Open Lab Cardiovascular Review

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Formulas

A. Cardiac output: The volume of blood pumped per minute by each ventricle.

B. Cardiac rate: Pumping ability of the heart in beats per minute.

C. Stroke volume: Volume of blood ejected from heart per heart beat

D. Cardiac output equation: cardiac output (mL/min) = cardiac rate (bpm) x stroke volume (mL/beat)
E. End-systolic volume (ESV) is the volume of blood in a ventricle at the end of contraction, or systole, and the beginning of filling, or diastole.
F. End-diastolic volume is the amount of blood that is in the ventricles before the heart contracts
G. Ejection fraction (EF) is a measurement, expressed as a percentage, of how much blood the left ventricle pumps out with each contraction.

Stroke volume, Cardiac output and heart sounds

1. **Cardiac output** – the volume of blood pumped from each ventricle per minute:

CO	=	SV	x	HR
cardiac output	=	stroke volume	X	heart rate
(ml/minute)		(ml/beat)		(beats/min)

Cardiac out put [CO]= heart rate x SV

CO = SV x HR]

Cardiac ouput = SV x pulse rate

----------= L/mn

1000

Pulse pressure :120/80= 120-80 = 40mmhg

$$CO = \frac{VO_2}{C_a - C_v}$$

CO = cardiac output

VO_2 = oxygen consumption in ml of pure gaseous oxygen per minute

C_a = oxygen content of arterial blood

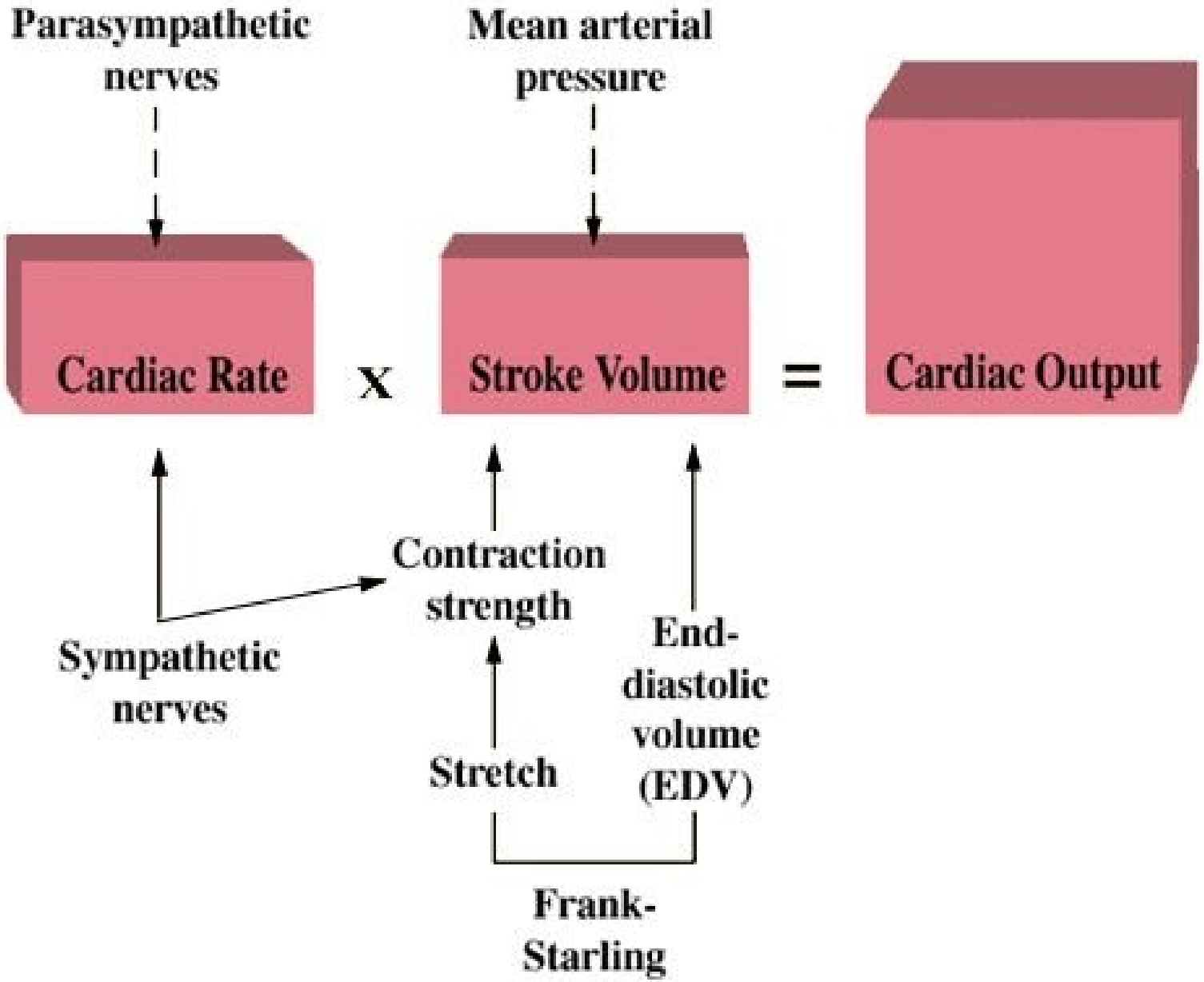
C_v = oxygen content of mixed venous blood

SV [stroke volume] = CO/HR =cardiac out put/ heart rtate

HR_{max} = 220 − age

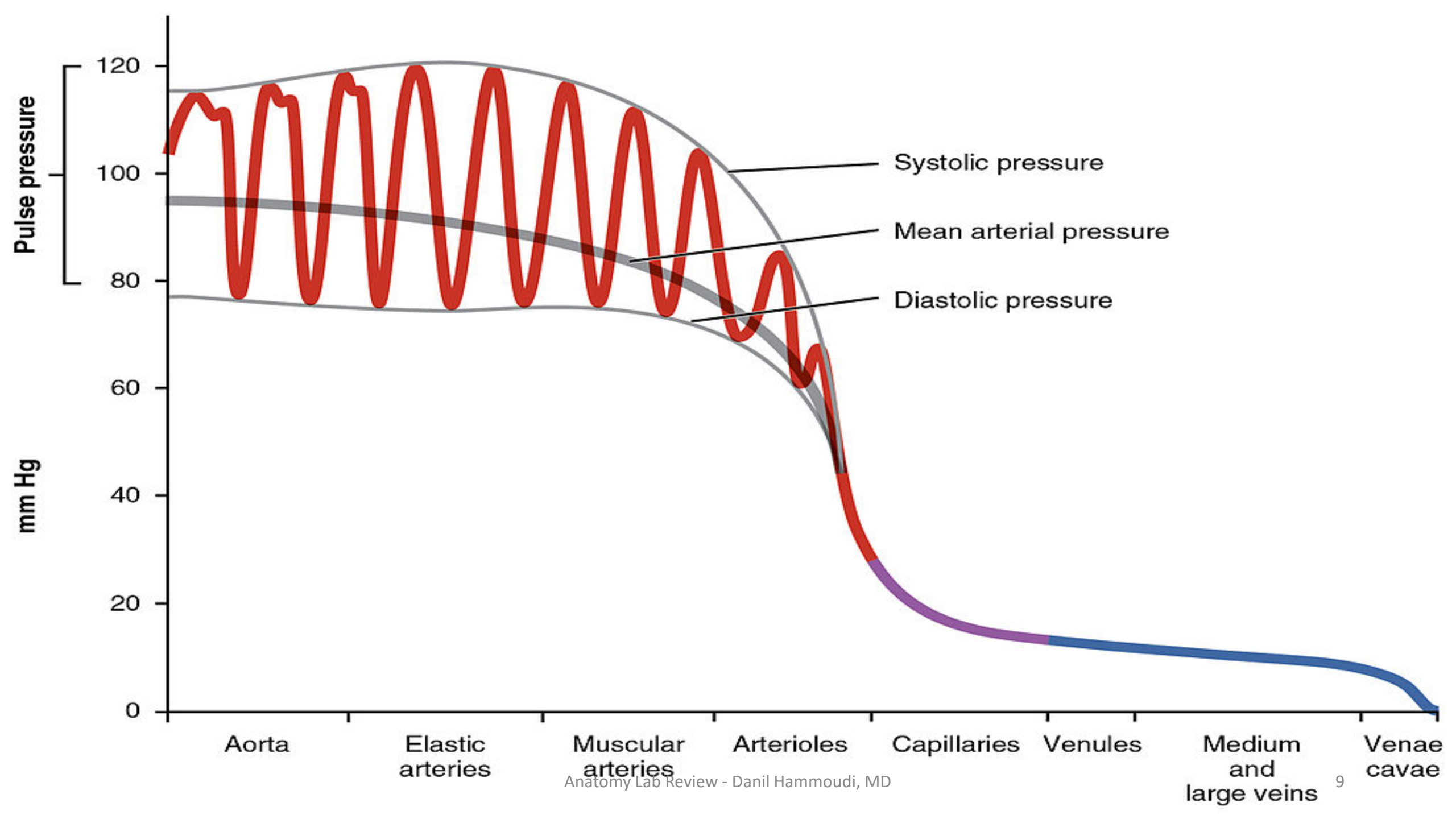
65% intensity: (220 − (age = 40)) * 0.65 → 117 bpm

85% intensity: (220 − (age = 40)) * 0.85 → 153 bpm


Parasympathetic nerves
Mean arterial pressure
Cardiac Rate
x
Stroke Volume
=
Cardiac Output
Contraction strength
Sympathetic nerves
End-diastolic volume (EDV)
Stretch
Frank-Starling

- ***PP = SV/2 PULSE PRESSURE =STROKE VOLUME/2***
- ***SV=PPX2*** Stroke Volume=EDV-ESV
- Pulse pressure :120/80= 120-80 = 40mmhg
- ***PP = 3(MP – DP)***
- ***DP [DIASTOLOC PRESSURE] = SP – PP [SYSTOLIC PRESSURE]-PULSE PRESSURE***

  MP [MEAN BLOOD PRESSURE]= DP + ⅓PP =


Pulse pressure
120
100
80
60
40
20
0
mm Hg
Systolic pressure
Mean arterial pressure
Diastolic pressure
Aorta
Elastic arteries
Muscular arteries
Arterioles
Capillaries
Venules
Medium and large veins
Venae cavae

Mean Arterial Pressure

Mean Arterial Pressure (MAP)

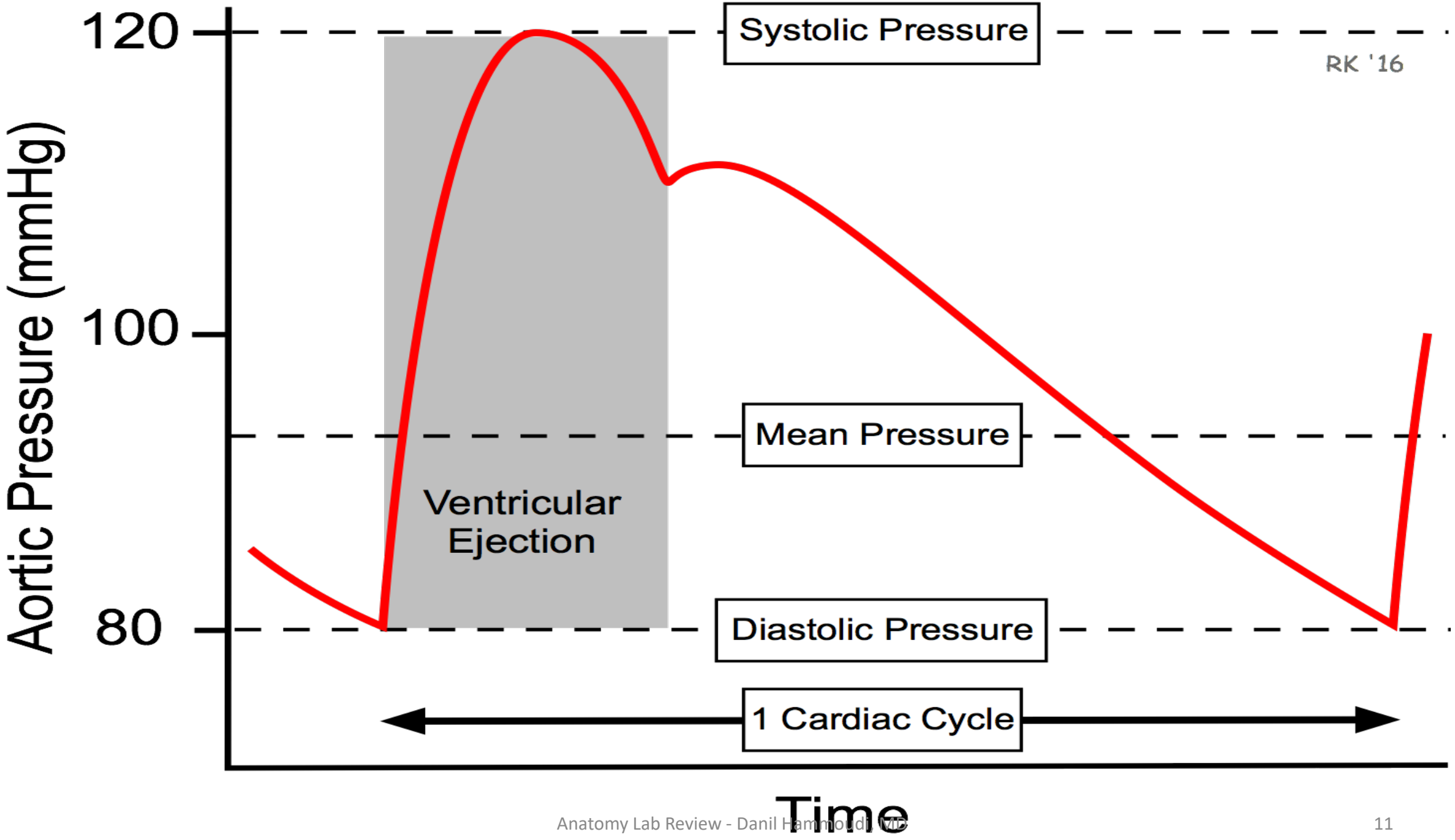
Range = 70 – 110 mmHg

The average pressure of the arteries

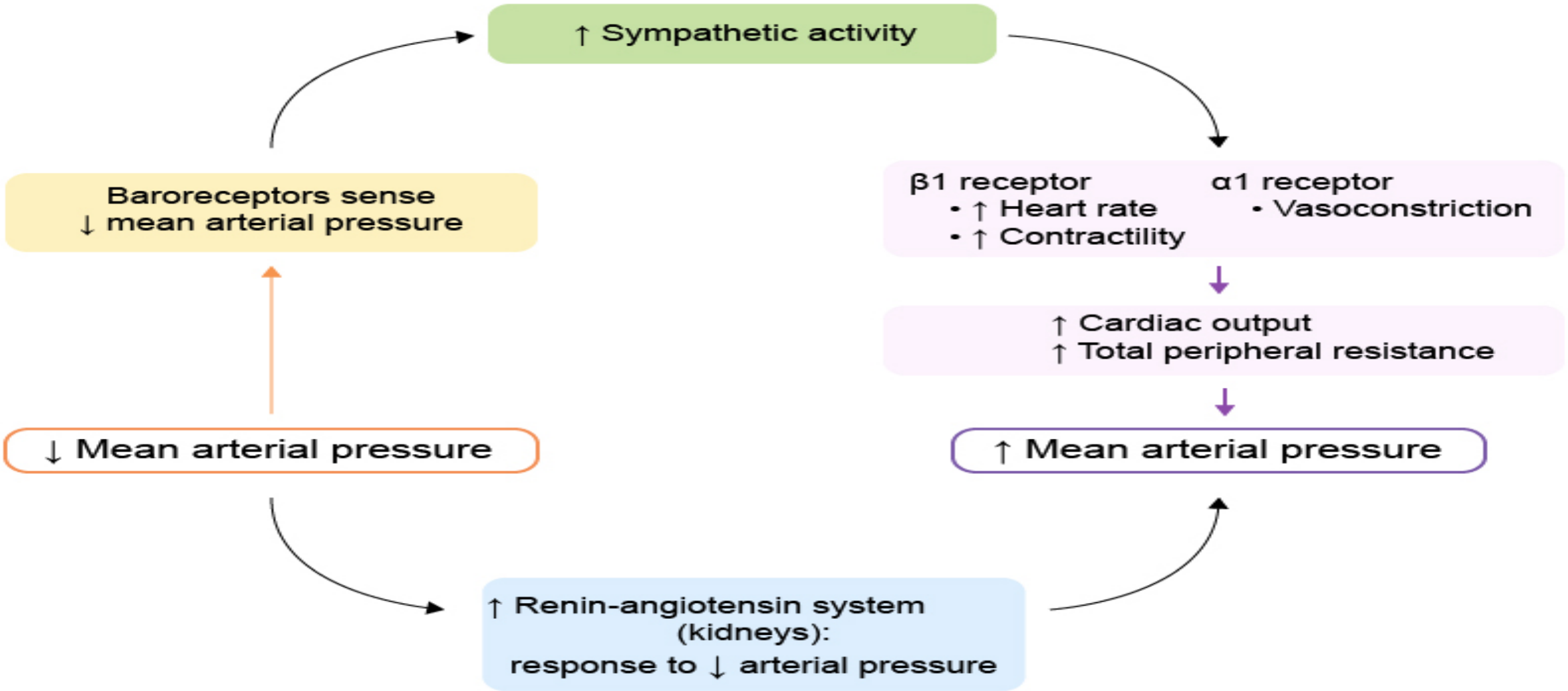
$$MAP = \frac{(2 \times DBP) + SBP}{3}$$

MAP is multiplied by 2 because diastolic phase lasts longer than the systolic phase

If B/P 120/75, then MAP = _____


120
100
80
Aortic Pressure (mmHg)
Systolic Pressure
RK '16
Mean Pressure
Ventricular
Ejection
Diastolic Pressure
1 Cardiac Cycle
Time

Maintanence of Mean Arterial Pressure



Mean arterial pressure = Cardiac output x Total peripheral resistance

Lucy Liu

$SV = EDV - ESV$	**stroke volume**
$EDV = SV + ESV$	**end diastolic volume**
$ESV = EDV - SV$	**end systolic volume**

$$\%\ \text{CHANGE IN CO} = \frac{\text{CO AFTER EXERCISE} - \text{CO REST}}{\text{CO AT REST}} \times 100$$

$$\text{Ejection Fraction (EF)} = (\text{SV} / \text{EDV}) \times 100\%$$

Normal EF is 0.5-0.75

Measure	Typical value	Normal range
end-diastolic volume (EDV)	120 ml	65 - 240 ml
end-systolic volume (ESV)	50 ml	16 - 143 ml
stroke volume (SV)	70 ml	55 - 100 ml
ejection fraction (E_f)	58%	55 to 70%
heart rate (HR)	70 bpm	60 to 100 bpm
cardiac output (CO)	4.9 L/minute	4.0 - 8.0 L/min

EXERCISES

What is the effect of a sudden decrease in blood pressure on heart rate and stroke volume?

What is the effect of a sudden increase in blood pressure on heart rate?

What is the effect of a sudden increase in blood pressure on stroke volume?

What is the effect of a sudden drop in blood volume on heart rate and stroke volume?

What is the effect of an increase in calcium on heart rate and stroke volume?

What is the effect of a sudden decrease in blood pressure on heart rate and stroke volume?
What is the effect of a sudden increase in blood pressure on heart rate?
What is the effect of a sudden increase in blood pressure on stroke volume?
What is the effect of a sudden drop in blood volume on heart rate and stroke volume?
What is the effect of an increase in calcium on heart rate and stroke volume?

