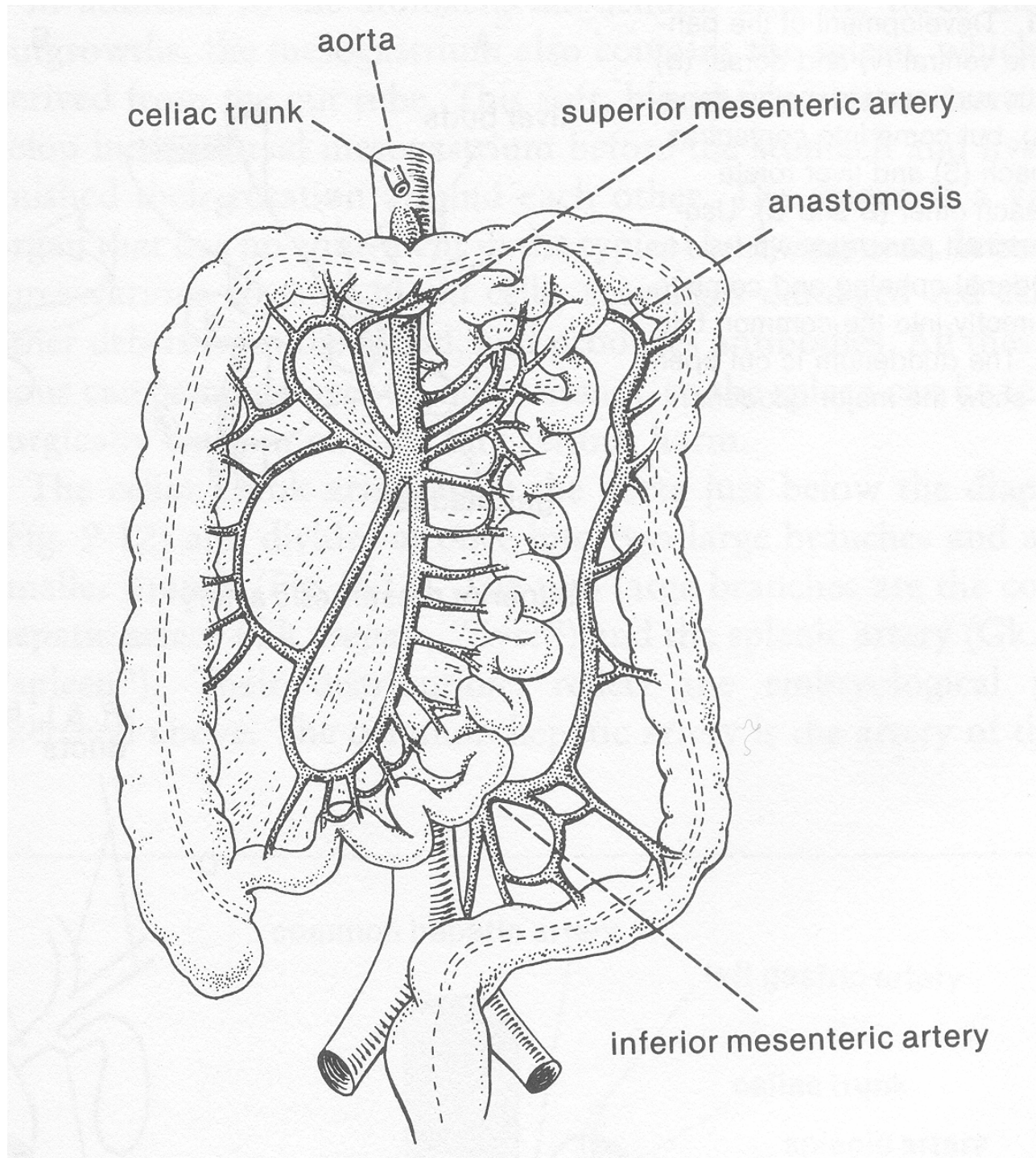








- 1 Diaphragm
- 2 Costal margin
- 3 Transverse colon
- 4 Ascending colon with haustra
- 5 Free taenia of cecum
- 6 **Ileum**
- 7 **Cecum**
- 8 **Falciform ligament of liver**
- 9 Liver
- 10 Stomach
- 11 Gastrocolic ligament
- 12 Jejunum
- 13 Sigmoid colon
- 14 **Vermiform appendix**
- 15 Terminal ileum
- 16 **Mesoappendix**
- 17 Mesentery