If there is a sudden drop in blood pressure, there is less venous return and stroke volume decreases. Heart rate increases due to increased sympathetic activity and cardiac output is maintained as a result.

Get less sympathetic activity so heart rate decreases.

High pressure in the arteries leaving the heart causes a decreased stroke volume since the semilunar valve opens only when pressure in the ventricle exceeds pressure in the arteries leaving the heart.

A drop in blood volume decreases blood pressure which increases sympathetic activity, causing an increase in heart rate. Since there is less blood, stroke volume decreases.

Increased calcium increases the number and force of contractions, increasing both heart rate and stroke volume.

Given the values for HR and SV, calculate cardiac output with normal value that you know:

Given the values for HR and SV, calculate cardiac output:
CO= SV x HR
CO= 70 x 75
CO= 5,250

	Heart Rate (beats/min)	Stroke Volume (mL/beat)	Cardiac output (mL/min)
A	60	80	
B	80	60	
C	100	100	
D	55	90	
E	120	140	

	Heart Rate (beats/min)	Stroke Volume (mL/beat)	Cardiac output (mL/min)
A	60	80	**4,800**
B	80	60	**4,800**
C	100	100	**10,000**
D	55	90	**4,950**
E	120	140	**16,800**

If the ESV is 50 ml and the EDV is 120 ml, what is the stroke volume?

If the ESV is 50 ml and the EDV is 120 ml, what is the stroke volume?

Stroke Volume = End-Diastolic Volume - End-Systolic Volume
~70 ml/beat = ~ 120 ml/beat - ~50 ml/beat

1. If CO = 6.4L/min, and SV = 73 ml/beat, what is the heart rate?

2. If Pulse = 110 beats/min and CO = 5.2L/min what is the SV?

3. If SV = 94mL/beat and SBP = 133mmHg, what is MBP?

1. If CO = 6.4L/min, and SV = 73 ml/beat, what is the heart rate?

CO=HR*SV

First convert CO to 6400 6400=HR*73 divide both sides by 73

HR=88 beats/minute

2. If Pulse = 110 beats/min and CO = 5.2L/min what is the SV?

CO=HR*SV

First convert CO to 5200 5200=110*SV divide both sides by 110

SV=47 ml/beat

3. If SV = 94mL/beat and SBP = 133mmHg, what is MBP?

MBP=DBP+1/3PP

First find PP based on SV SV/2=PP, 94/2=47 so PP=47ml/beat

Use SV to find DBP PP=SBP-DBP, 47=133-DBP, so DBP=86mmHg

Calculate MBP MBP=DBP+1/3PP, 86 + 1/347 = 102mmHg

- At REST Pulse = 12 beats/10 seconds. BP = 110/70mmHg. What is CO?

- After exercise Pulse = 75 beats/45 sec, BP = 150/95mmHg. What is CO?

- What is the % change in HR from rest to post exercise?

- At REST Pulse = 12 beats/10 seconds. BP = 110/70mmHg. What is CO?
- After exercise Pulse = 75 beats/45 sec, BP = 150/95mmHg. What is CO?
  - What is the % change in HR from rest to post exercise?

a. At REST Pulse = 12 beats/10 seconds. BP = 110/70mmHg. What is CO?

*COrest = HR*SV* *convert pulse from 12beats/10seconds to 72 beats/1minute*

Use BP to get PP *PP=SBP-DBP, PP=110-70 = 40mmHg*

Use PP to get SV *SV=PP*2, SV=40*2 = 80ml/beat*

Now get COrest *COr=HR*SV, COr=72*80 = 5760 = 5.760L/min*

- After exercise Pulse = 75 beats/45 sec, BP = 150/95mmHg. What is CO?

Same plan as above *75beats/45seconds*60seconds/minute = 100beats/minute*

PP=SBP-DBP, PP=150-95=55mmHg

*SV=PP*2, SV=55*2=110ml/beat*

*COe=HR*SV, COe=100*110=11000=11L/minute*

a. What is the % change in HR from rest to post exercise?

$$\%changeHR = \frac{HRe-HRr}{HRr} *100 = 11-5.760 / 5.760 *100 = 91\% \text{ increase}$$

HR = 49 beats/min, CO = 5L/min, SBP = 105mmHg, what is DBP?

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HR = 49 beats/min, CO = 5L/min, SBP = 105mmHg, what is DBP?

Use CO and HR to get SV	5000=49*SV, SV=102ml/beat
SV/2=PP	102/2=PP, PP=51mmHg
PP=SBP-DBP	51=105-DBP, DBP=54mmHg

1a. At rest an individual has an arterial blood pressure of 128/84 mm Hg. The pulse is 63 beats/45 seconds. What is the cardiac output? Indicate correct units.

1b. One minute after exercise the measured values are : BP = 136/82, pulse 48 beats/30 seconds. What is the post-exercise cardiac output? Don't forget the units.

1c. What is the percent increase in cardiac output from rest to post exercise?

1a. At rest an individual has an arterial blood pressure of 128/84 mm Hg. The pulse is 63 beats/45 seconds. What is the cardiac output? Indicate correct units.

1a. Pulse rate = 63 beats/45 seconds X 60 seconds/1 minute = 84 beats/min

PP = SBP – DBP = 128-84 = 44 mmHg

SV = PP X 2 = 44 X 2 = 88 mL/beat

CO = SV X HR = 88 X 84 = 7,392 mL/min

1b. One minute after exercise the measured values are : BP = 136/82, pulse 48 beats/30 seconds. What is the post-exercise cardiac output? Don't forget the units.

1b. Pulse rate = 48 beats/30 seconds X 60 seconds/1 minute = 96 beats/min

PP = SBP – DBP = 136-82 = 54 mmHg

SV = PP X 2 = 54 X 2 = 108 ml/beat

CO = SV X HR = 108 X 96 = 10,368 mL/min

1c. What is the percent increase in cardiac output from rest to post exercise?

1c. % change = $\frac{\text{COE} - \text{COR}}{\text{COR}} \times 100 = \frac{10{,}368 - 7{,}392}{7{,}392} \times 100 =$ 40%

2. If the cardiac output is 6.3 L/min and the pulse rate is 80 beats/min, what is the stroke volume? Indicate the correct units.

3. If the stroke volume is 65 mL/beat and the cardiac output is 5.7 L/min, what is the heart rate? Indicate the correct units.

2. If the cardiac output is 6.3 L/min and the pulse rate is 80 beats/min, what is the stroke volume? Indicate the correct units.

SV = CO/HR = 6,300/80 = 79 ml/beat

3. If the stroke volume is 65 mL/beat and the cardiac output is 5.7 L/min, what is the heart rate? Indicate the correct units.

HR = CO/SV = 5,700/65 = 88 beats/min

4. If the cardiac output is 6.9L/min, and the heart rate is 85 beats/min, and the systolic pressure is 118 mmHg, what is the diastolic pressure?

5. If a patient's systolic BP is 165 mmHg and his stroke volume is 68 mL/beat, calculate his mean blood pressure.

4. If the cardiac output is 6.9L/min, and the heart rate is 85 beats/min, and the systolic pressure is 118 mmHg, what is the diastolic pressure?

SV = CO/HR = 6900/85 = 81 ml/beat

PP = SV/2 = 81/2 = 41 mmHg

DBP = SP – PP = 118 – 41 = 77 mmHg

5. If a patient's systolic BP is 165 mmHg and his stroke volume is 68 mL/beat, calculate his mean blood pressure.

PP = SV/2 = 68/2 = 34 mmHg

DBP = SBP – PP = 165-34 = 131 mmHg

MBP = DBP + 1/3 PP = 131 +34/3 = 131 +11 = 142 mmHg

If cardiac output is 6.4 L/min, and the stroke volume is 73 mL/beat, what is the heart rate?

2. If pulse rate is 110 beats/min, and cardiac output is 5.2 L/min, what is the stroke volume?

If cardiac output is 6.4 L/min, and the stroke volume is 73 mL/beat, what is the heart rate?

2. If pulse rate is 110 beats/min, and cardiac output is 5.2 L/min, what is the stroke volume?

1. $CO = SV \times HR$; $\frac{CO \times 1{,}000}{1{,}000} = HR$ $\frac{}{SV}$

$\frac{6{,}400 \text{ mL/min}}{73 \text{ mL/beat}} = HR$; HR = 88 beats/min

2. $CO = SV \times HR$; $\frac{CO \times 1{,}000}{1{,}000} = SV$ $\frac{}{HR}$

$\frac{5{,}200 \text{mL/min}}{110 \text{ beats/min}} = 47 \text{ mL/beat}$

3. If stroke volume is 94 mL/beat, and the systolic pressure is 133 mmHg, what is the mean blood pressure?

4. At rest a pulse rate is 12 beats/10 seconds. The BP is 110/70 mmHg. What is the cardiac output?

3. If stroke volume is 94 mL/beat, and the systolic pressure is 133 mmHg, what is the mean blood pressure?

4. At rest a pulse rate is 12 beats/10 seconds. The BP is 110/70 mmHg. What is the cardiac output?

3. SV = PP X 2; PP = SV/2; PP = 94/2 = 47 mmHg

PP = SBP – DBP; DBP = SBP – PP; DBP = 133-47 = 86 mmHg

MBP = DBP + 1/3PP; MBP = 86 + 47/3 = 102 mmHg

4. Pulse rate = 12 beats/10 sec X 60 sec/1 minute = 72 beats/min

PP = SBP – DBP ; 110-70 = 40 mmHg

SV = PP X 2 = 40 X 2 = 80 mL/beat

$$\text{CO} = \frac{\text{SV X HR}}{1{,}000} = \frac{80 \text{ X } 72}{1{,}000} = 5.76 \text{ L/min } (5{,}760 \text{ mL/min})$$

5. After exercise the pulse rate is 75 beats/45 sec, and the BP is 150/95. What is the cardiac output?

6. What is the % change in heart rate from rest to post exercise? (Use data from questions 4 and 5.)

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6. What is the % change in heart rate from rest to post exercise? (Use data from questions 4 and 5.)

5. Pulse rate is 75 beats/45 sec X 60 sec/1 min = 100 beats/min

PP = SBP – DBP ; 150-95 = 55 mmHg
SV = PP X 2 ; 55 X 2 = 110 mmHg
CO = $\frac{\text{SV X HR}}{1{,}000}$; $\frac{110 \text{ X } 100}{1{,}000}$ = 11 L/min (11,000 mL/min)

6. % change = $\frac{\text{HRe – HRr}}{\text{HRr}}$ X100; $\frac{100\text{-}72}{72}$ X 100; 38.9%

7. If the heart rate is 49 beats/min; the cardiac output is 5 L/min, and the systolic pressure is 105 mmHg, what is the diastolic pressure?

7. If the heart rate is 49 beats/min; the cardiac output is 5 L/min, and the systolic pressure is 105 mmHg, what is the diastolic pressure?

$CO = \frac{SV \times HR}{1{,}000}$; $SV = \frac{CO \times 1{,}000}{HR}$; 5,000/49 = 102 mL/beat

SV = PP X 2; SV/2 = PP; 102/2 = 51 mmHg

PP = SBP-DBP; DBP = SBP –PP; 105-51 = 54 mmHg

1. Michelle walked 5 kilometers. Prior to walking she had the following:

Pulse rate = 16 pulses / 15 seconds Systolic BP = 136 mmHg Diastolic BP = 90 mmHg

At the end of the walk she had the following:
Pulse rate = 24 pulses / 10 seconds Mean BP = 132mmHg Diastolic BP = 98 mmHg

Calculate Michelle's percent change in Cardiac Output.

1. Michelle walked 5 kilometers. Prior to walking she had the following:

Pulse rate = 16 pulses / 15 seconds Systolic BP = 136 mmHg Diastolic BP = 90 mmHg

At the end of the walk she had the following:
Pulse rate = 24 pulses / 10 seconds Mean BP = 132mmHg Diastolic BP = 98 mmHg

Calculate Michelle's percent change in Cardiac Output.

1. Calculate Michelle's percent change in Cardiac Output.

CO before exercise:

HR = 12*4 = 48bpm SBP-DBP = PP = 89-70 = 19; 19*2 = 38 = SV

CO = 48 * 38 = 1824 = 1.824 L/min

CO after exercise:

HR = 21*6 = 126bpm MBP = DBP + 1/3 PP = 91 = 82 + 1/3PP; PP = 27*2 = 54 = SV

CO = 126 * 54 = 6804 = 6.804 L/min

%change = COexercise – Corest / COrest *100 %change = 6804 – 1824 / 1824 * 100 = 273% increase

2. Give the following:

Cardiac Output = 9.2L/min Pulse rate = 50 pulses / 30 seconds Diastolic BP = 102 mmHg

Calculate: HR

SV

PP

SBP

MBP

2. Give the following:

Cardiac Output = 9.2L/min Pulse rate = 50 pulses / 30 seconds Diastolic BP = 102 mmHg

Calculate:HR

SV

PP

SBP

MBP

1. Given the following: CO= 8.1L/min, Pulse Rate = 71 pulses / 30 seconds, DBP= 89 mmHg

Calculate:HR 71*2 = 142 bpm

SV CO=HR*SV, 8100=142*SV, SV=8100/142 = 57ml/beat

PP SV/2=PP, 57/2 = 28.5 mmHg = PP

SBP PP=SBP-DBP, 28.5 = SBP – 89, SBP =117.5 mmHg

MBP DBP + 1/3PP, 89 + 1/3(28.5) = 98.5 mmHg

George’s heart rate is 60 beats per minute, his EDV is 120 ml, and his ESV is 50 ml. What is George’s cardiac output?

a. 3000 ml per minute
b. 4200 ml per minute
c. 7200 ml per minute
d. 10,200 ml per minute
e. None of the responses above is correct.

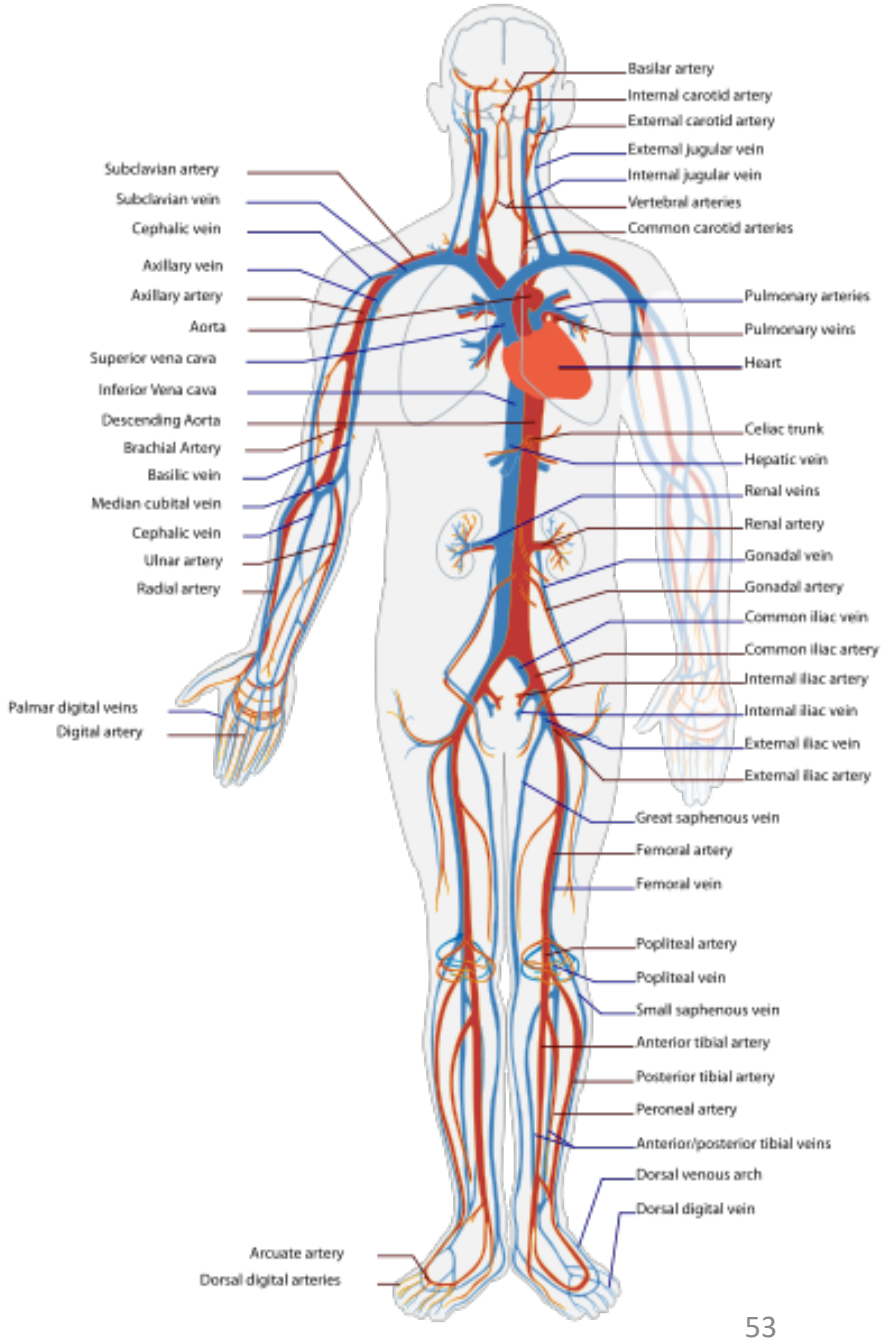
George's heart rate is 60 beats per minute, his EDV is 120 ml, and his ESV is 50 ml. What is George's cardiac output?