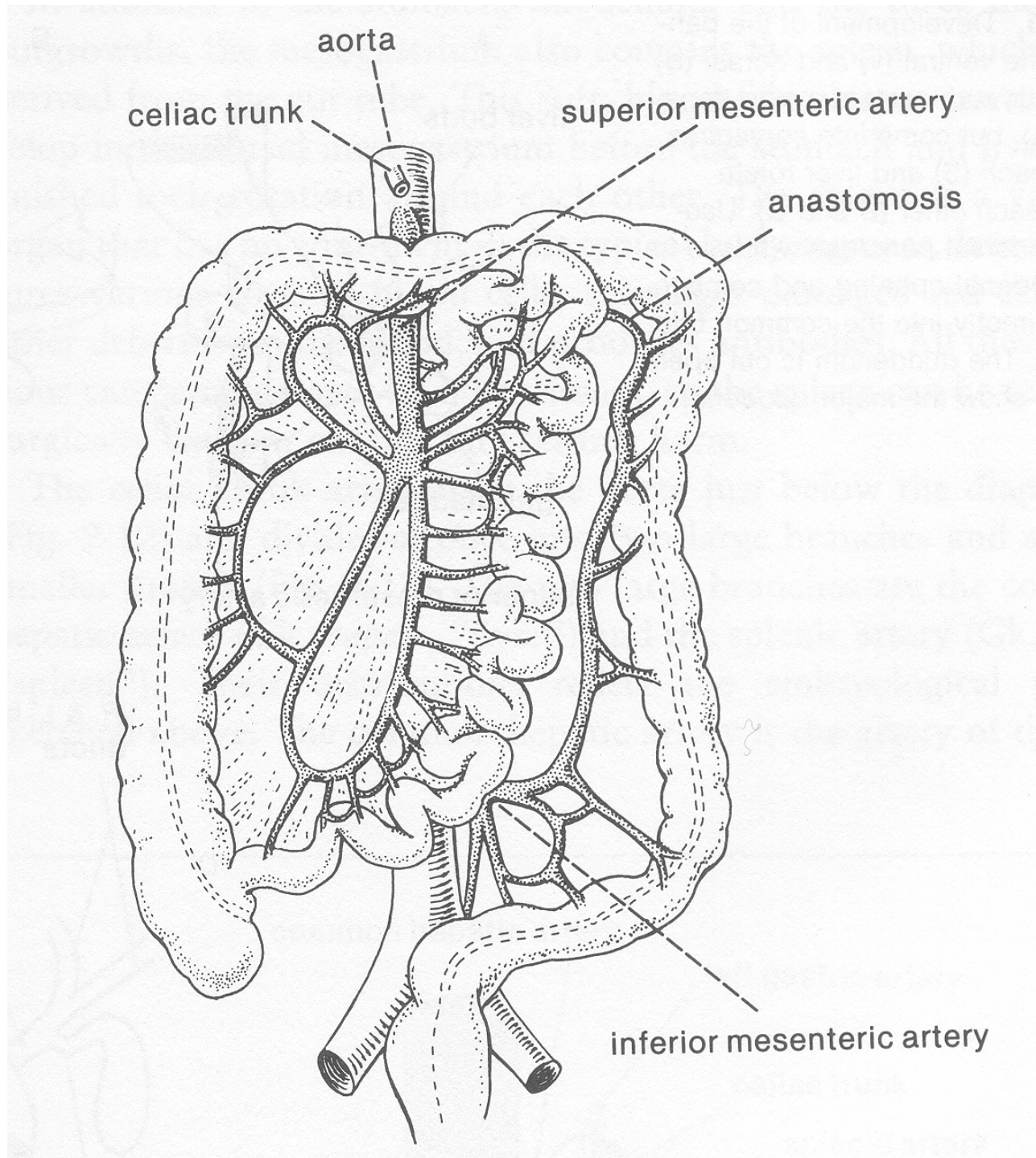


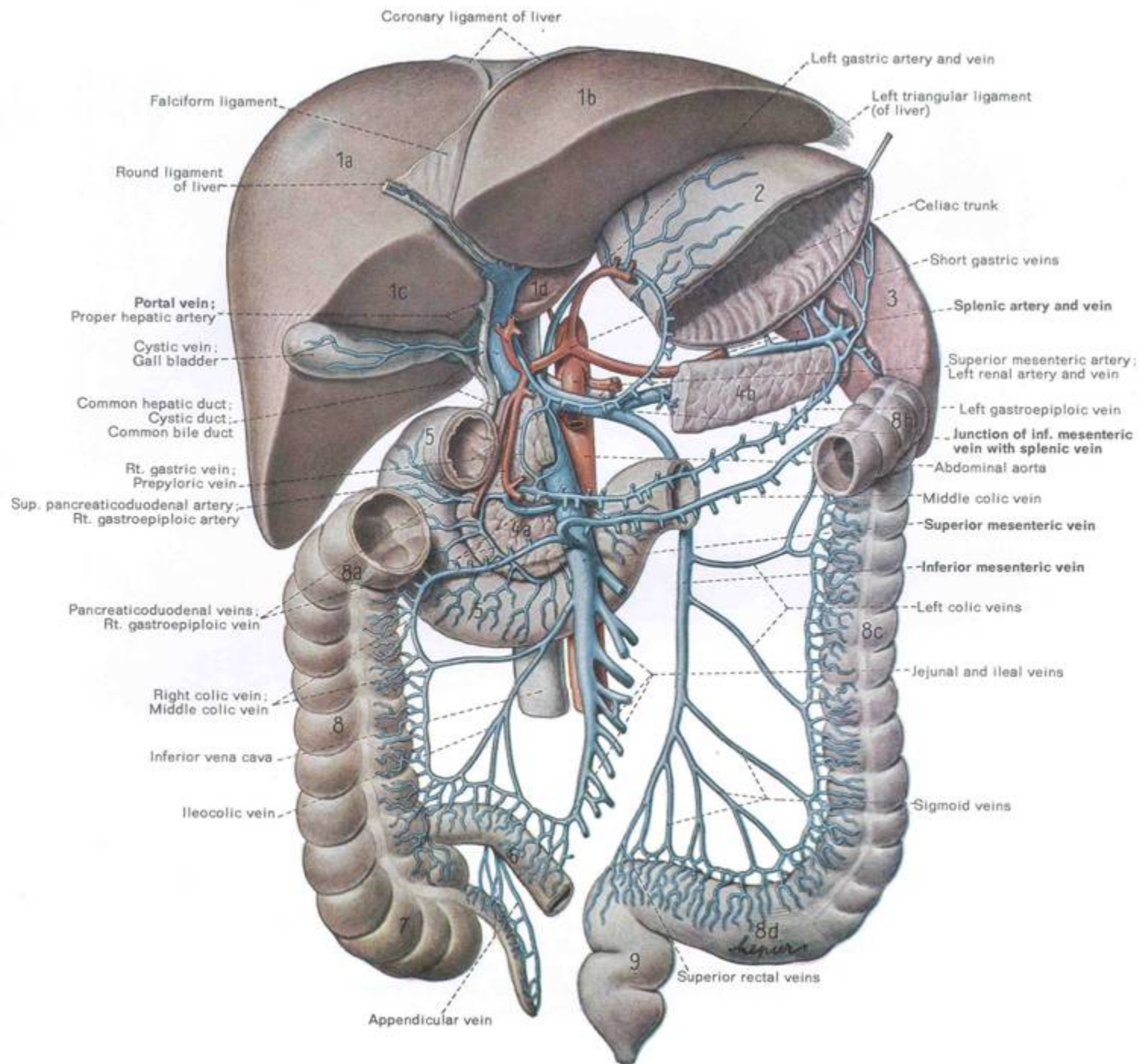
COMPONENTS OF EMBRYONIC HINDGUT

Including and through to:

- Descending Colon
- Sigmoid Colon
- (through to) Rectum

- Sympathetic Innervation: Least Splanchnic nerve (T12)
- Parasympathetic Innervation: Sacral Outflow (S2-4)
- Arterial Supply: Inferior Mesenteric Artery and its branches
- Venous Drainage: Inferior Mesenteric Vein and its tributaries.

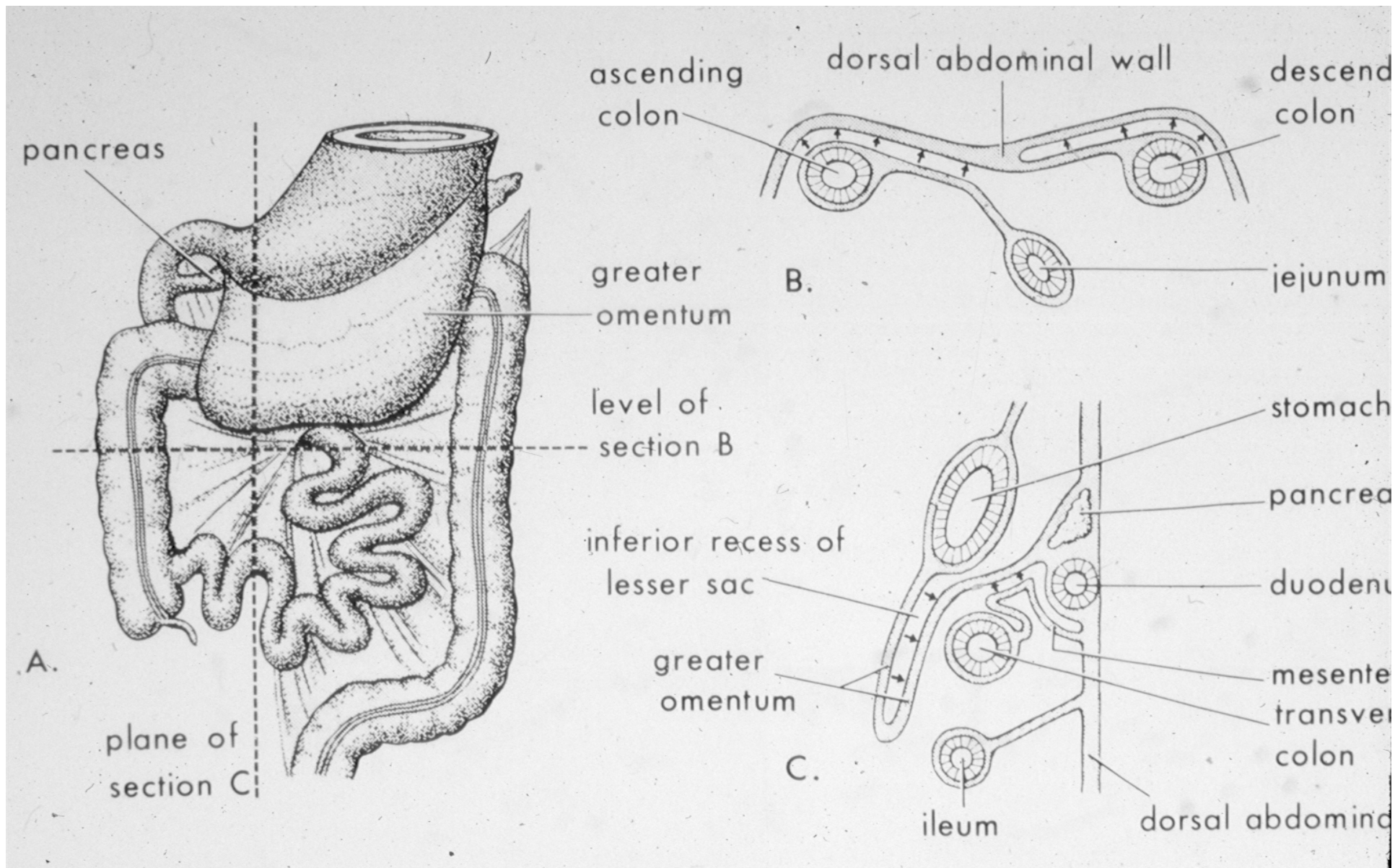




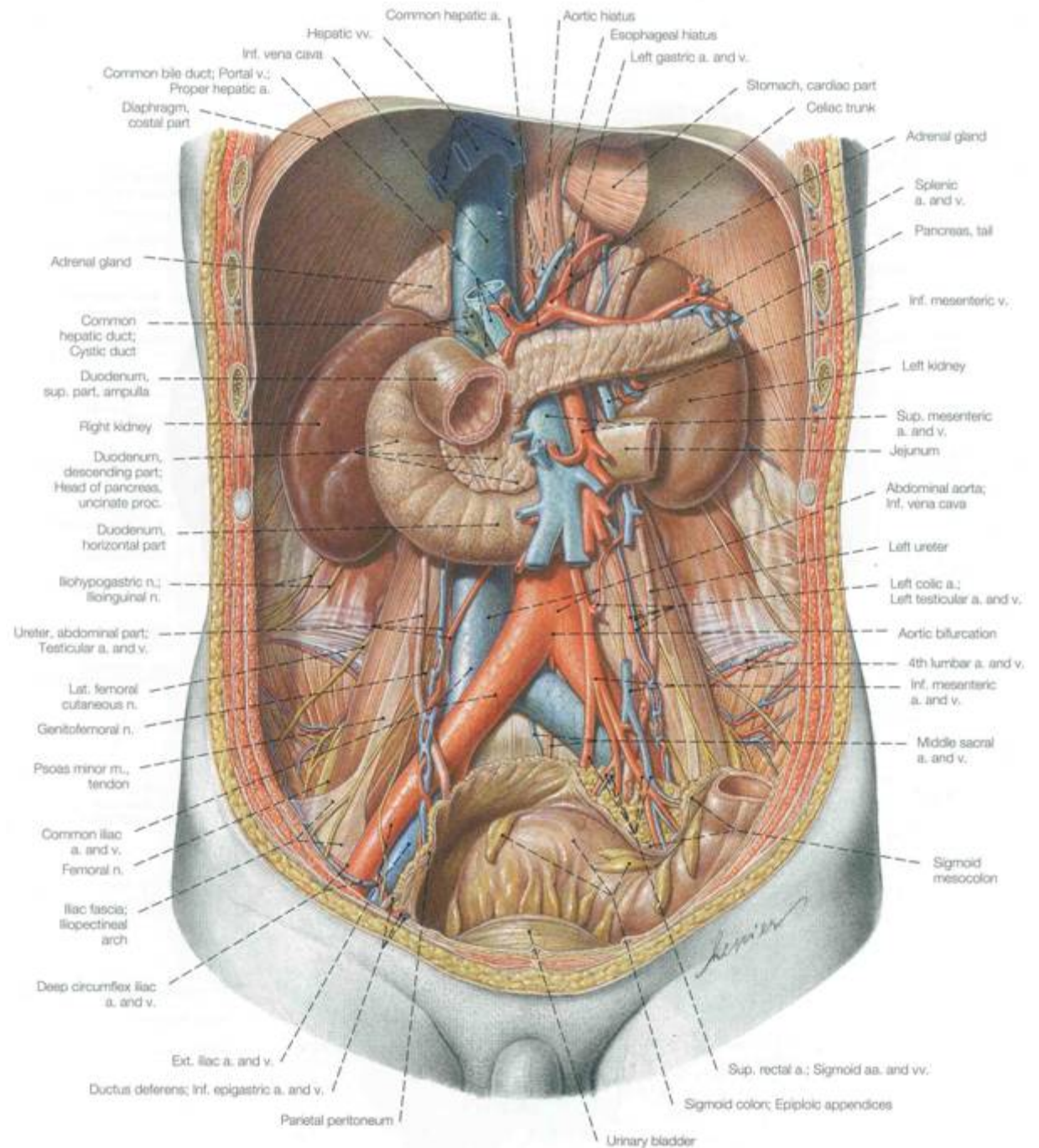
INTRAPERITONEAL vs. RETROPERITONEAL

Most of the internal organs are surrounded by visceral peritoneum – the INTRAPERITONEAL condition.