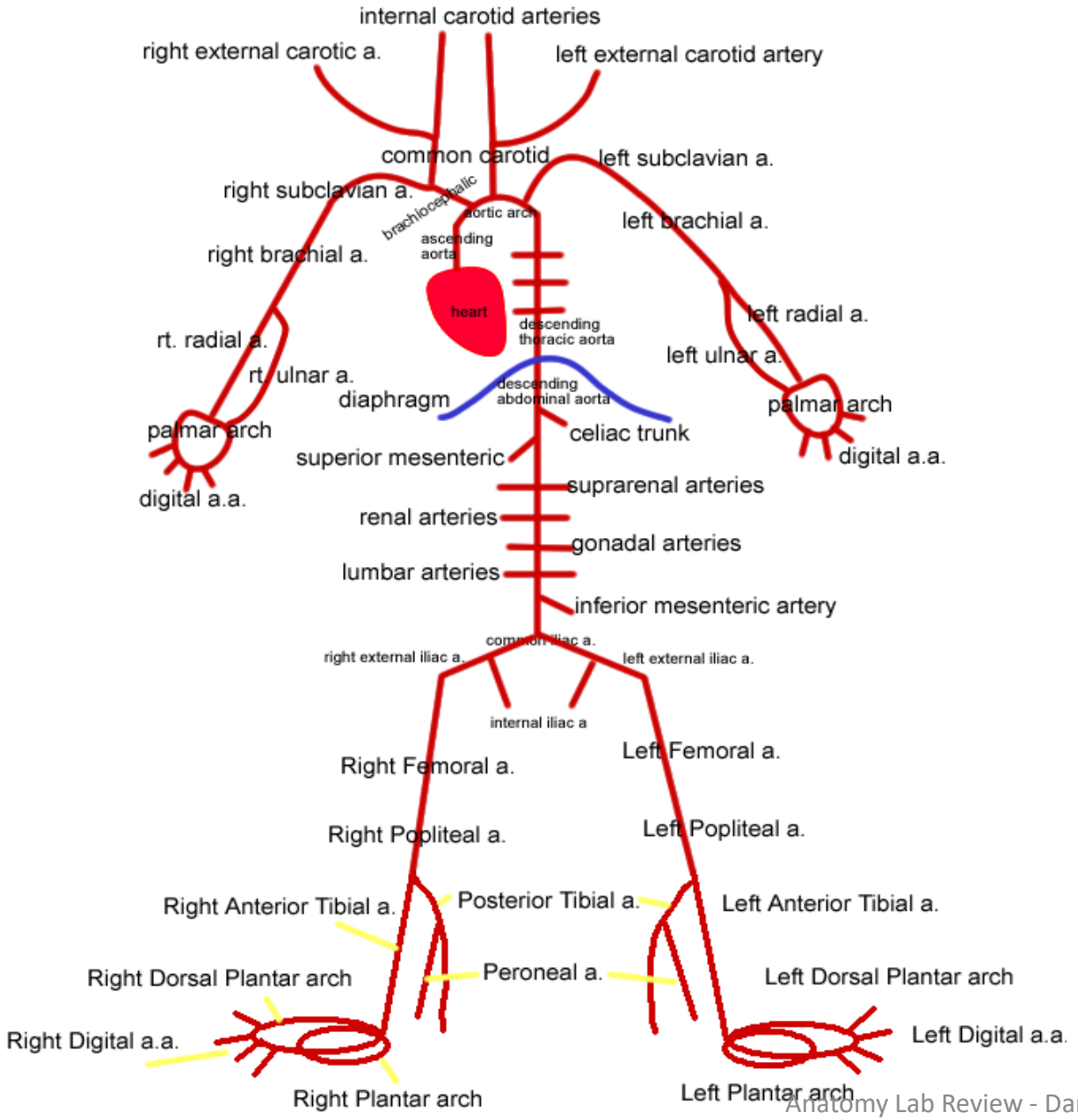
a. 3000 ml per minute
b. 4200 ml per minute
c. 7200 ml per minute
d. 10,200 ml per minute
e. None of the responses above is correct.

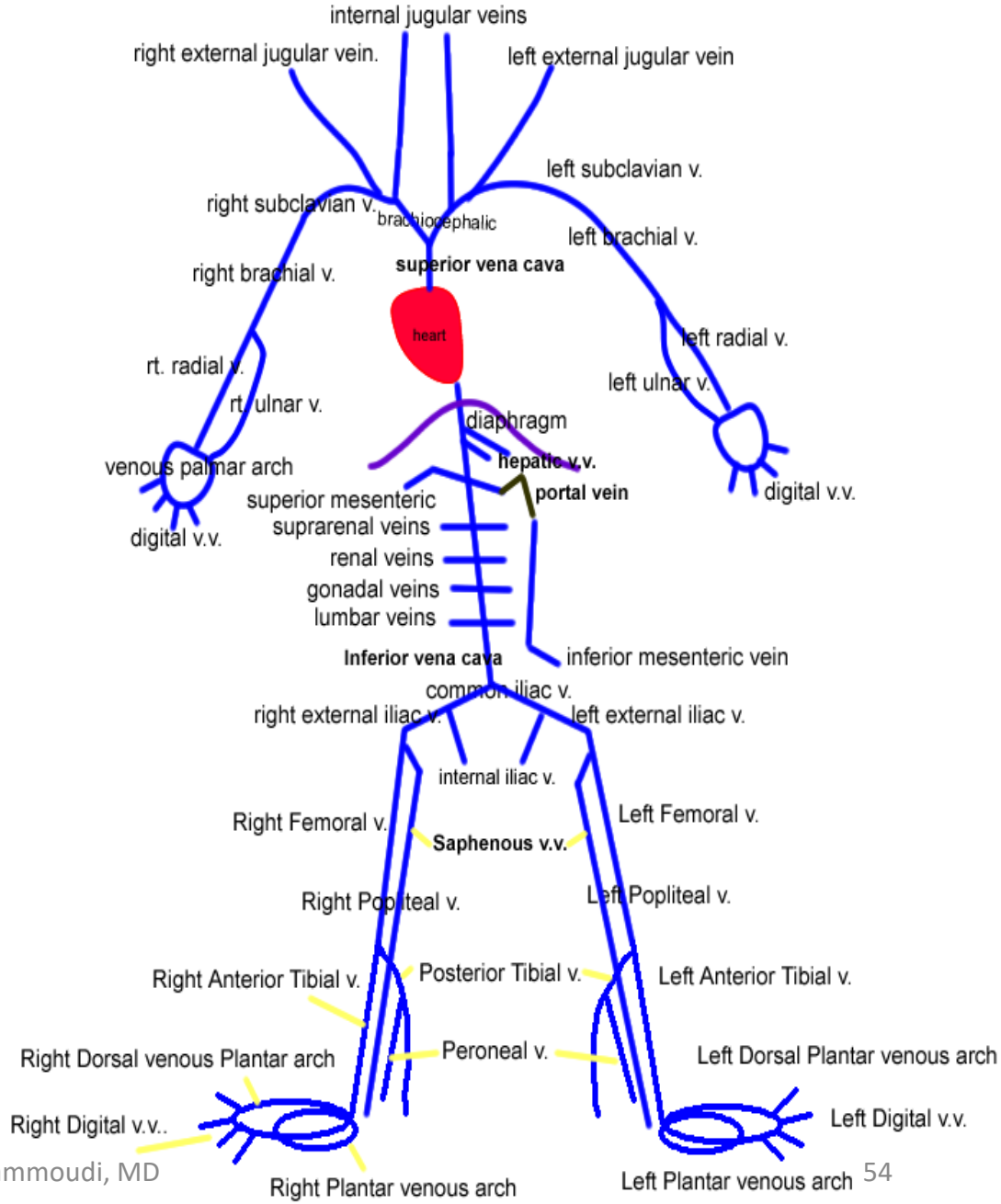
Vaculature

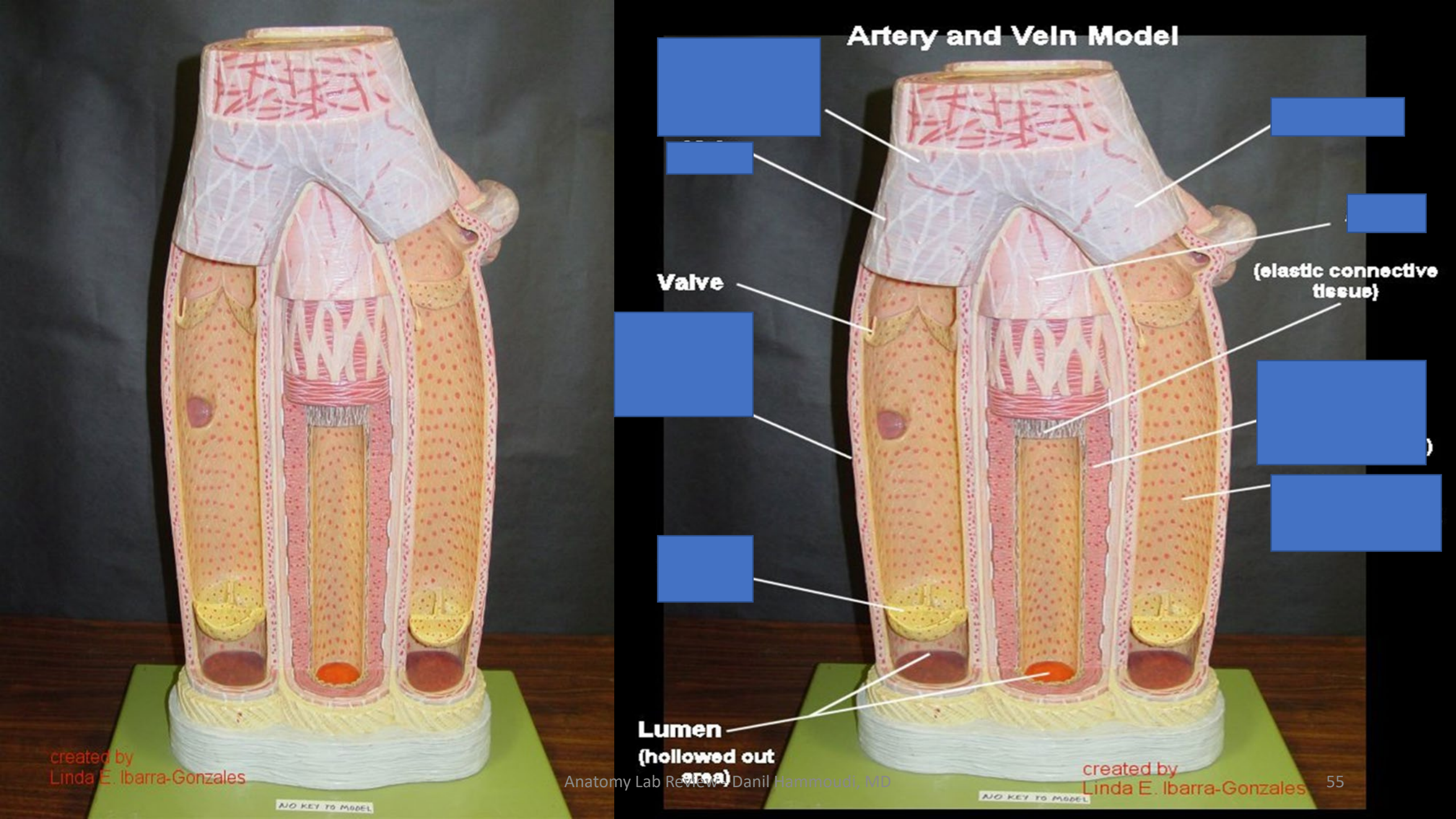
Trace a drop of blood from the spleen to the right kidney naming every vein, artery, organ, heart chamber and heart valve through which it passes.

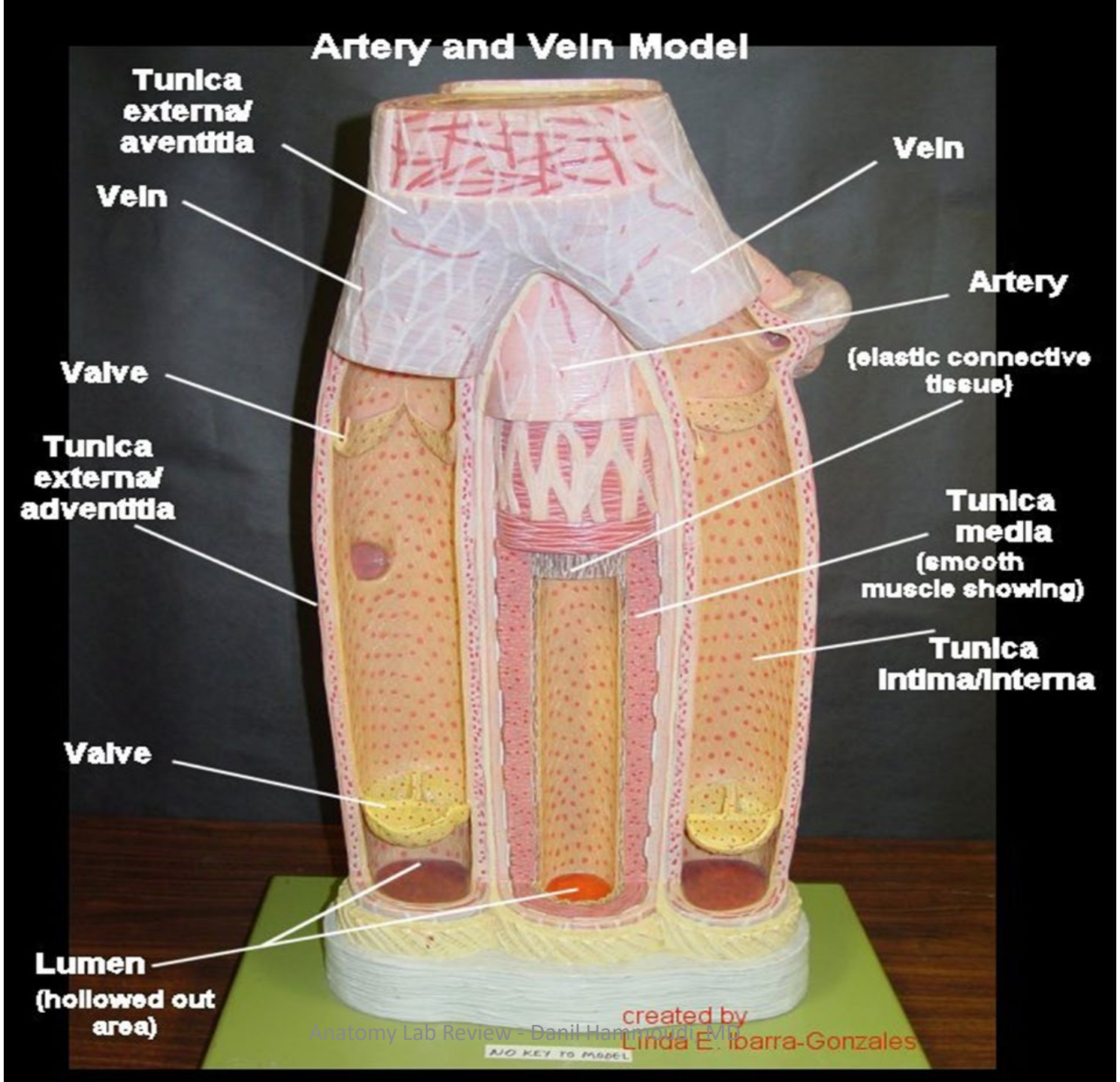
Splenic V→ gastrosplenic V → hepatic portal V → capillaries of liver → hepatic V → inferior vena cava → R atria → tricuspid valve → R ventricle → pulmonary semilunar valve → pulmonary trunk → R/L pulmonary artieries → R/L pulmonary capillaries → R/L pulmonary veins → L atria → bicuspid valve → L ventricle → aortic semilunar valve → ascending aorta → aortic arch → descending thoracic aorta → descending abdominal aorta → R Renal artery