Some organs (e.g. kidneys) are between peritoneum on one surface, and the body wall on the other – the RETROPERITONEAL condition.



Retroperitoneal components of abdominal cavity



STRUCTURES WITHIN THE PELVIS

- End of digestive system
- Female reproductive organs
- Bladder
- Ducts to, and exiting from, bladder

Introduction to Blood

CIRCULATORY SYSTEMS:

Cardiovascular - heart (pump) & blood
Lymphatic

Cardiovascular system includes pump (heart) and associated vessels (arteries, veins, capillaries)

Blood carried within cardiovascular system usually grouped with “connective tissue”.

Blood derived from cells in bone marrow, therefore (ultimately) from mesoderm

BLOOD – FUNCTIONS

TRANSPORT – oxygen, CO₂, cellular waste, nutrients, hormones, enzymes.

PROTECTION – immune response (white blood cells), blood clotting.

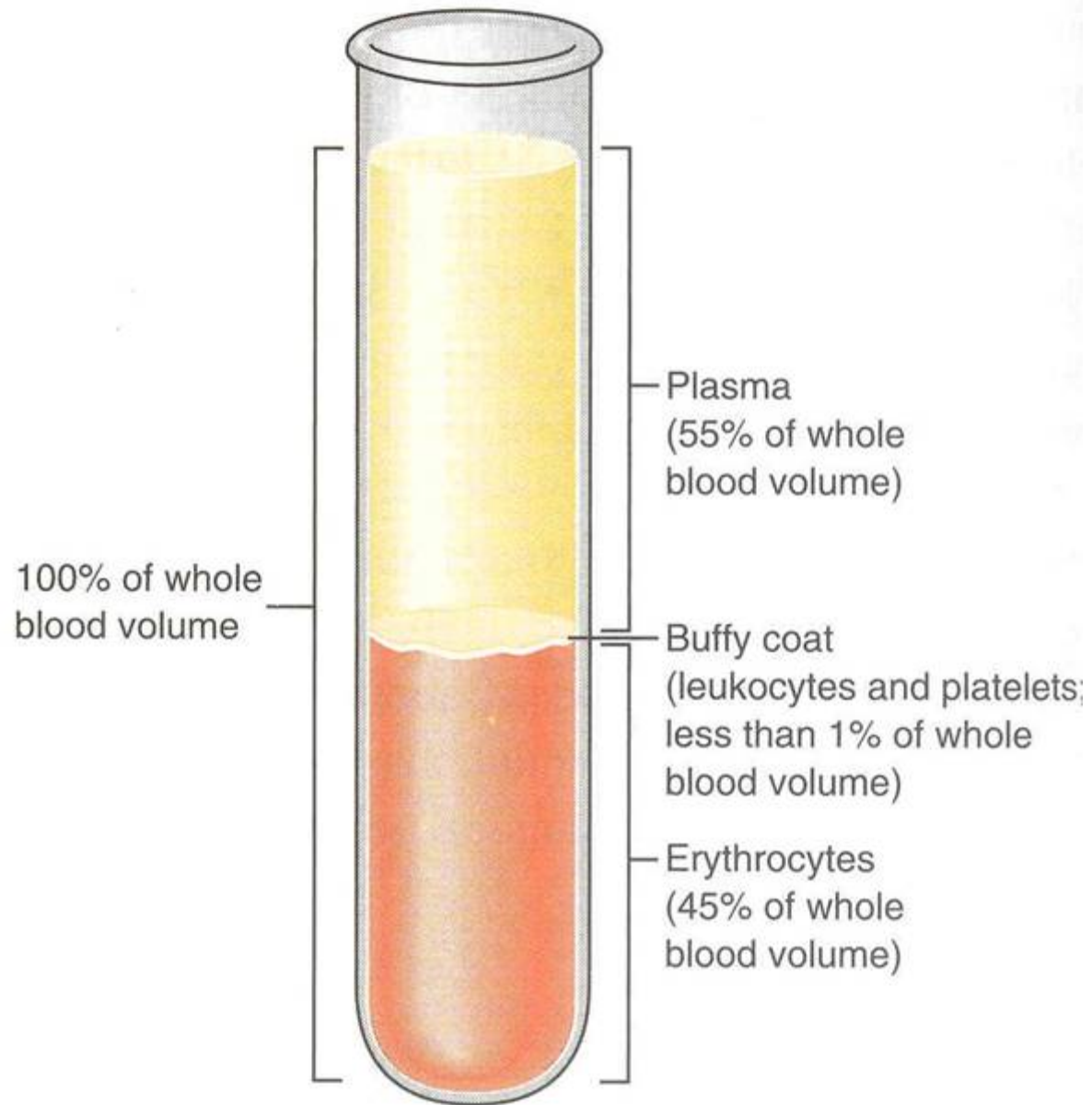
REGULATION – water balance, chemical levels, pH, body temperature.

BLOOD COMPONENTS

- RED BLOOD CELLS
- WHITE BLOOD CELLS
- PLASMA (about 55%)

About 90% of plasma is simple water, remaining 10% = important proteins (3 main types):

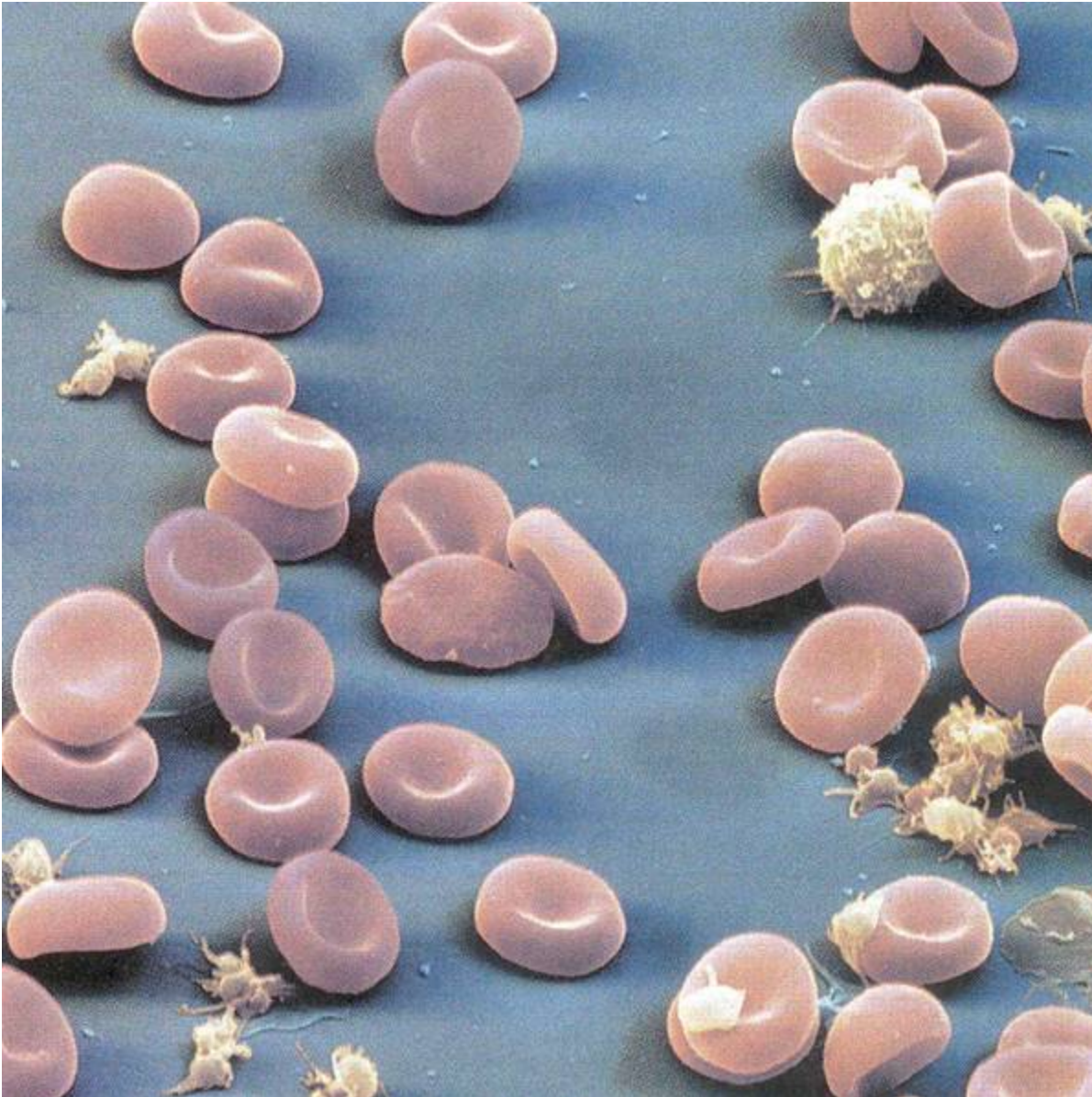
- Albumins – promote water retention (thus maintaining normal blood volume & pressure)
- Fibrinogen – essential for blood clotting
- Globulins
 - Alpha* and *Beta* globulins function to transport fat-soluble materials and lipids.
 - Gamma* globulins are antibodies functioning in preventing certain diseases



ERYTHROCYTES (RED BLOOD CELLS)

About 50% of blood volume.

ERYTHROCYTES



~ 2 microns thick

~ 7 microns across

Disc shaped

Concave on each side

Mature RBC have no nuclei.

Almost entire volume taken up by oxygen carrying molecule HEMOGLOBIN.

RED BLOOD CELL PRODUCTION:

Before birth: yolk sac, liver, spleen.

After birth (normally): large cells of bone marrow of certain bones – vertebrae, sternum, hip, long bones.

After trauma: spleen can come back into service.

NORMAL LIFE SPAN: ~ 180 days.

HEMOGLOBIN AND OXYGEN TRANSPORT

- Transport of oxygen accomplished by iron-rich molecule, HEMOGLOBIN.
- Hemoglobin is characterized by its ability to bind Oxygen where oxygen concentration is high, and release it where it is low.
- “Heme” component is only 5% of actual molecule, but very important – the iron containing part.
- Reduced iron content in body reduces blood’s ability to carry oxygen.

CO₂ IN BLOOD

- RBCs also carry carbon dioxide.
- Part carried in hemoglobin, but much is dissolved directly in the plasma.
- Most carbon dioxide converted to CARBONIC ACID by reaction with water.



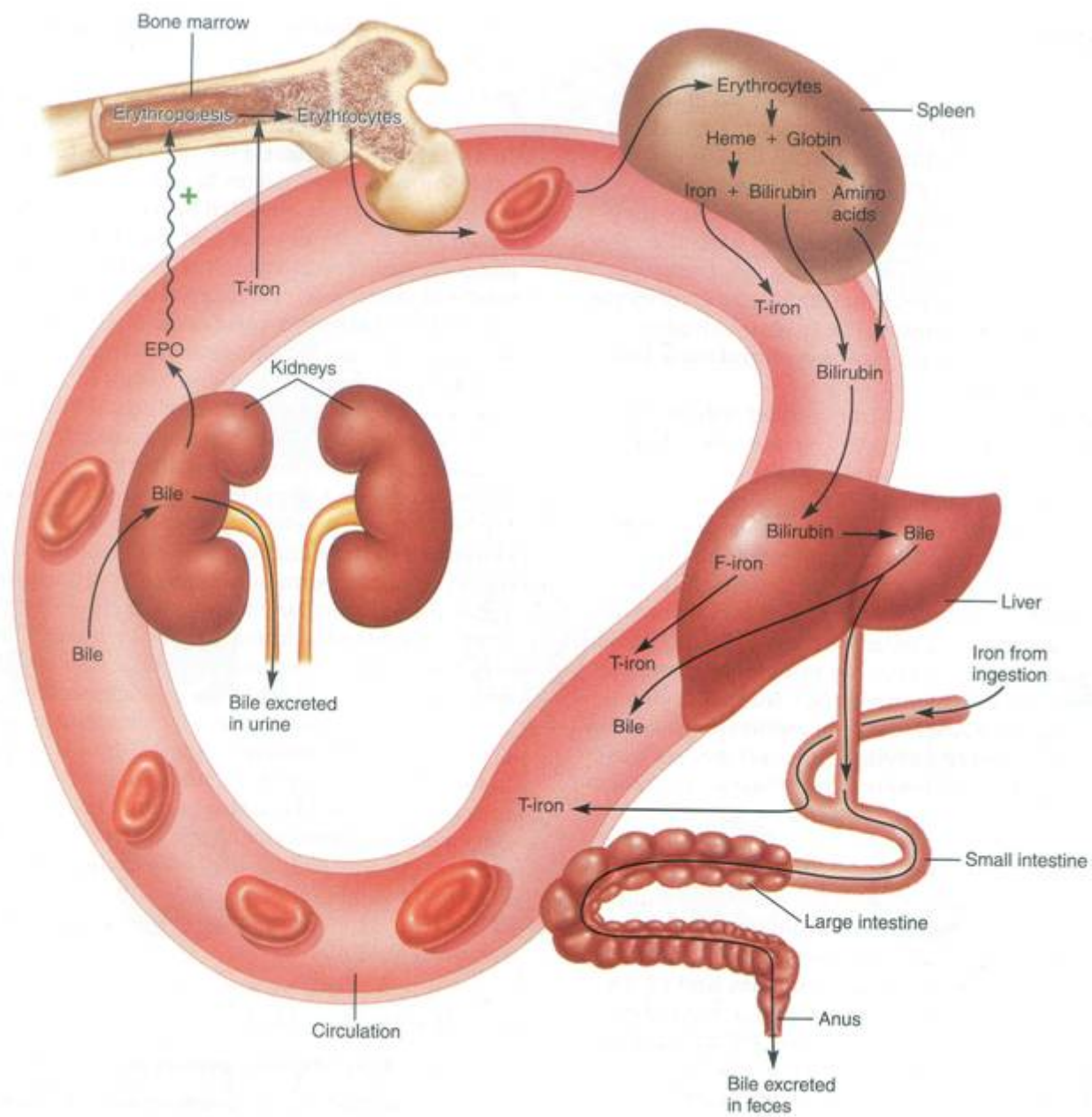
RBC LIFECYCLE:

Generated by HEMATOPOIETIC STEM CELLS in bone marrow.