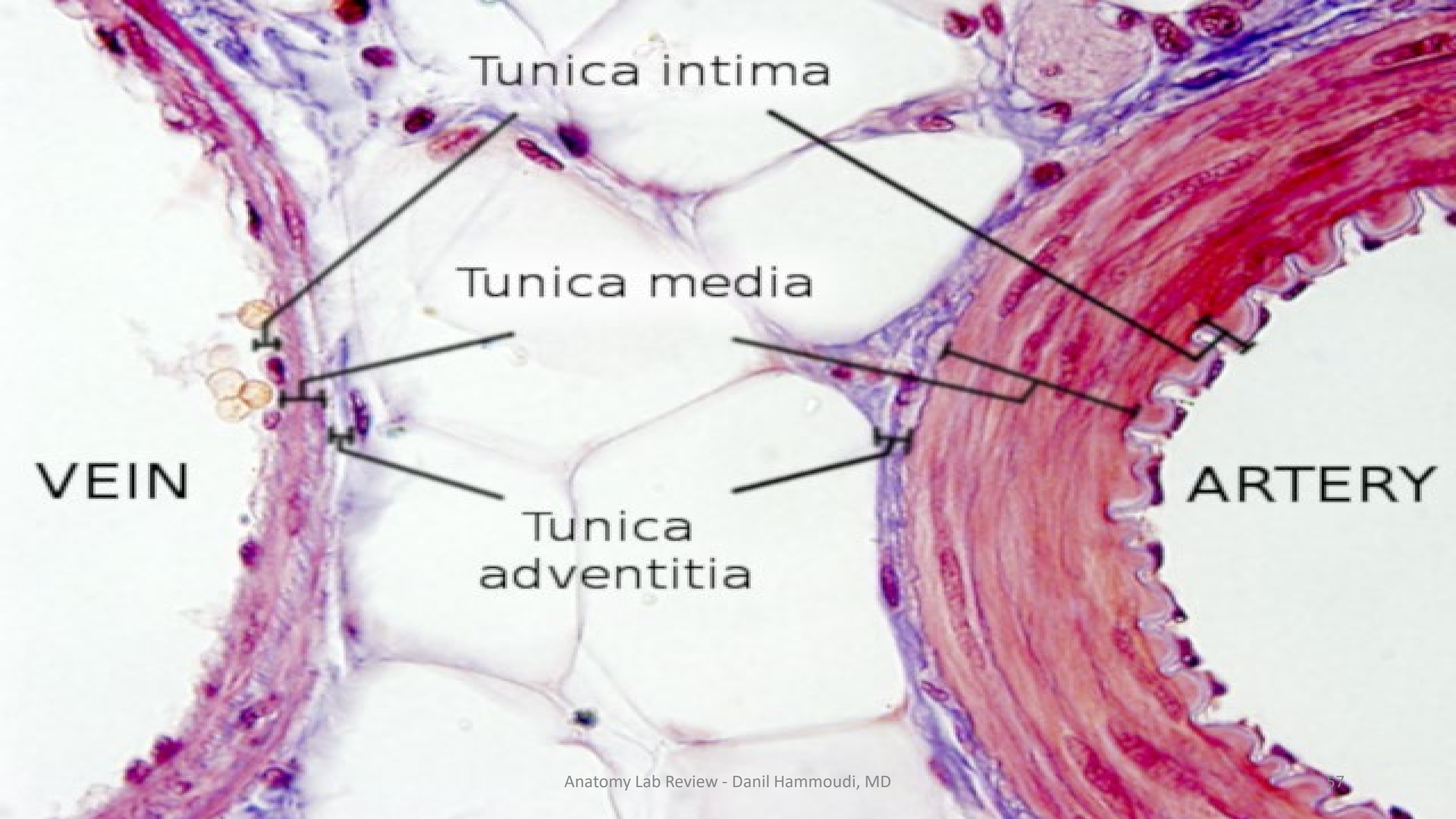


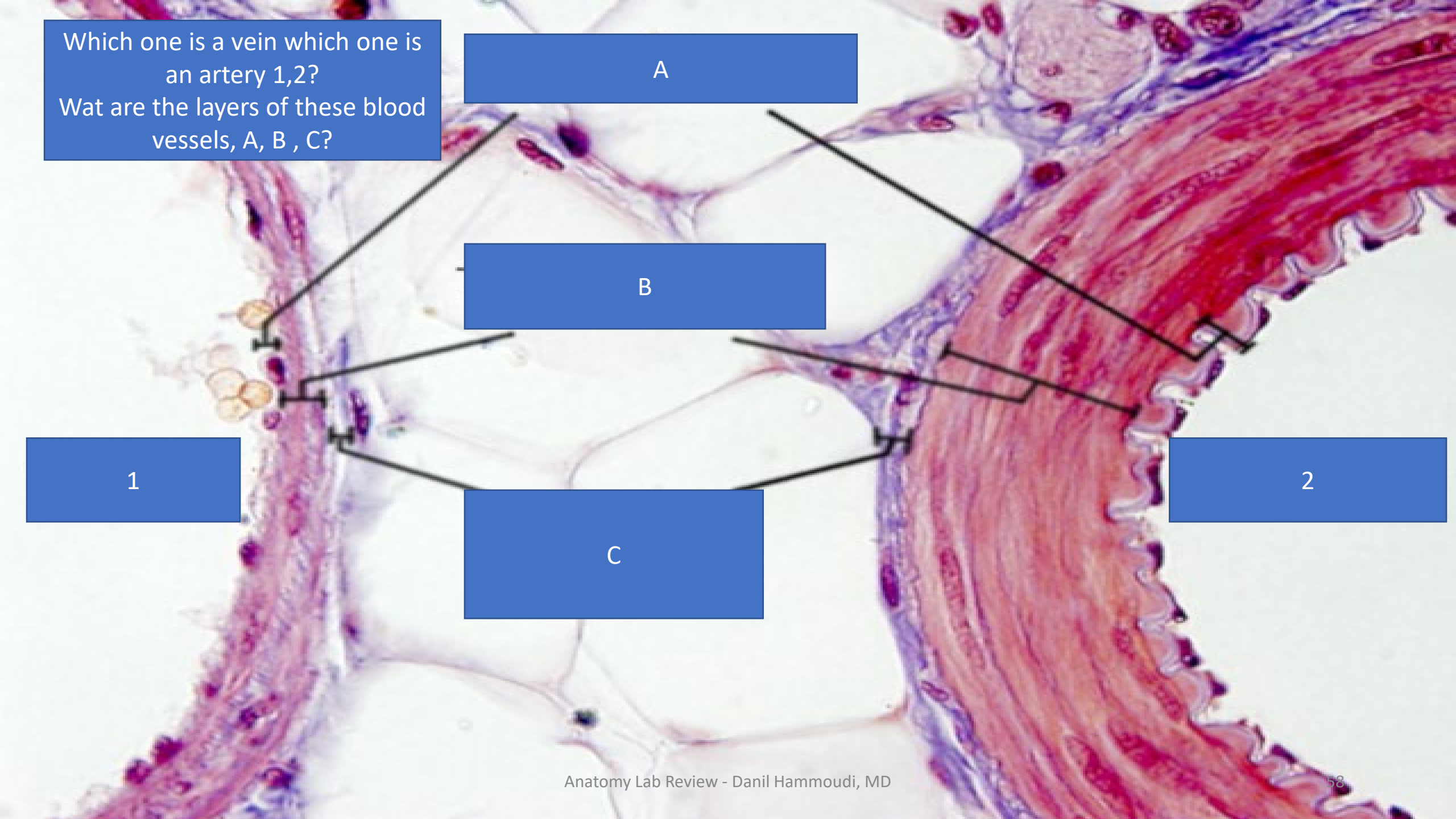

internal carotid arteries
right external carotic a.
left external carotid artery
common carotid
left subclavian a.
right subclavian a.
brachiocephalic
aortic arch
ascending aorta
left brachial a.
right brachial a.
heart
descending thoracic aorta
left radial a.
rt. radial a.
left ulnar a.
rt. ulnar a.
diaphragm
descending abdominal aorta
palmar arch
palmar arch
celiac trunk
superior mesenteric
digital a.a.
digital a.a.
suprarenal arteries
renal arteries
gonadal arteries
lumbar arteries
inferior mesenteric artery
common iliac a.
right external iliac a.
left external iliac a.
internal iliac a
Right Femoral a.
Left Femoral a.
Right Popliteal a.
Left Popliteal a.
Right Anterior Tibial a.
Posterior Tibial a.
Left Anterior Tibial a.
Right Dorsal Plantar arch
Peroneal a.
Left Dorsal Plantar arch
Right Digital a.a.
Left Digital a.a.
Right Plantar arch
Left Plantar arch


internal jugular veins
right external jugular vein.
left external jugular vein
left subclavian v.
right subclavian v.
brachiocephalic
left brachial v.
superior vena cava
right brachial v.
heart
left radial v.
rt. radial v.
left ulnar v.
rt. ulnar v.
diaphragm
hepatic v.v.
venous palmar arch
portal vein
digital v.v.
superior mesenteric
suprarenal veins
renal veins
gonadal veins
lumbar veins
Inferior vena cava
inferior mesenteric vein
common iliac v.
right external iliac v.
left external iliac v.
internal iliac v.
Right Femoral v.
Saphenous v.v.
Left Femoral v.
Right Popliteal v.
Left Popliteal v.
Right Anterior Tibial v.
Posterior Tibial v.
Left Anterior Tibial v.
Right Dorsal venous Plantar arch
Peroneal v.
Left Dorsal Plantar venous arch
Right Digital v.v..
Left Digital v.v.
Right Plantar venous arch
Left Plantar venous arch


Artery and Vein Model
Valve
(elastic connective tissue)
Lumen
(hollowed out area)
created by
Linda E. Ibarra-Gonzales
NO KEY TO MODEL
created by
Linda E. Ibarra-Gonzales
NO KEY TO MODEL


Artery and Vein Model
Tunica externa/ adventitia
Vein
Valve
Tunica externa/ adventitia
Valve
Lumen (hollowed out area)
Vein
Artery
(elastic connective tissue)
Tunica media (smooth muscle showing)
Tunica intima/interna
NO KEY TO MODEL
created by Linda E. Ibarra-Gonzales

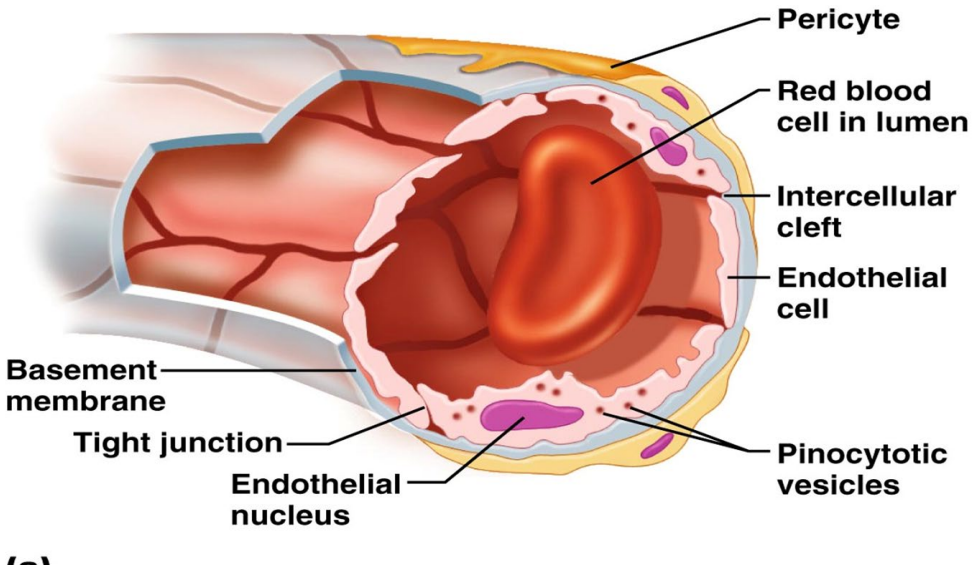

Tunica intima
Tunica media
VEIN
ARTERY
Tunica
adventitia


Which one is a vein which one is an artery 1,2?
Wat are the layers of these blood vessels, A, B , C?
A
B
C
1
2

What are the different types of capillaries?

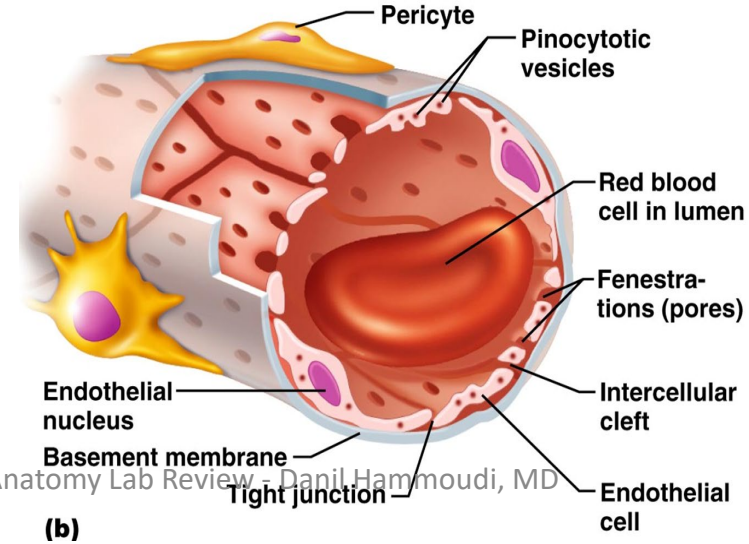
Continuous Capillaries

- **Continuous capillaries are abundant in the skin and muscles**
  - **Endothelial cells provide an uninterrupted lining**
  - **Adjacent cells are connected with tight junctions**
  - **Intercellular clefts allow the passage of fluids**
- **Continuous capillaries of the brain:**
  - **Have tight junctions completely around the endothelium**
  - **Constitute the blood-brain barrier**



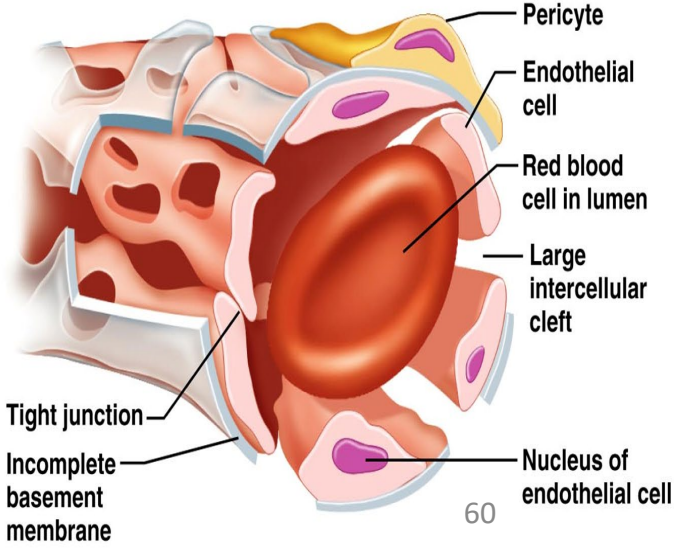
Fenestrated Capillaries

- **Found wherever active capillary absorption or filtrate formation occurs (e.g., small intestines, endocrine glands, and kidneys)**
- **Characterized by:**
  - **An endothelium riddled with pores (fenestrations)**
  - **Greater permeability than other capillaries**



Sinusoids

- **Highly modified, leaky, fenestrated capillaries with large lumens**
- **Found in the liver, bone marrow, lymphoid tissue, and in some endocrine organs**
- **Allow large molecules (proteins and blood cells) to pass between the blood and surrounding tissues**
- **Blood flows sluggishly, allowing for modification in various ways**



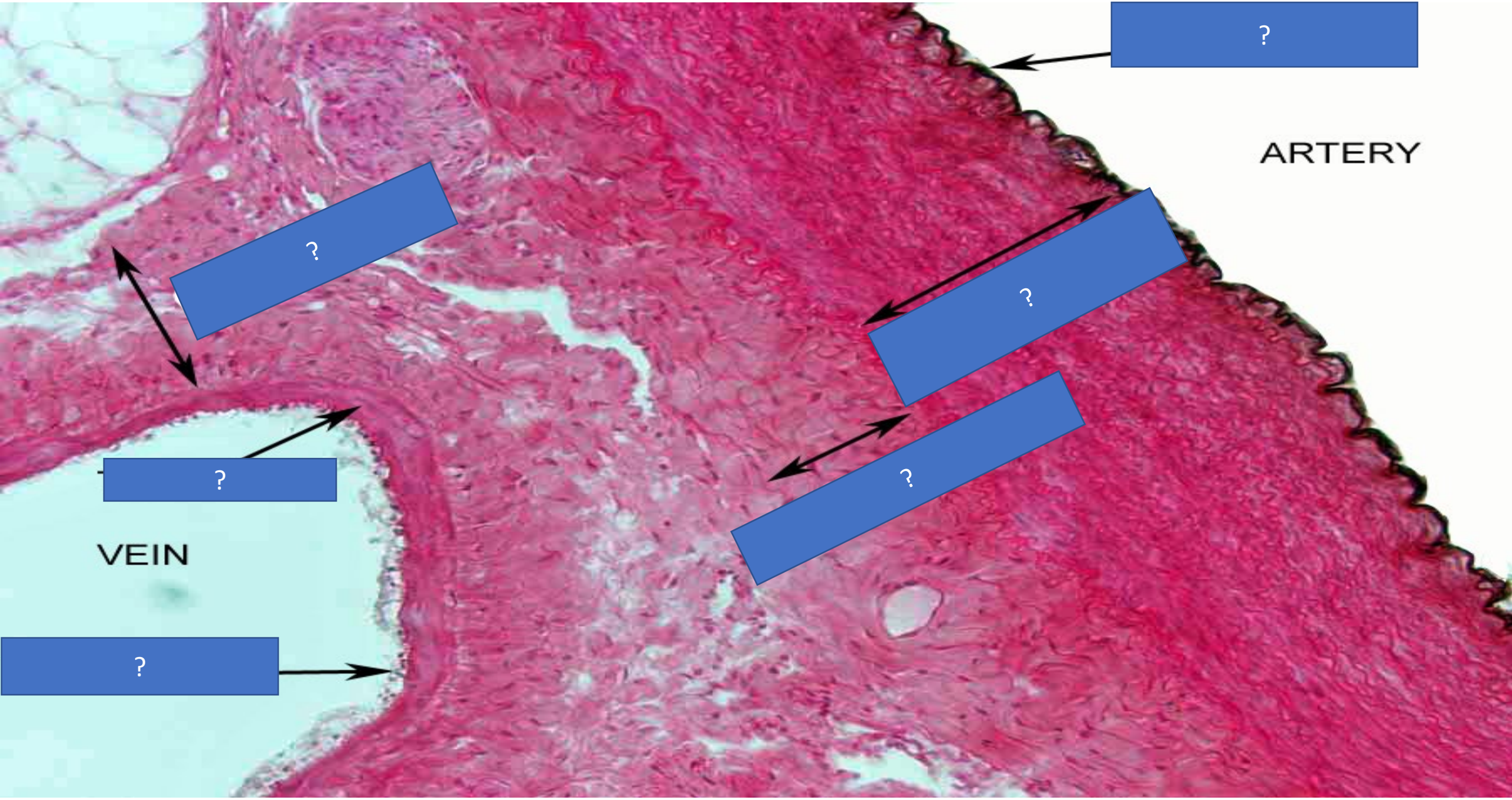
Differences Between Arteries and Veins

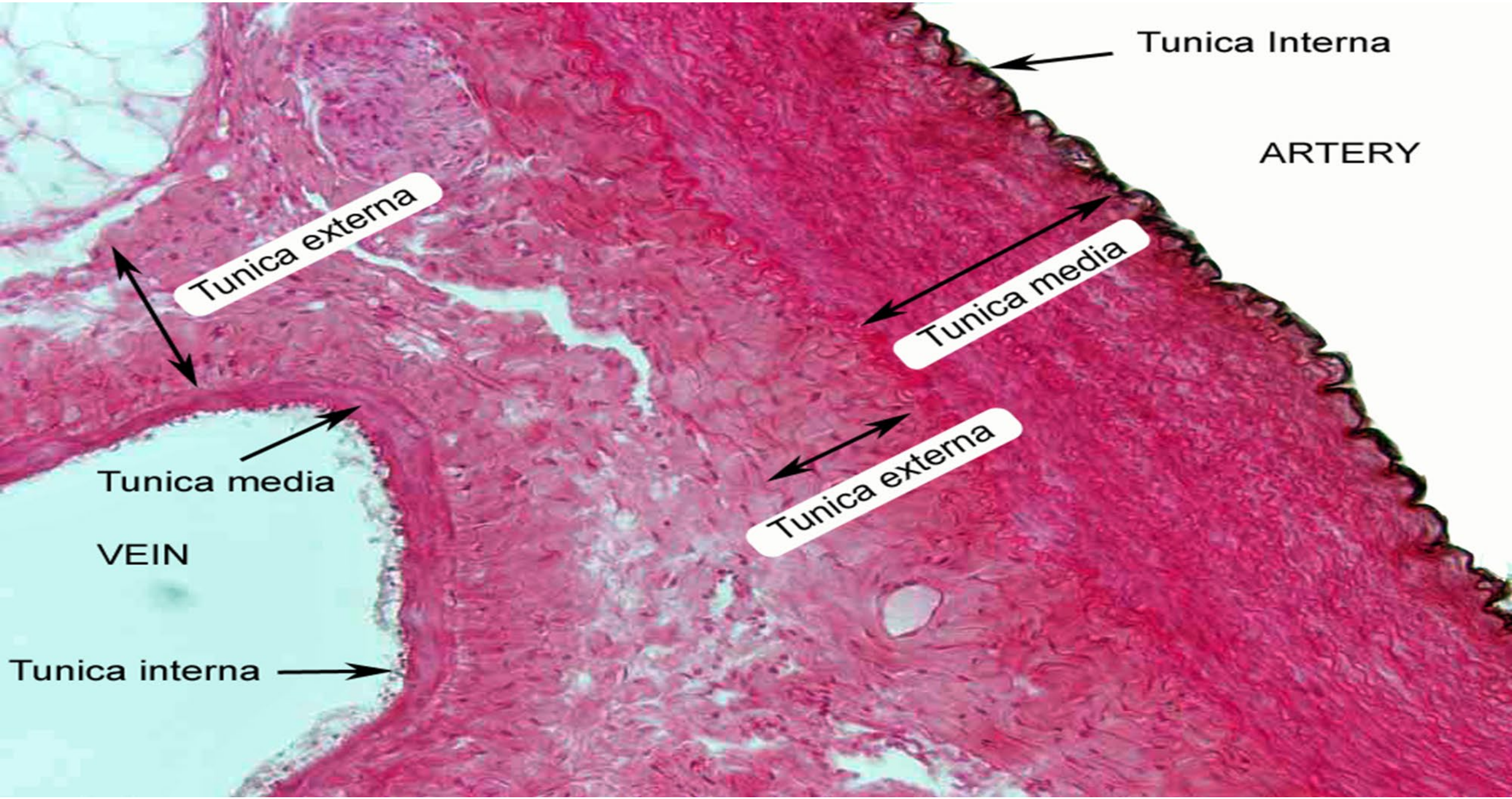
	Arteries	Veins
Delivery	Blood pumped into single systemic artery – the aorta	Blood returns via superior and interior venae cavae and the coronary sinus
Location	Deep, and protected by tissue	Both deep and superficial
Pathways	Fair, clear, and defined	Convergent interconnections
Supply/drainage	Predictable supply	Dural sinuses and hepatic portal circulation

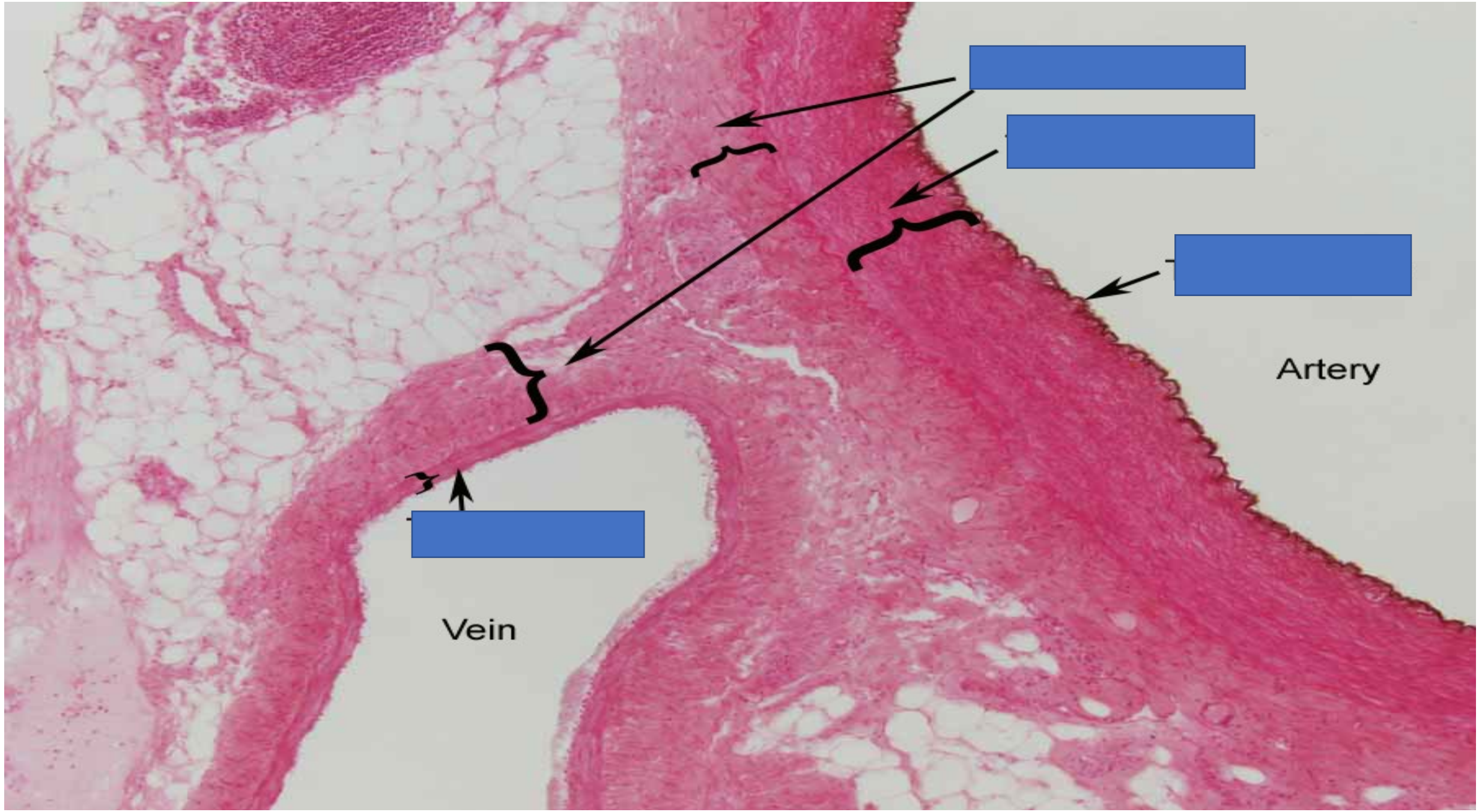
Differences Between Arteries and Veins

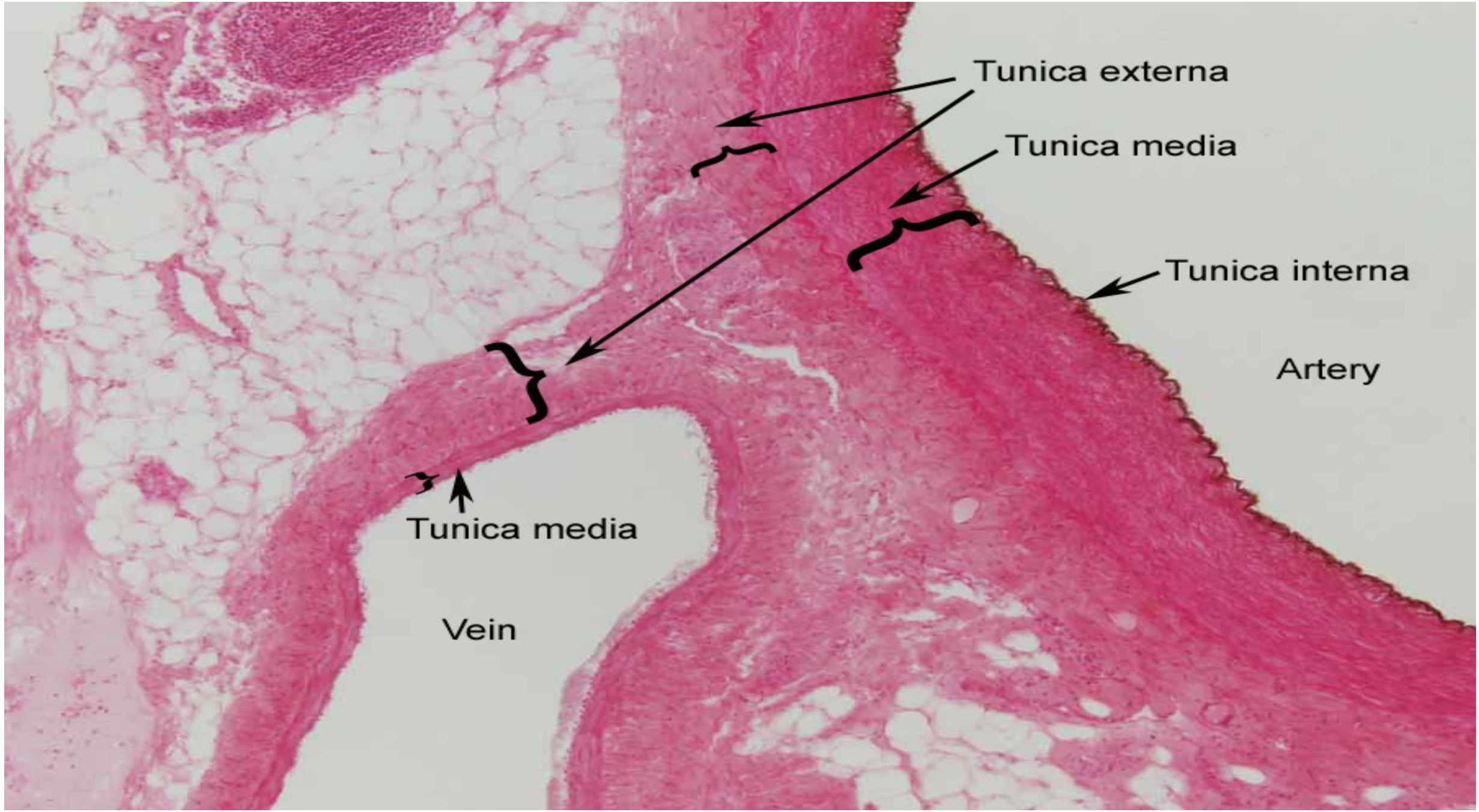
	Arteries	Veins
Delivery	?	?
Location	?	?
Pathways	?	?
Supply/drainage	?	?

Elastic artery
The Aorta

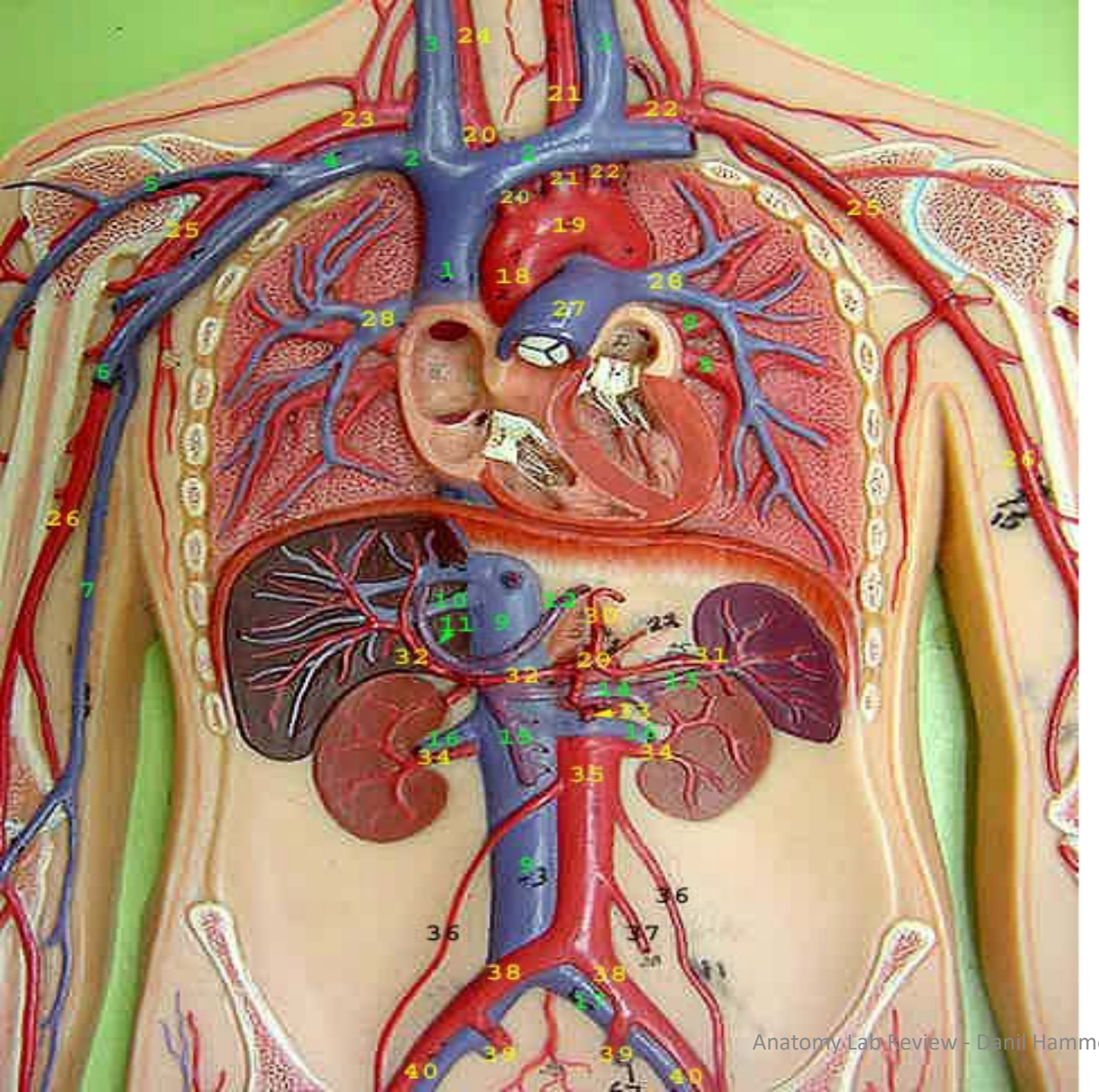

?
ARTERY
?
?
?
VEIN
?


Tunica Interna
ARTERY
Tunica externa
Tunica media
Tunica externa
Tunica media
VEIN
Tunica interna