Circulation in blood. (Remember, no nucleus, so it breaks down (wears out) eventually – about 80-120 days.)

Consumed by phagocytic cells, particularly in liver and spleen.

Components broken down and recycled. (See following diagram for further details.)










WHITE BLOOD CELLS (LEUKOCYTES)

- Retain nucleus
- Live for a long time
- Usually complexly shaped (“lobate”)
- Outnumbered by RBC 1000 to 1 (though the number is somewhat higher in newborn infants).

2 Types: GRANULOCYTES and AGRANULOCYTES

Granulocytes derived from bone marrow

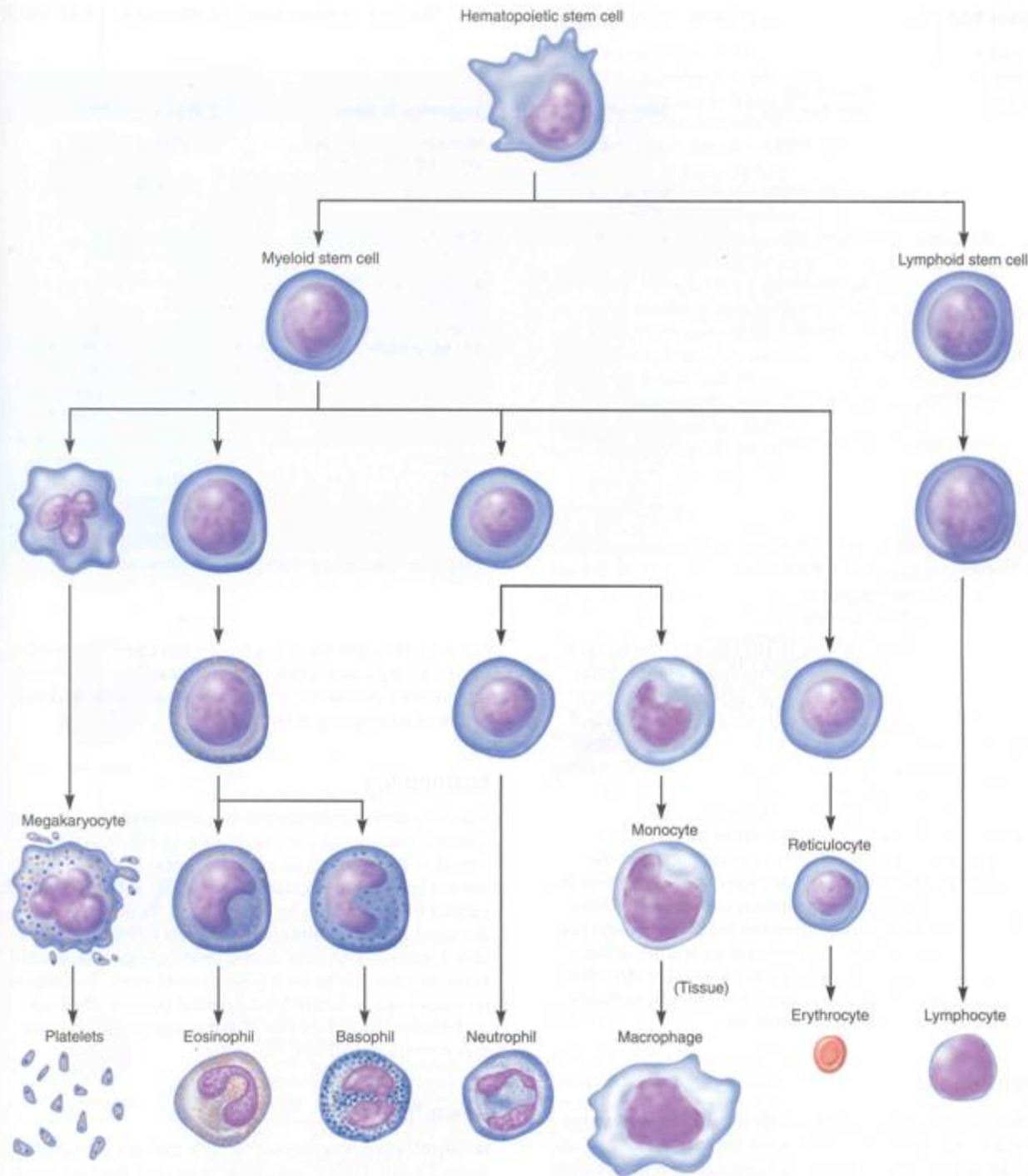
Leukocyte morphology	Functions in immunity
 Neutrophil	Engulf microorganisms, abnormal cells, and foreign particles by phagocytosis
 Eosinophil	Secrete enzymes that kill parasites; contribute to tissue damage in allergic reactions
 Basophil	Secrete chemical mediators of inflammation and allergic reactions
 Monocyte 	Secrete cytokines; engulf microorganisms by phagocytosis
 Macrophage	
 Lymphocyte	Plasma cells (mature form of B cells) secrete antibodies Helper T cells secrete cytokines that activate multiple cell types; cytotoxic T cells secrete factors that lead to the death of infected cells and tumor cells Null cells called natural killer cells secrete factors that lead to the death of infected cells and tumor cells

NEUTROPHILS: phagocytes that seek out, engulf, and destroy microorganisms.

EOSINOPHILS: lobate (“B”-shaped), mobile phagocytes, similar to neutrophils, particularly important for attacking microorganisms.

BASOPHILS: (elongate, lobed nuclei), regulate immunity against parasites and certain allergic responses.

MONOCYTES: mobile phagocytes; large (4-5x size of RBC). Line vascular network of lymphatics and associated organs. (Important! OSTEOCYTES differentiate from these.)



White Blood Cell Development

LYMPHOCYTES

(We'll talk about these in greater detail during immunology lecture.)

- Common in lymphatic vessels.
- Originate in bone marrow, then migrate to lymphoid tissues – establish colonies.
- Then, can produce MORE lymphocytes without involving bone marrow.
- Particularly common in lymph nodes, spleen, tonsils, and lymphoid tissue of gut.
- Not phagocytes.
- Regulate cellular immune responses.