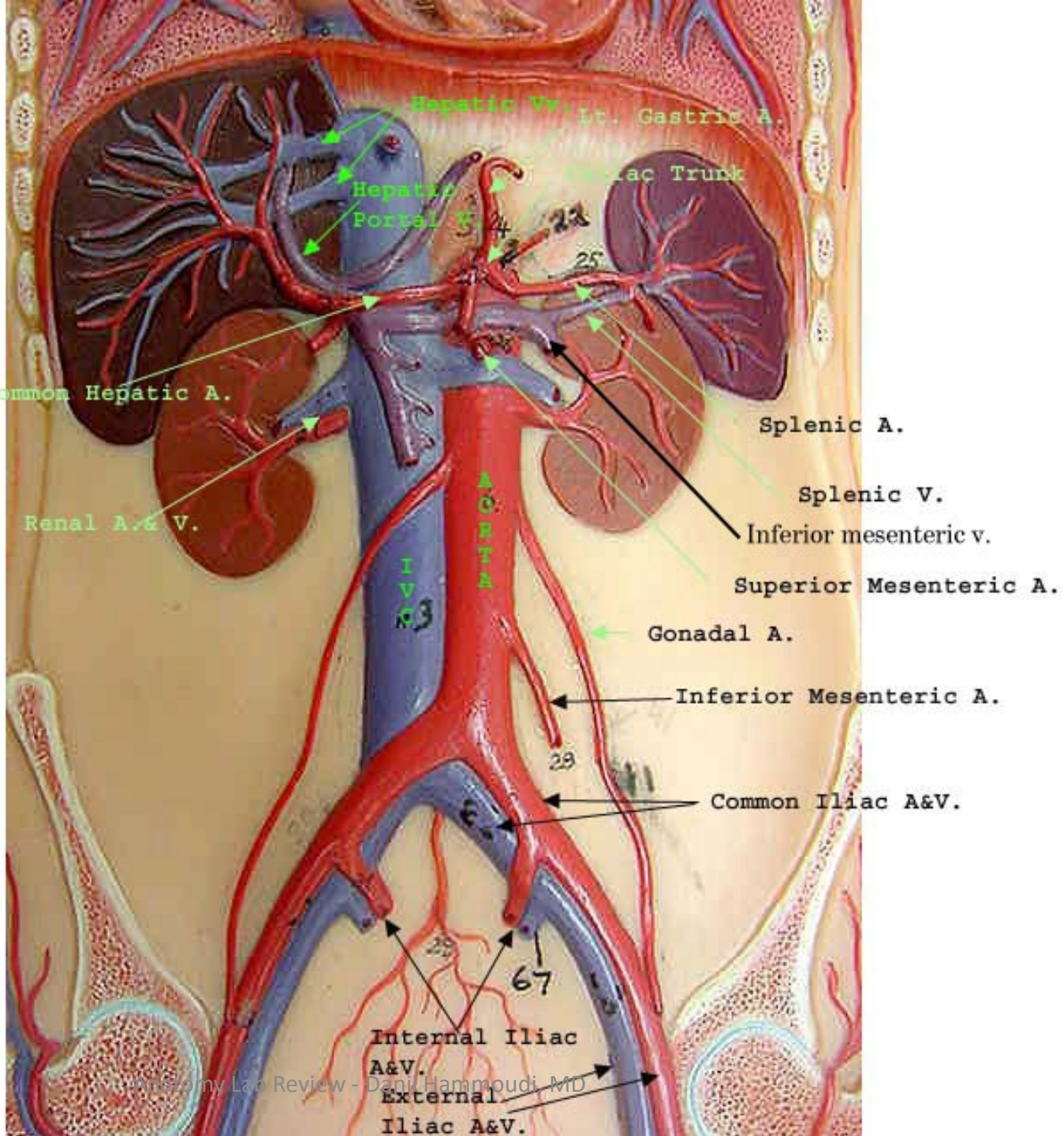

Artery
Vein

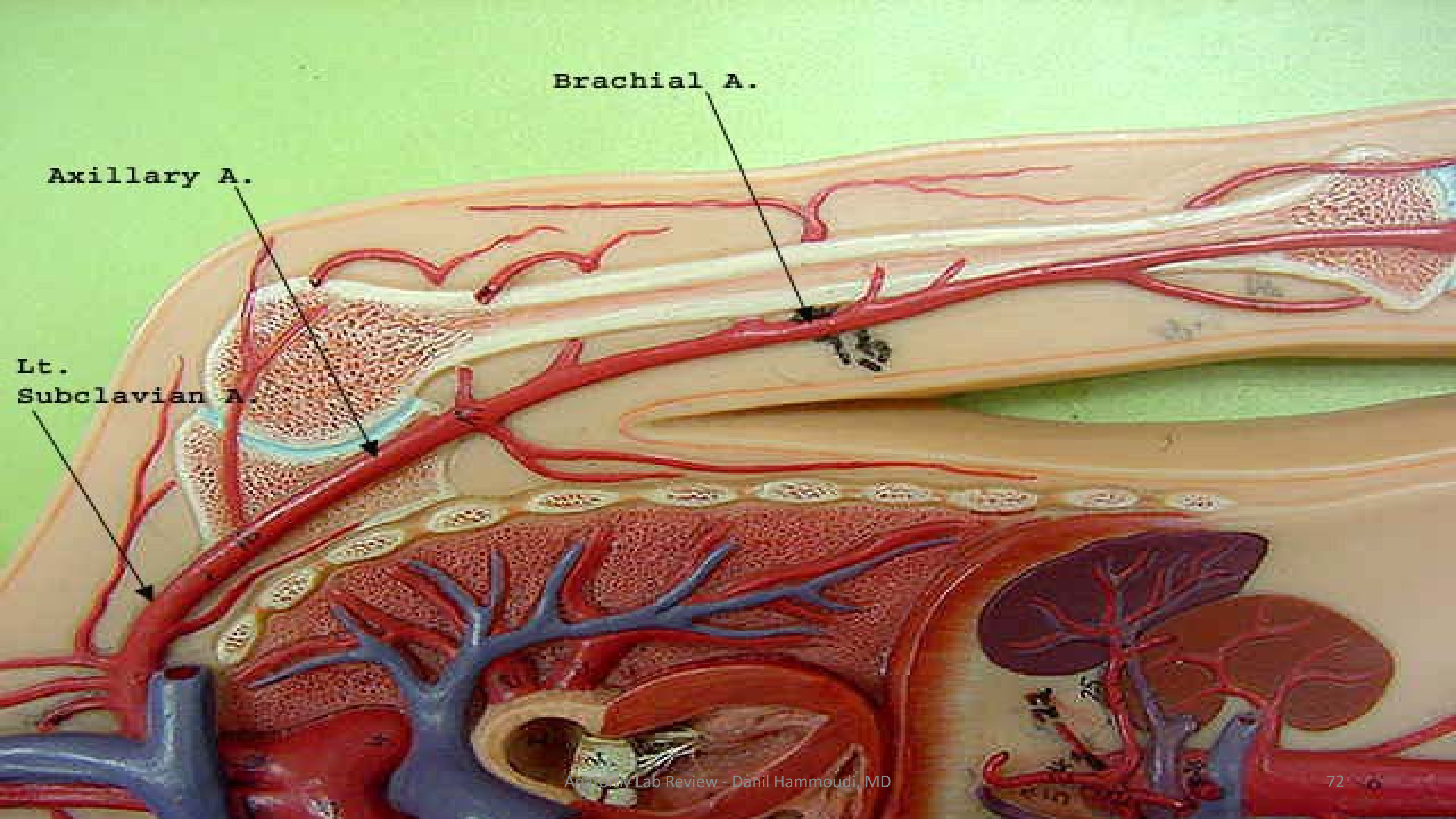

Tunica externa
Tunica media
Tunica interna
Artery
Tunica media
Vein

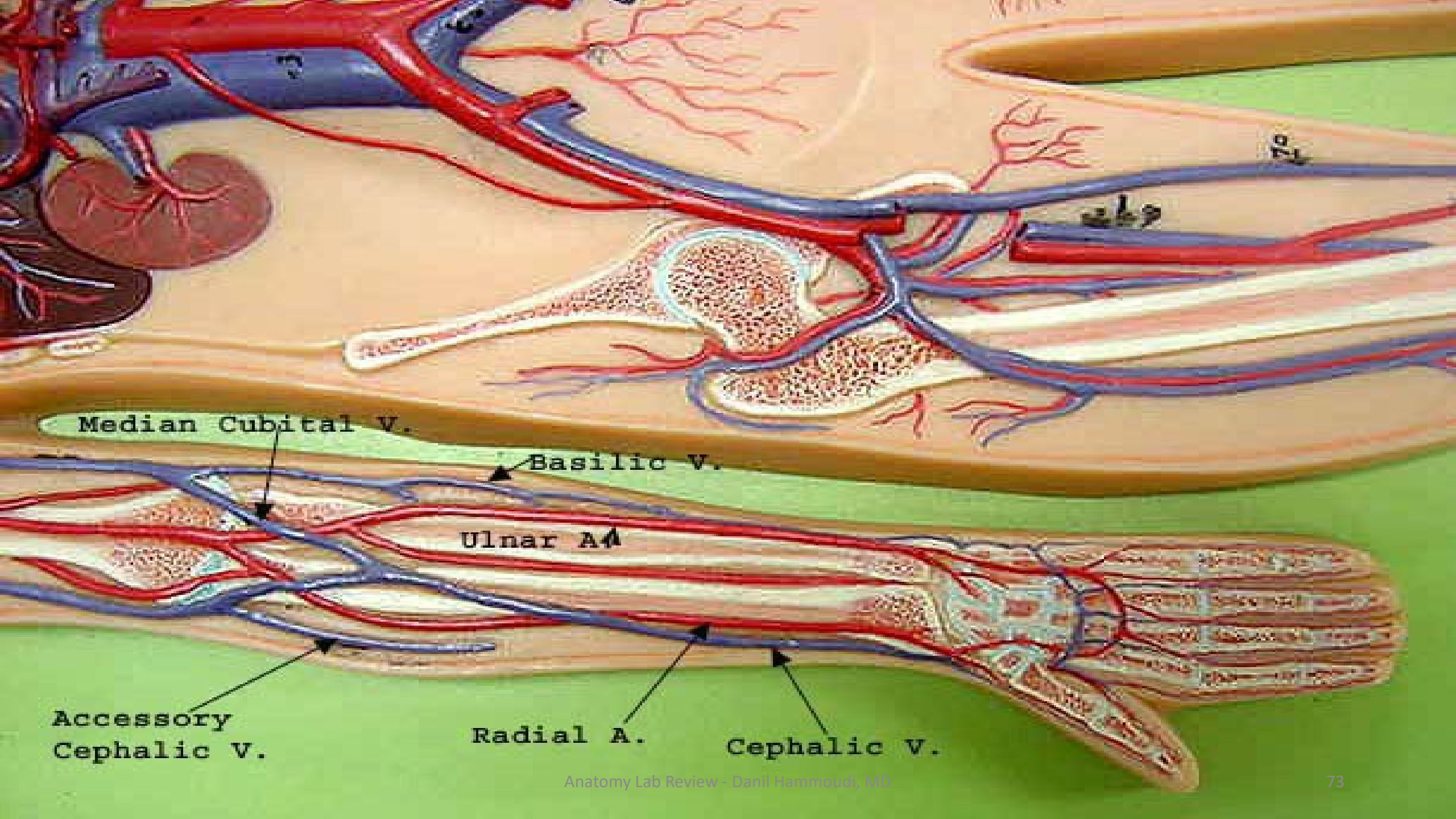
VASCULARIZATION MODELS LABELED

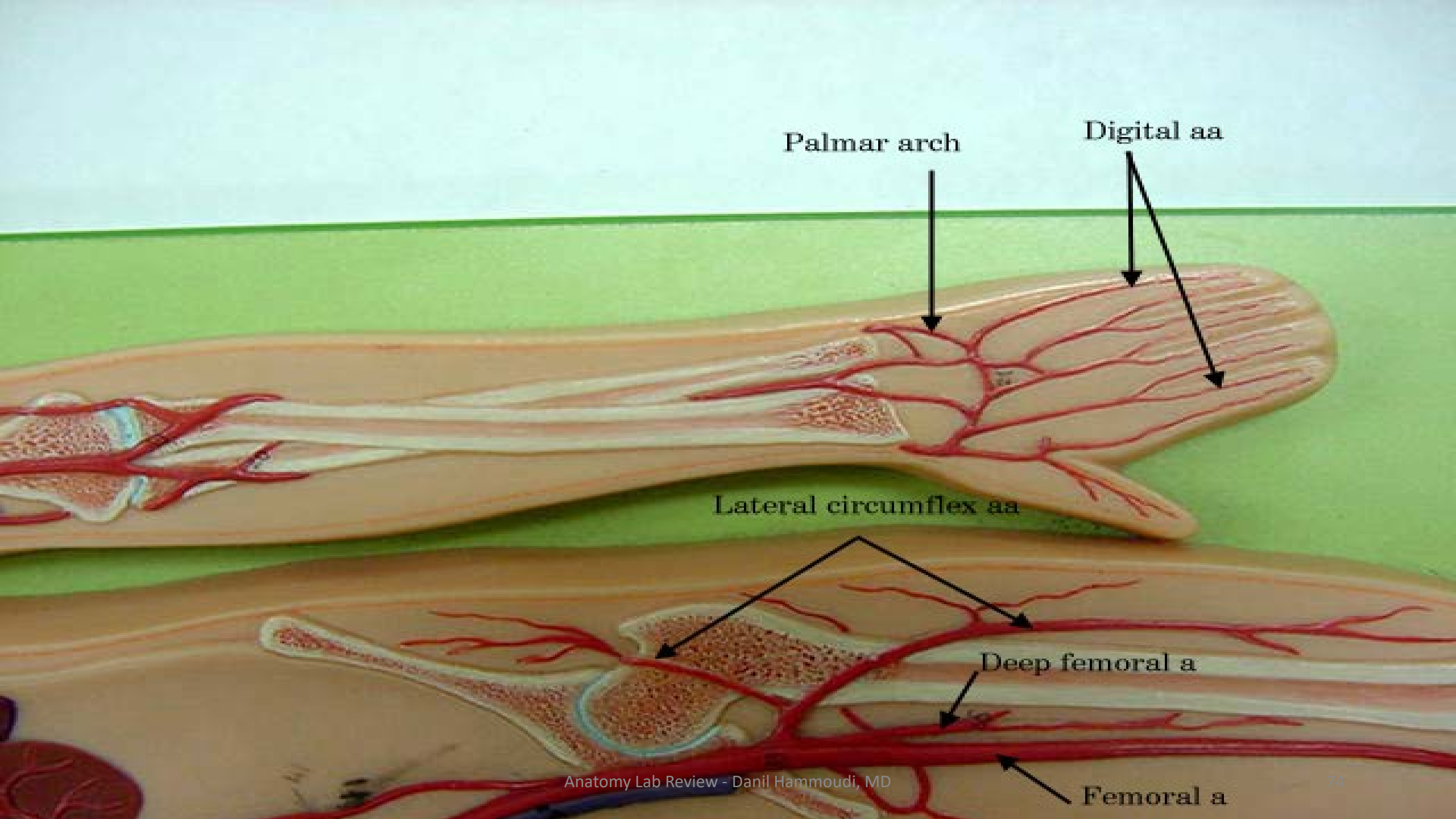


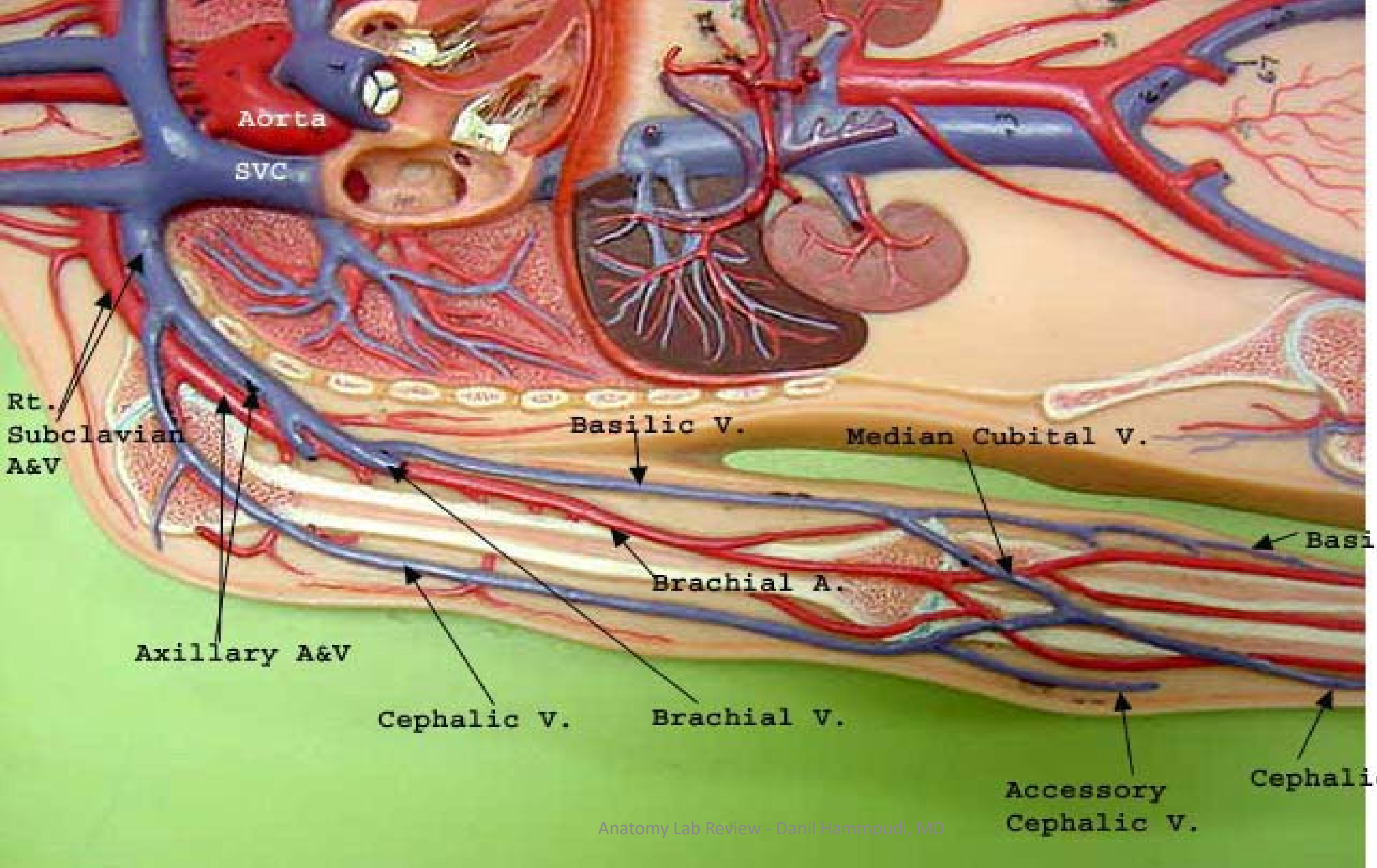
1. SVC
2. Brachiocephalic Vv.
3. Internal Jugular Vv.
4. Subclavian V.
5. Cephalic V.
6. Brachial V.
7. Basilic V.
8. Pulmonary Vv.
9. IVC
10. Hepatic V.
11. Hepatic Portal V.
12. Lt. Gastric V.
13. Splenic V.
14. Inferior Mesenteric V.
15. Superior Mesenteric V.
16. Renal Vv.
17. Common Iliac V.
18. Ascending Aorta
19. Aortic Arch
20. Brachiocephalic A.
21. Left Common Carotid A.
22. Left Subclavian A.
23. Right Subclavian A.
24. Right Common Carotid A.
25. Axillary Aa.
26. Brachial Aa.
27. Pulmonary Trunk
28. Lt. & Rt. Pulmonary Aa.
29. Celiac Trunk
30. Left Gastric A.
31. Splenic A.
32. Common Hepatic A.
33. Superior Mesenteric A.
34. Renal Aa.
35. Abdominal Aorta
36. Gonadal (Testicular/Ovarian) Aa.
37. Inferior Mesenteric A.
38. Common Iliac Aa.
39. Internal Iliac A&V
40. External Iliac A&V

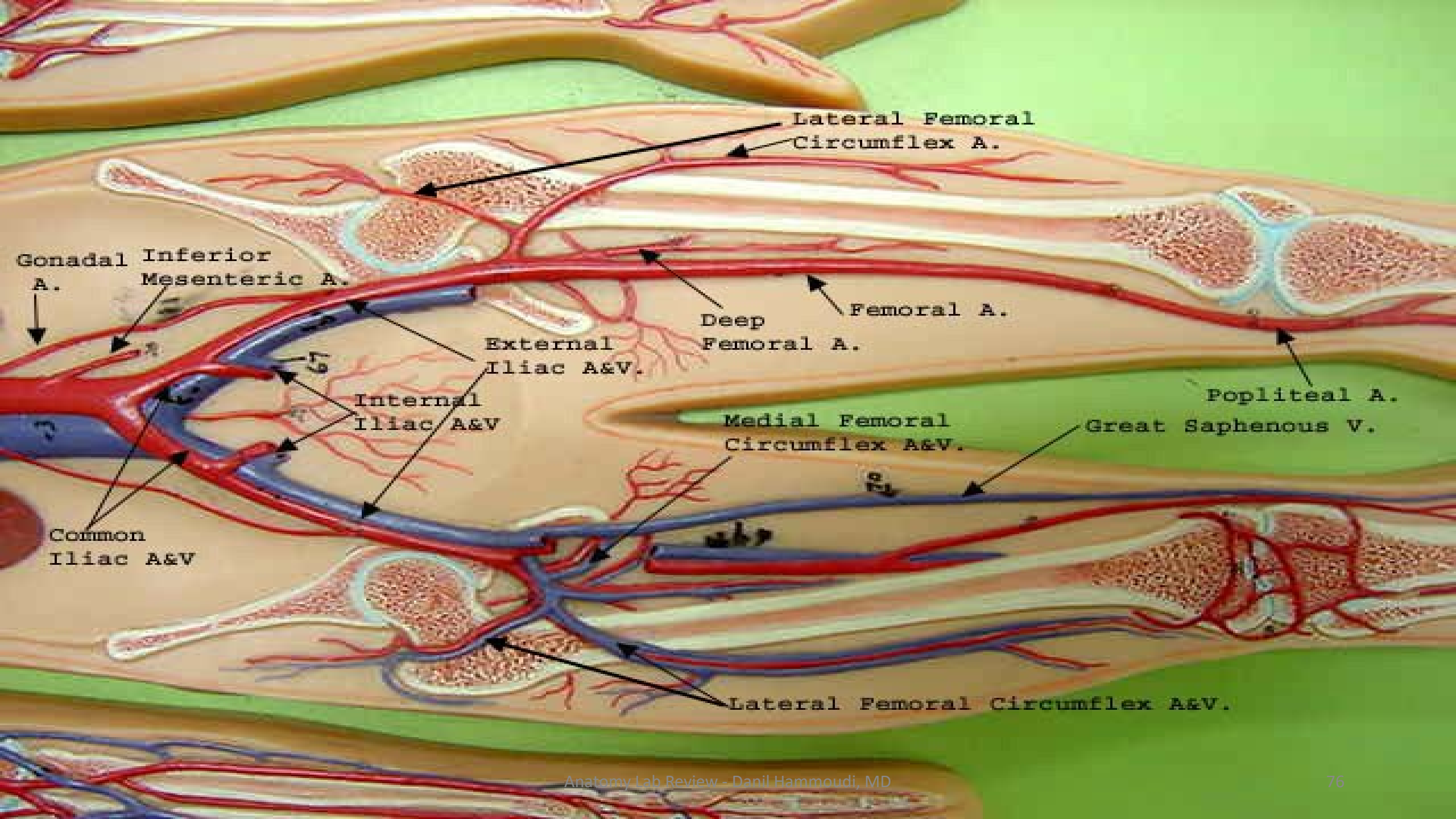

Hepatic Vv.
Lt. Gastric A.
Hepatic Portal V.
Celiac Trunk
Common Hepatic A.
Renal A.& V.
Splenic A.
Splenic V.
Inferior mesenteric v.
Superior Mesenteric A.
Gonadal A.
Inferior Mesenteric A.
Common Iliac A&V.
Internal Iliac A&V.
External Iliac A&V.
AORTA
IVC

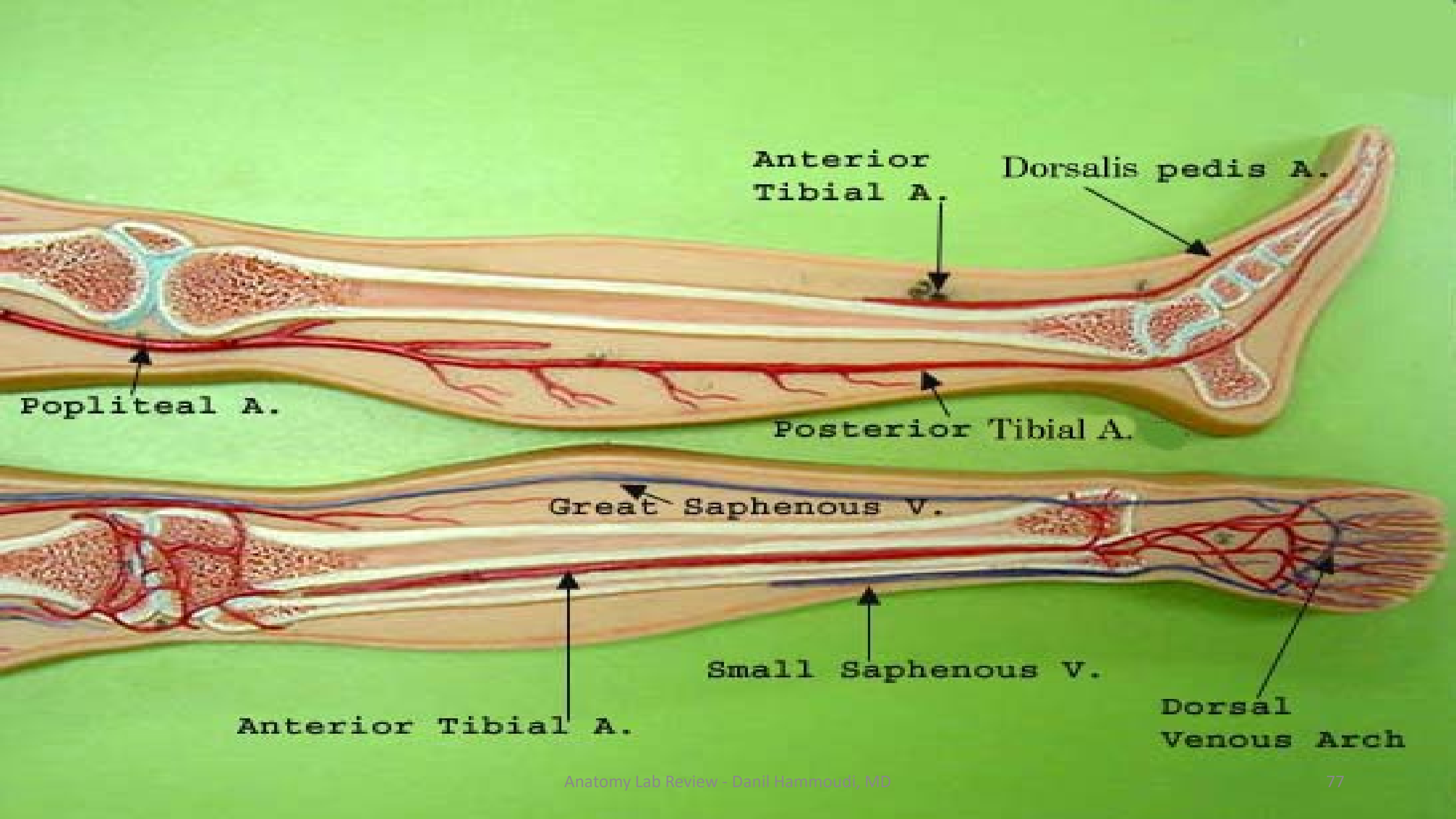

Brachial A.
Axillary A.
Lt.
Subclavian A.


Median Cubital V.
Basilic V.
Ulnar A.
Accessory Cephalic V.
Radial A.
Cephalic V.

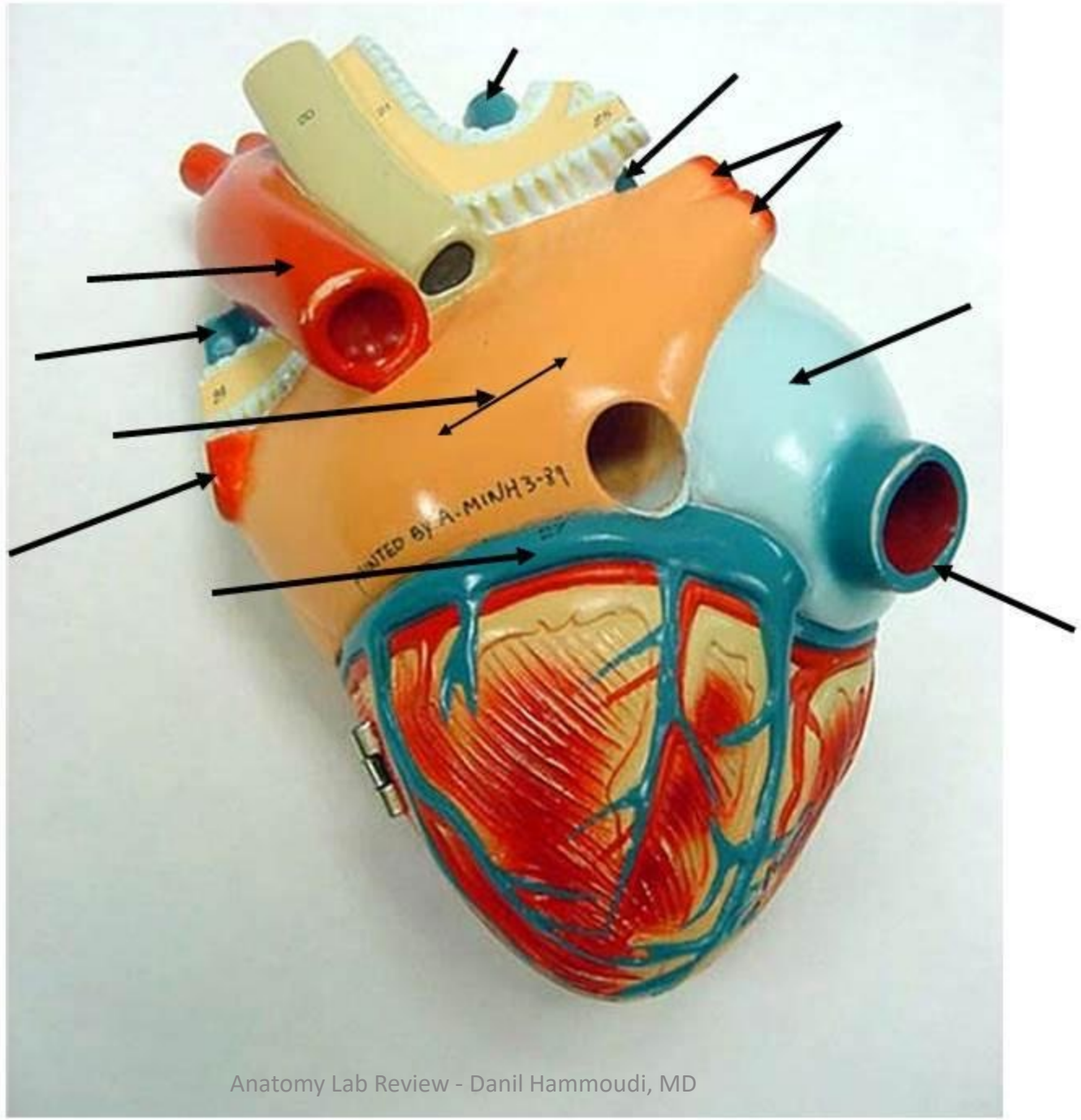

Palmar arch
Digital aa
Lateral circumflex aa
Deep femoral a
Femoral a

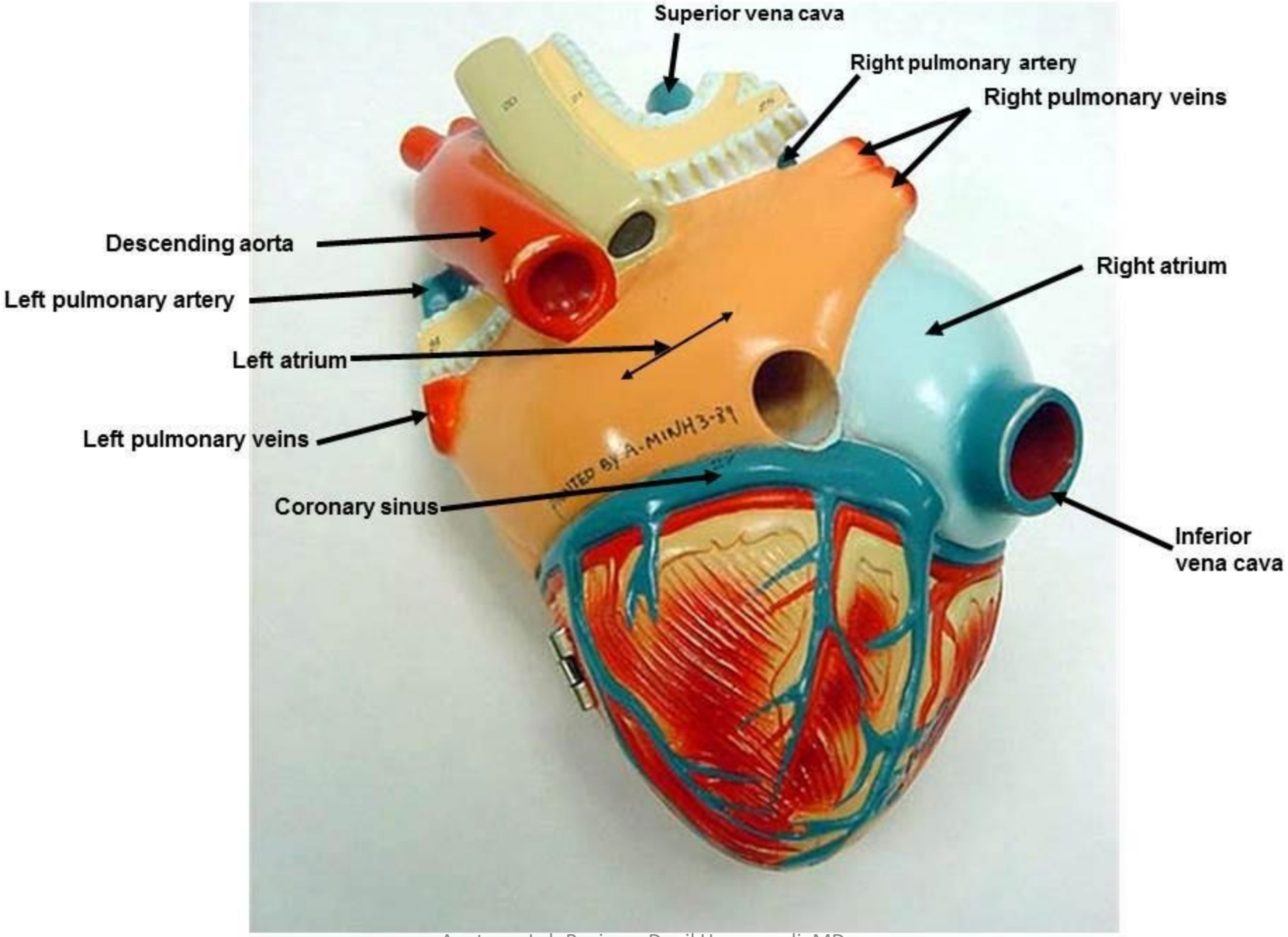

Aorta
SVC
Rt. Subclavian A&V
Basilic V.
Median Cubital V.
Basilic V.
Brachial A.
Axillary A&V
Cephalic V.
Brachial V.
Accessory Cephalic V.
Cephalic V.

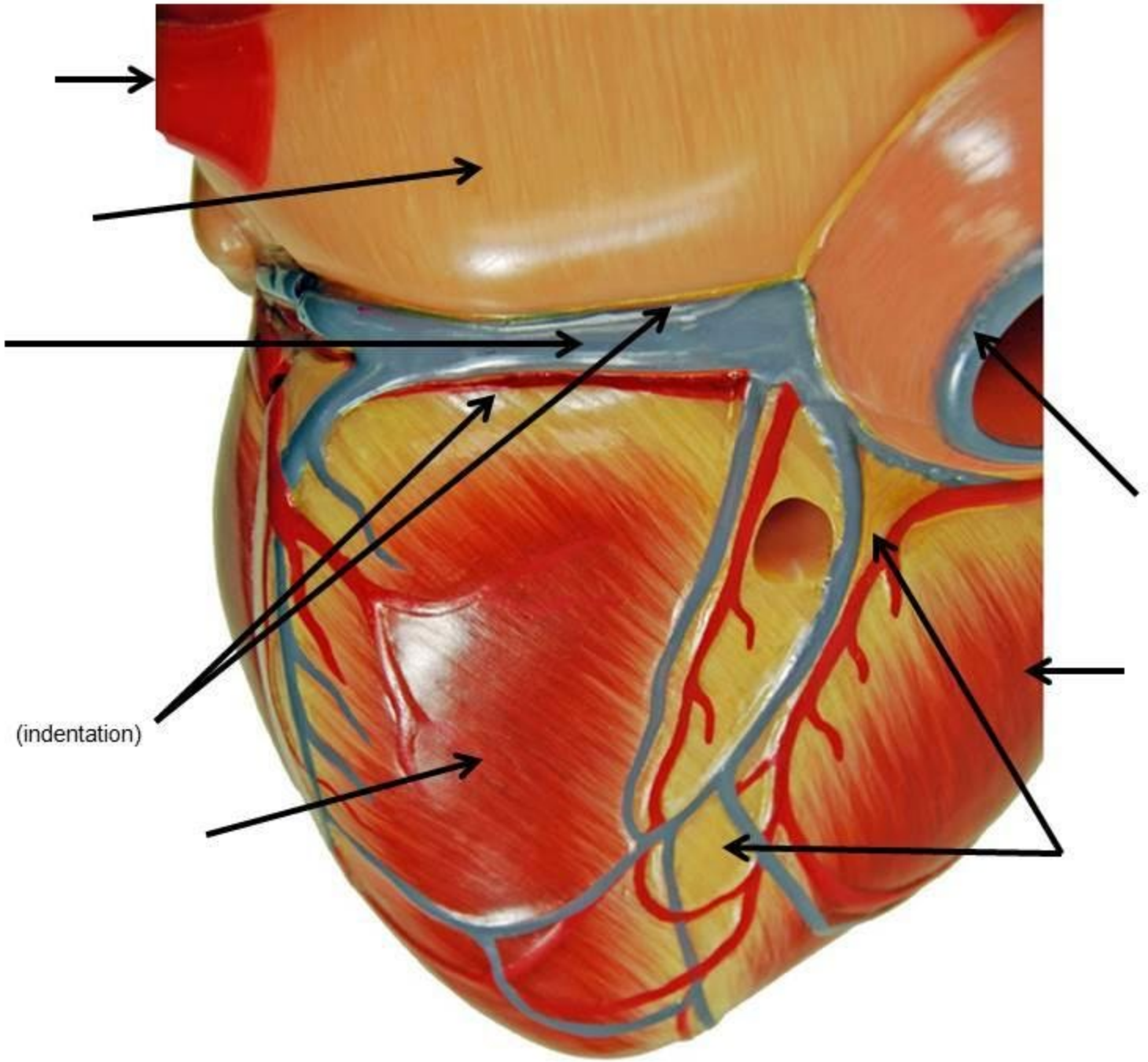

Lateral Femoral Circumflex A.
Gonadal A.
Inferior Mesenteric A.
Deep Femoral A.
Femoral A.
External Iliac A&V.
Popliteal A.
Internal Iliac A&V
Medial Femoral Circumflex A&V.
Great Saphenous V.
Common Iliac A&V
Lateral Femoral Circumflex A&V.

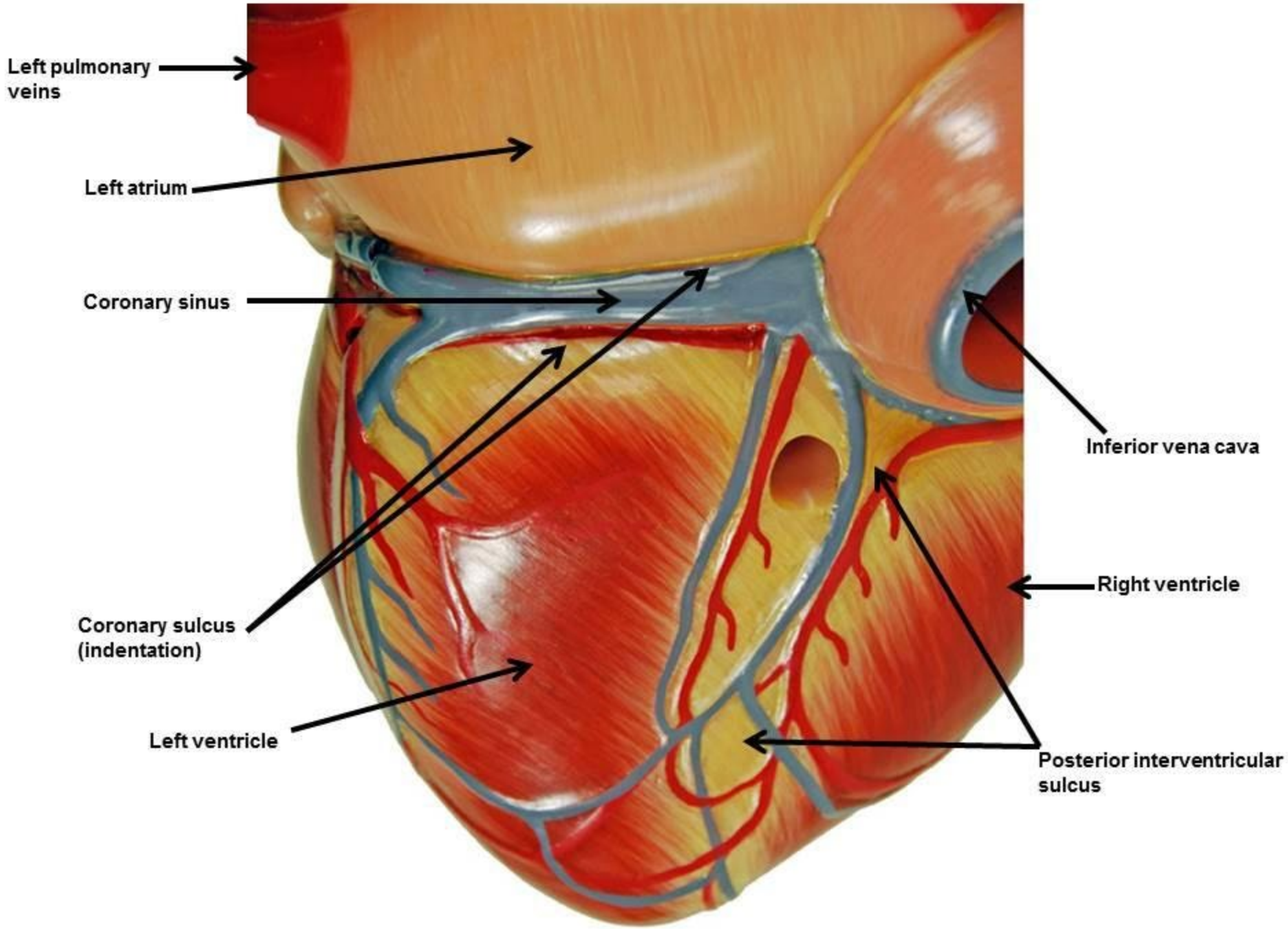

Anterior
Tibial A.
Dorsalis pedis A.
Popliteal A.
Posterior Tibial A.
Great Saphenous V.
Small Saphenous V.
Anterior Tibial A.
Dorsal
Venous Arch

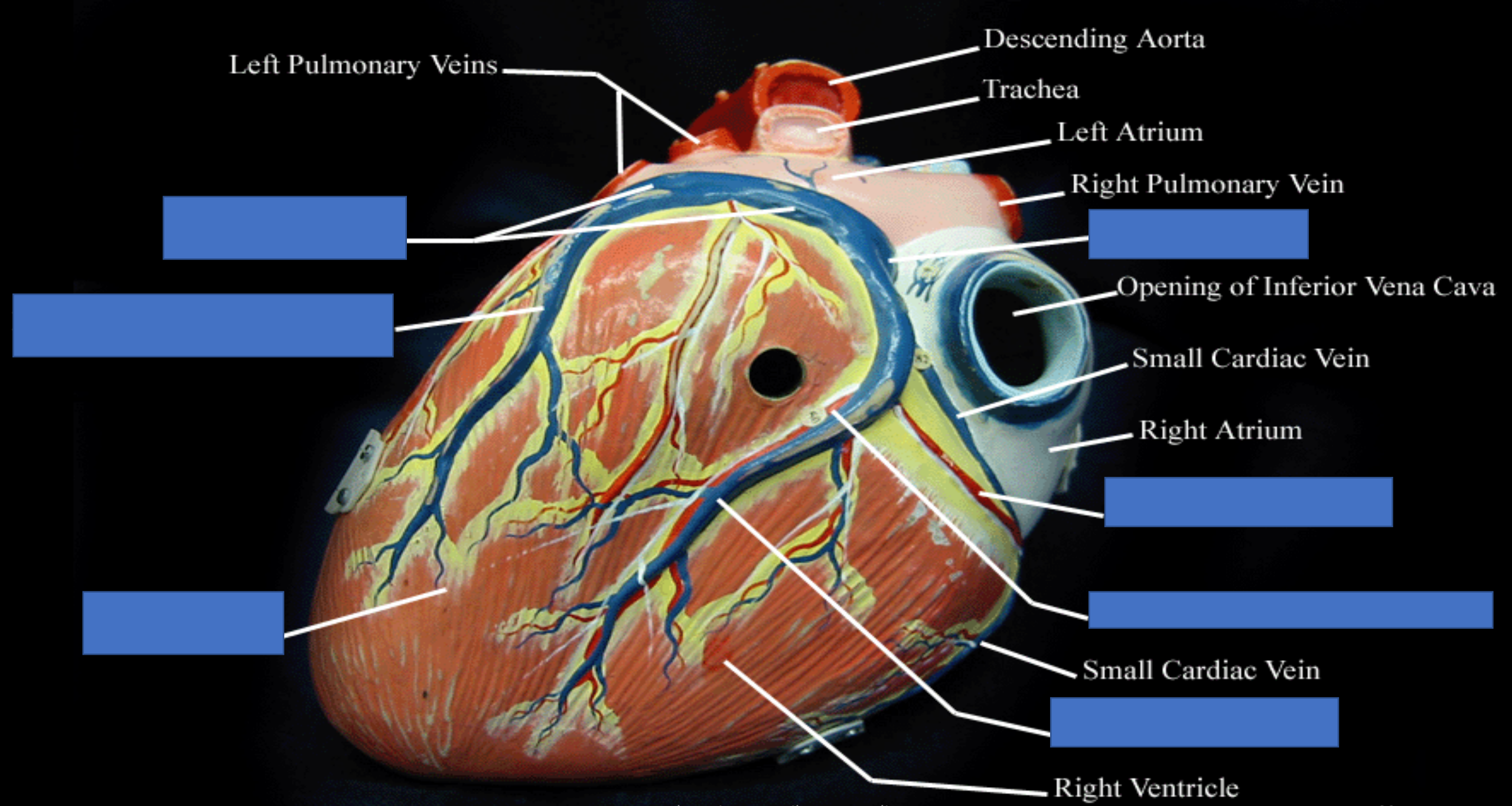
What do you know?