PLATELETS

- Function in: process of blood clotting & protection of vascular channels from internal damage.
- Can adhere to each other and collagen of connective tissue.
- HOWEVER, DON'T adhere to WBC or RBC.
- Good plug, but don't adhere to blood cells themselves!

ABO BLOOD TYPES

Red blood cells have particular proteins on their surfaces. In combination with different (incompatible) kinds of blood, they induce blood cells to clump up (“agglutination”).

Two different versions of these types of proteins (called “agglutinogens”: A and B.

Based on possible combinations of A & B types of agglutinogens, there are four possible blood types in this system: A, B, AB, neither (called O)

ANTIGEN – any substance that, as a result of coming into contact with appropriate tissues, induces a state of sensitivity and which reacts in a demonstrable way with tissues of the sensitized subject.

ANTIBODY – an immune or protective protein (usually associated with a particular type of cell) that is characterized by reacting with a specific antigen.

Cell Surface Protein	Blood Type	Antibodies	Compatible with(!)
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A

A

Anti-B

A, O

B

B

Anti-A

B, O

AB

AB

None

A, B, AB, O

O

O

Anti-A

Anti-B

ALL

INTRODUCTION TO BLOOD VESSELS

Blood vessels – tubular structures, with particular named layers from innermost to outermost:

INNERMOST

Tunica Intima (has three subcomponents):

Inner lining of simple epithelial cells attached to a basement membrane.

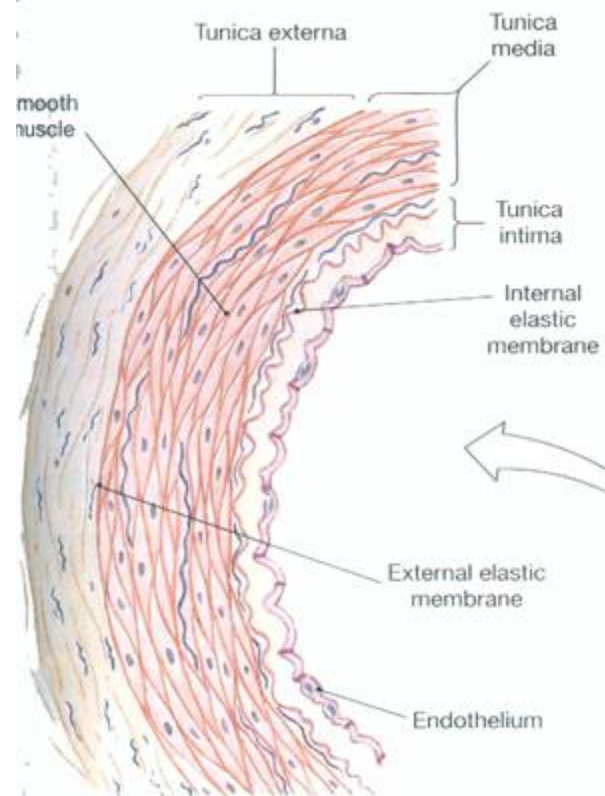
Middle layer of fine connective tissue made up of collagen.

Internal elastic lamina – outer elastic layer

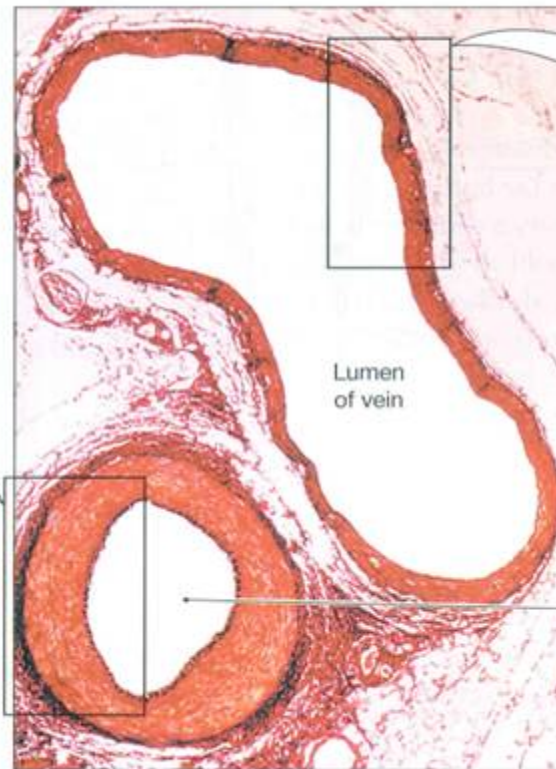
Tunica Media – smooth muscle, elastic fibers, other connective tissue components.

Tunica Adventitia (or *Tunica Externa*)– mostly elastic and collagenous fibers. (In large vessels this layer has dedicated nerves, tiny blood vessels and lymphatics.

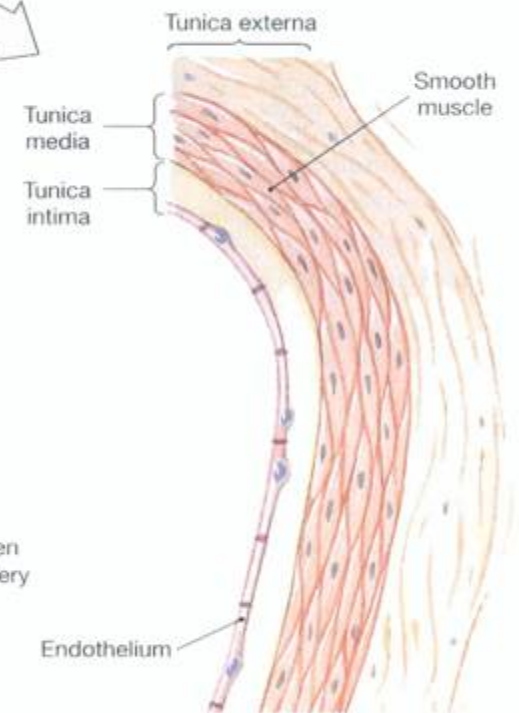
OUTERMOST



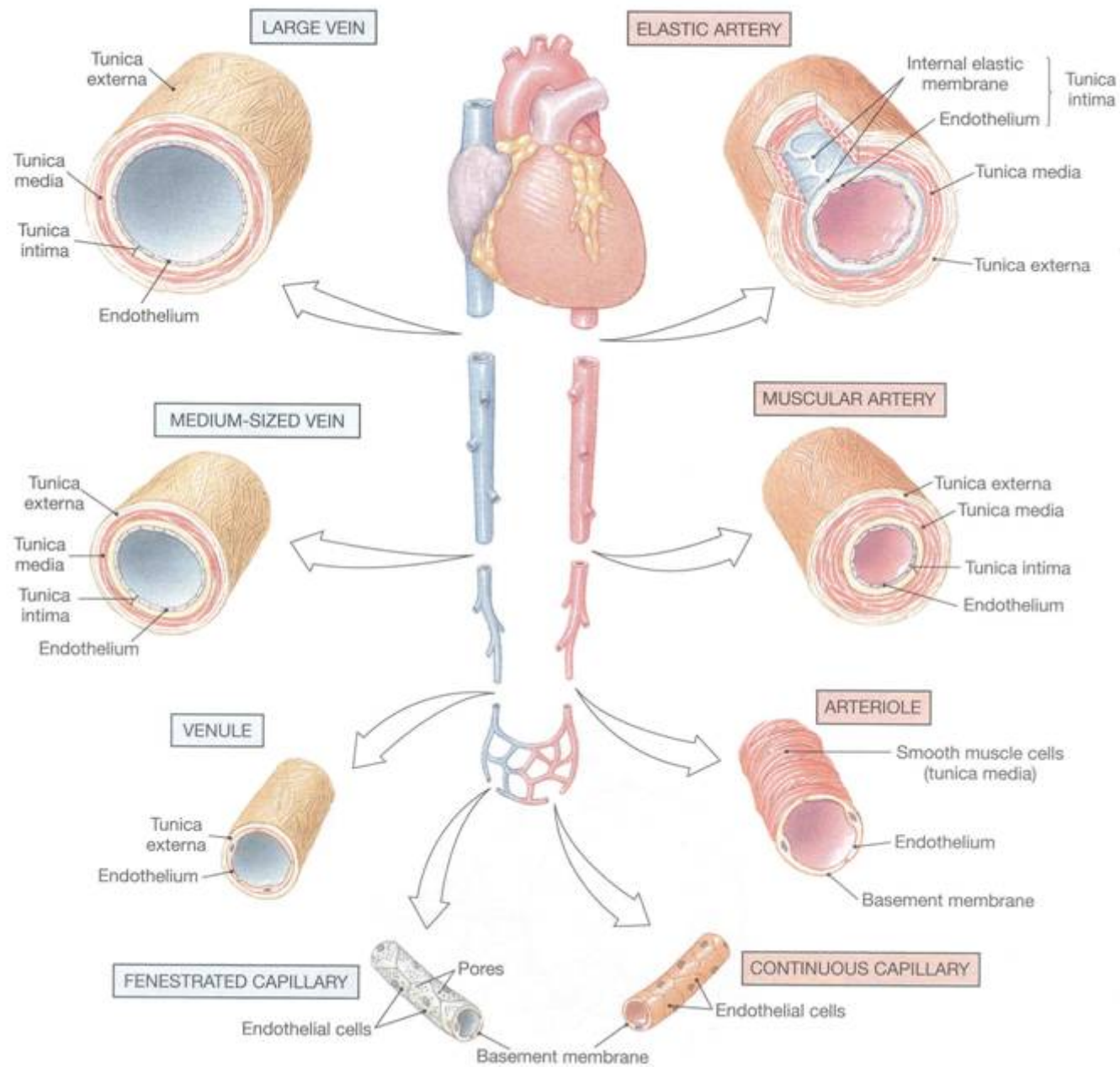
Arterial wall



Artery and vein (LM $\times 90$)

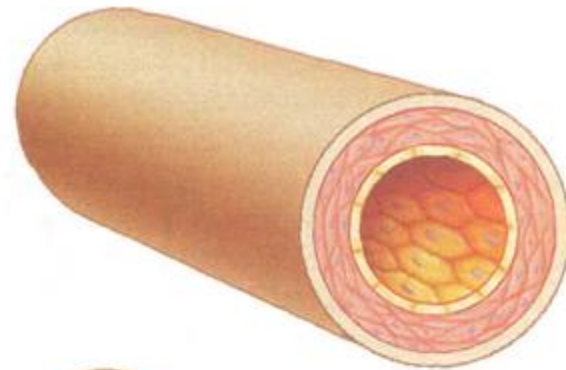


Venous wall

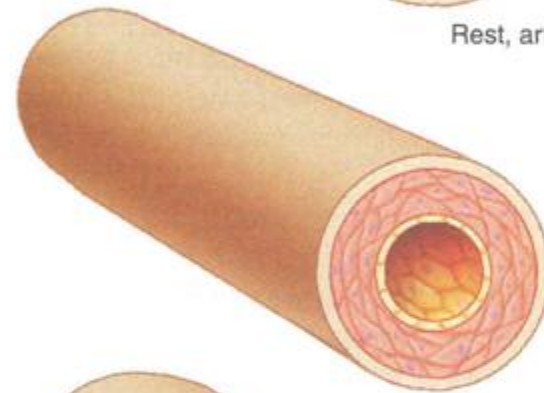


ARTERIES to ARTERIOLES

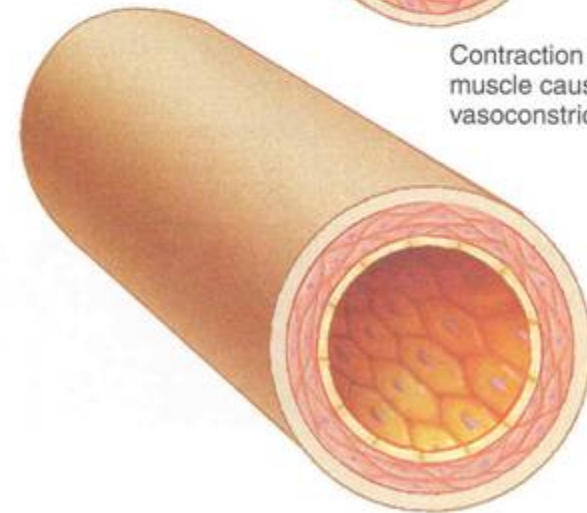
- Smallest definable arteries are arterioles.
- They have relatively more smooth muscular tissue, less elastic tissue.
- Thus, they are more easily regulated by (autonomic) nervous control.
- Very smallest arterioles (terminal arterioles):
 - Have no internal elastic layer.
 - Tunica media* densely supplied with sympathetic nerve fibers.



Rest, arteriolar tone



Contraction of smooth muscle causes vasoconstriction



Relaxation of smooth muscle causes vasodilation

VEINS TO VENULES

- Some veins to have smooth muscle in them (the very largest).
- Have same layers as arteries, but *tunica media* is much thinner.
- Have relatively less elastic tissue.
- Operate at low pressure.
- Have periodic bicuspid-shaped valves to prevent backflow.
- Smallest (venules) receive capillary blood – have no *tunica media*.

CAPILLARIES

- Smallest and thinnest of blood vessels – usually constructed of only a single layer of tunica intima.
- Often as narrow as a single blood cell.
- Greatest loss of blood pressure at the capillary level.
- Location of nutrient and gas exchange with other tissues.