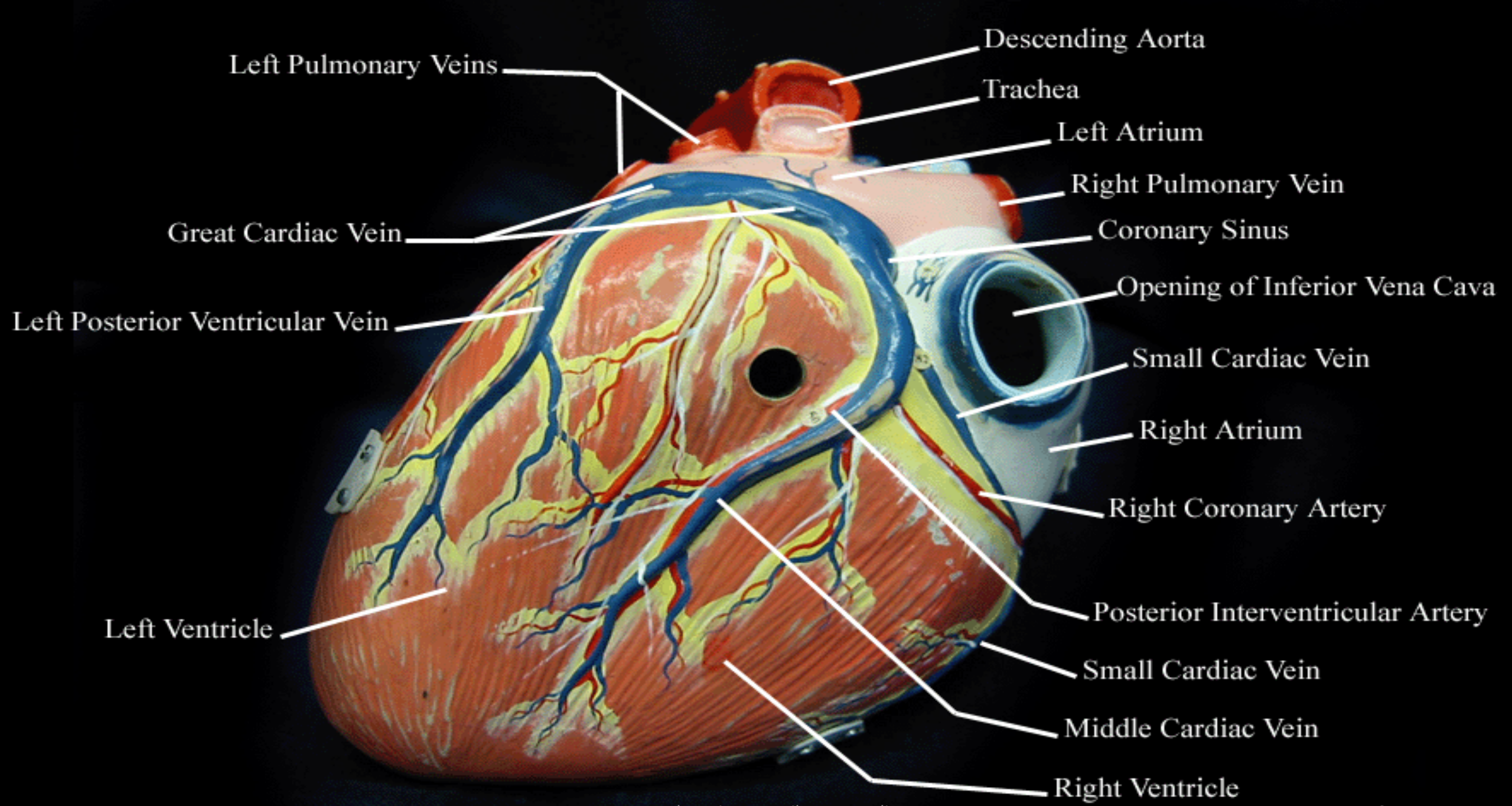

Superior vena cava
Right pulmonary artery
Right pulmonary veins
Descending aorta
Left pulmonary artery
Left atrium
Left pulmonary veins
Coronary sinus
Right atrium
Inferior vena cava


(indentation)

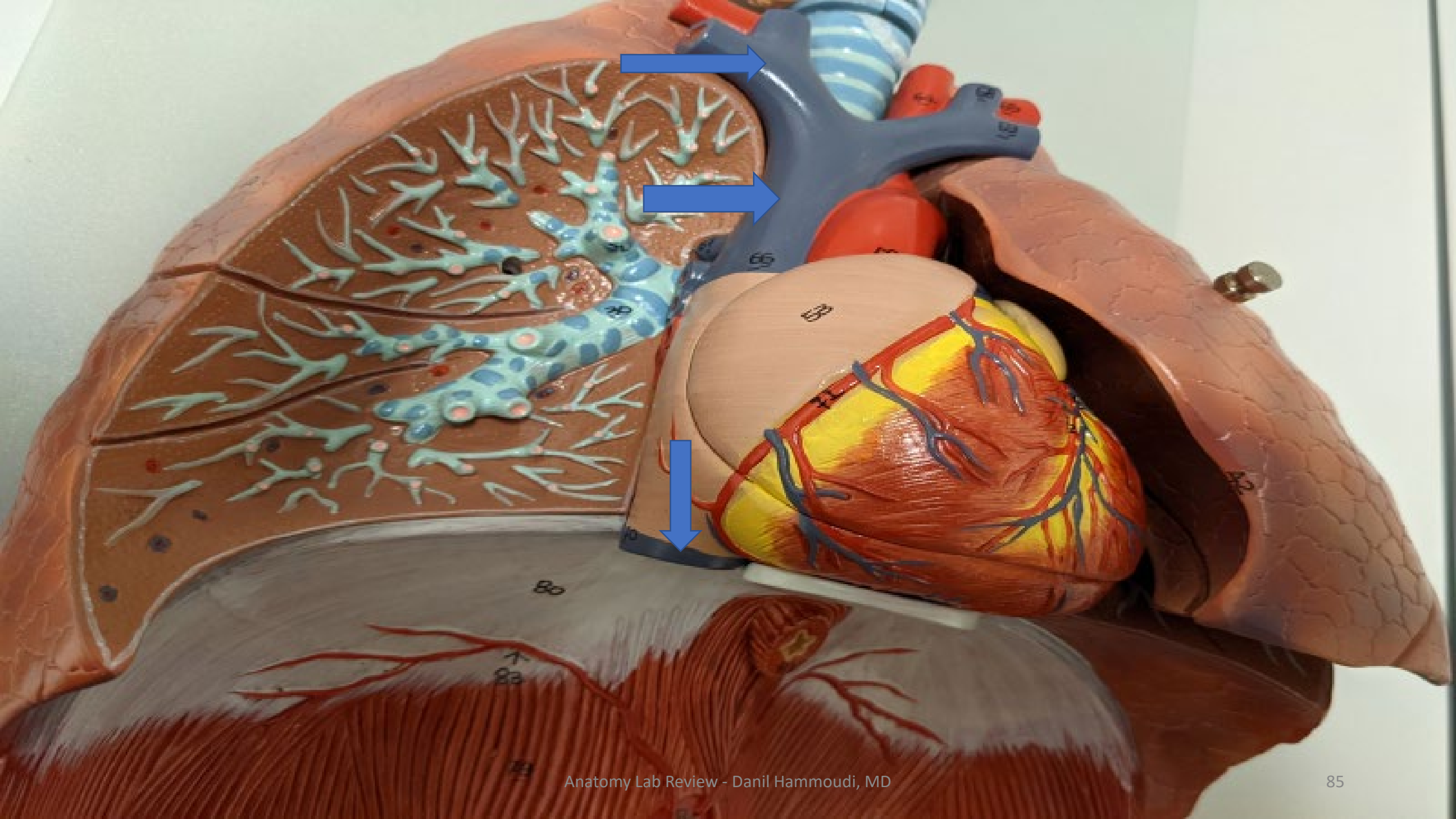

Left pulmonary veins
Left atrium
Coronary sinus
Inferior vena cava
Right ventricle
Coronary sulcus (indentation)
Left ventricle
Posterior interventricular sulcus

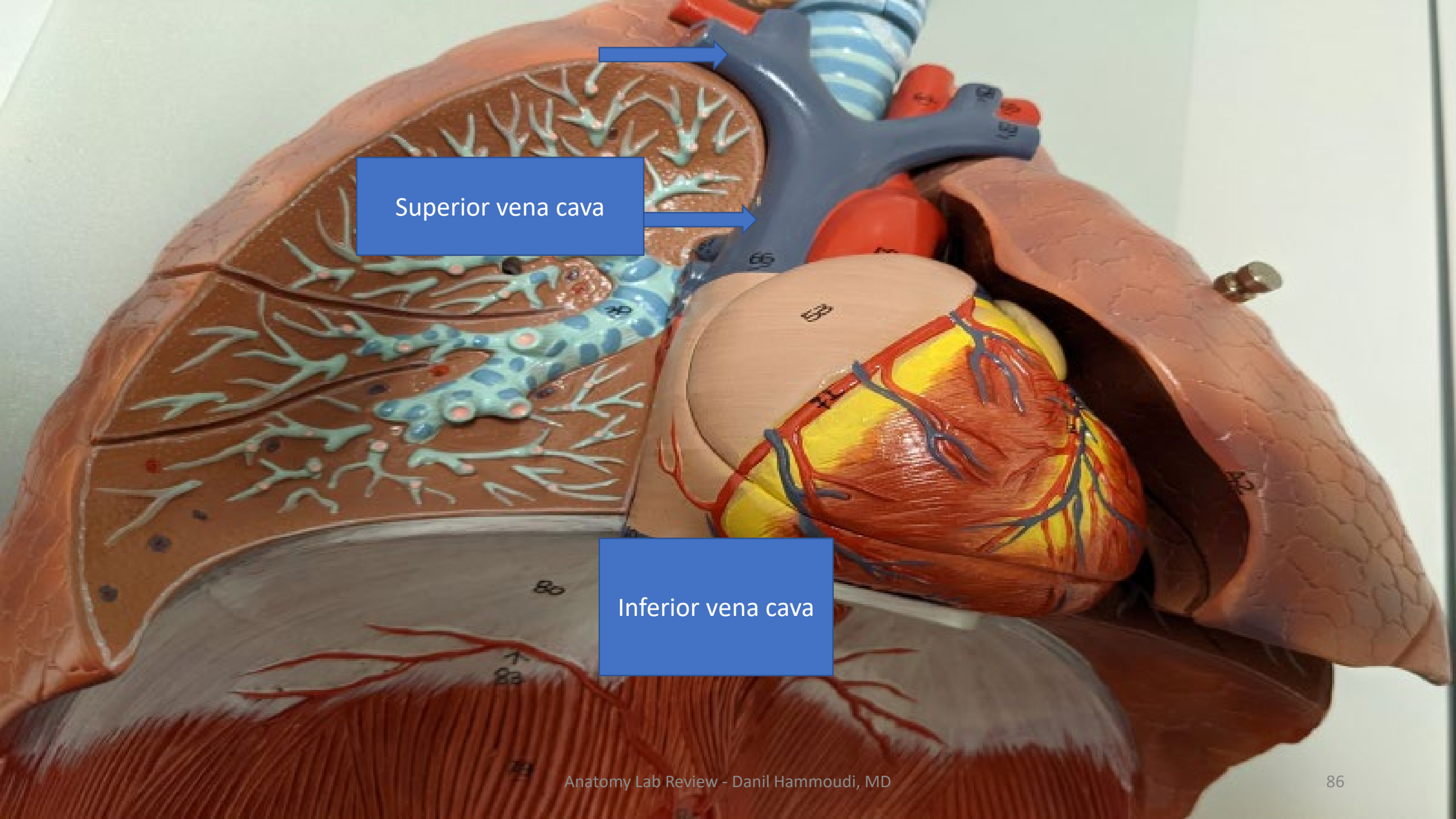


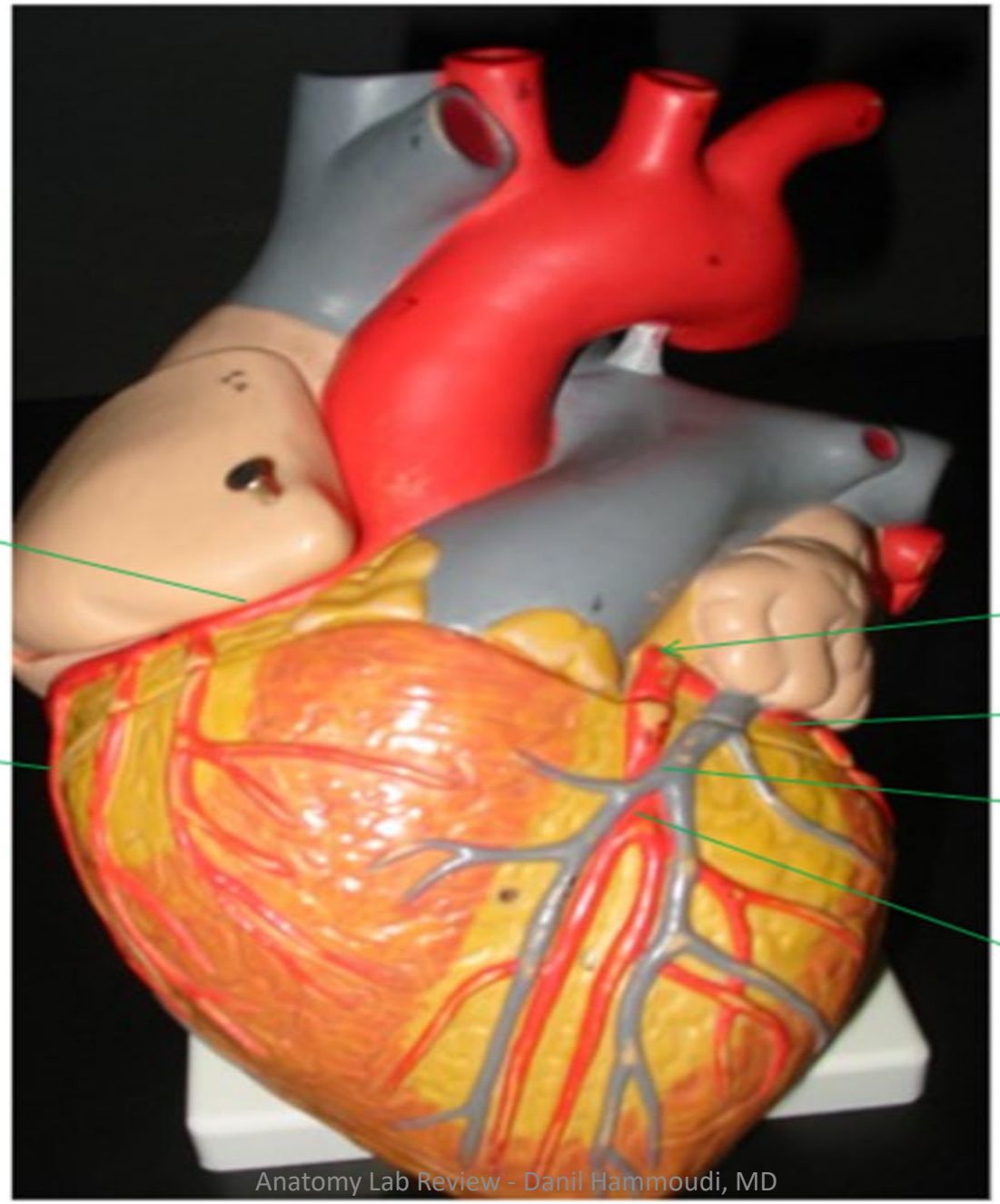
Heart: Inferior View



Heart: Inferior View




Superior vena cava
Inferior vena cava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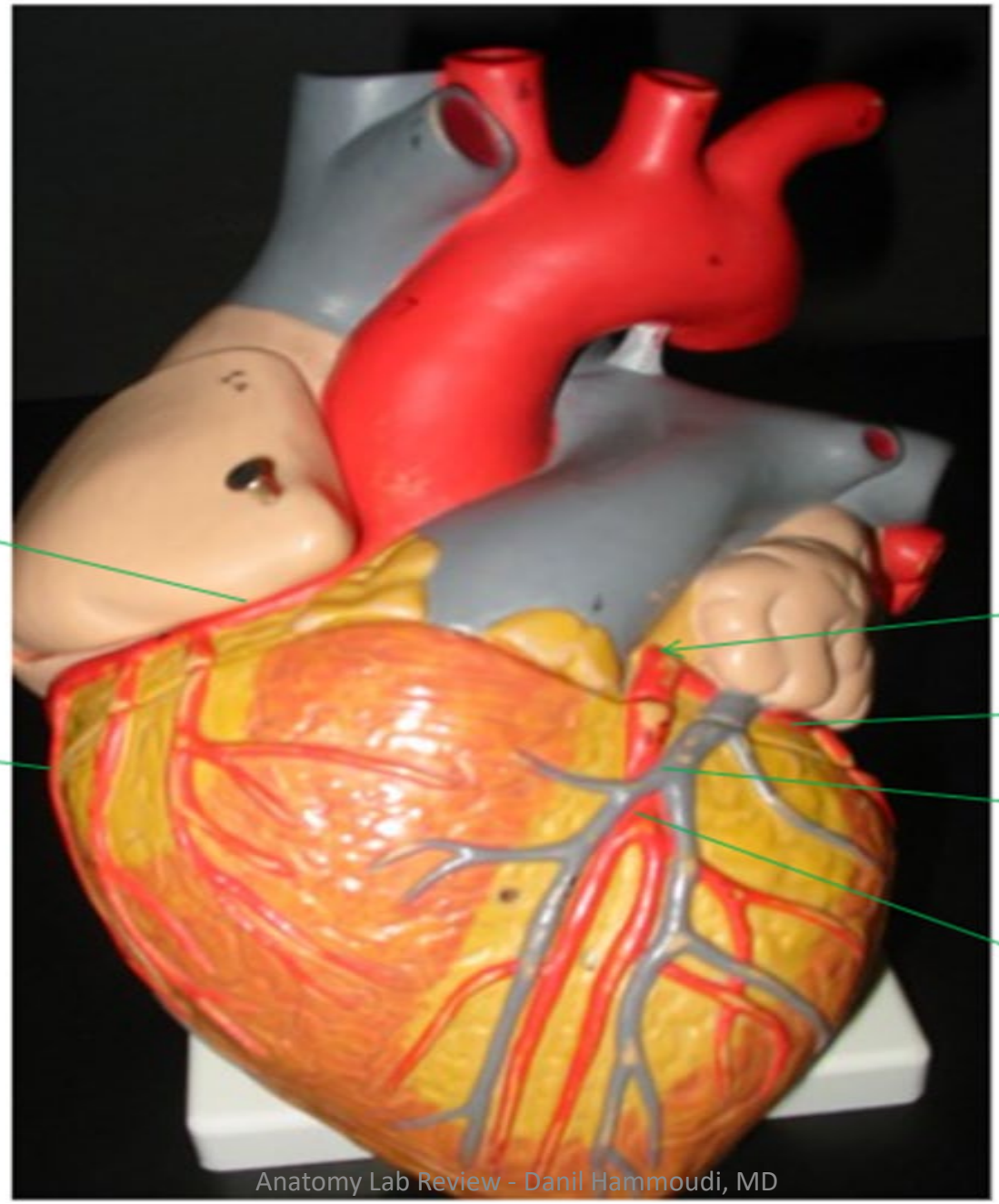
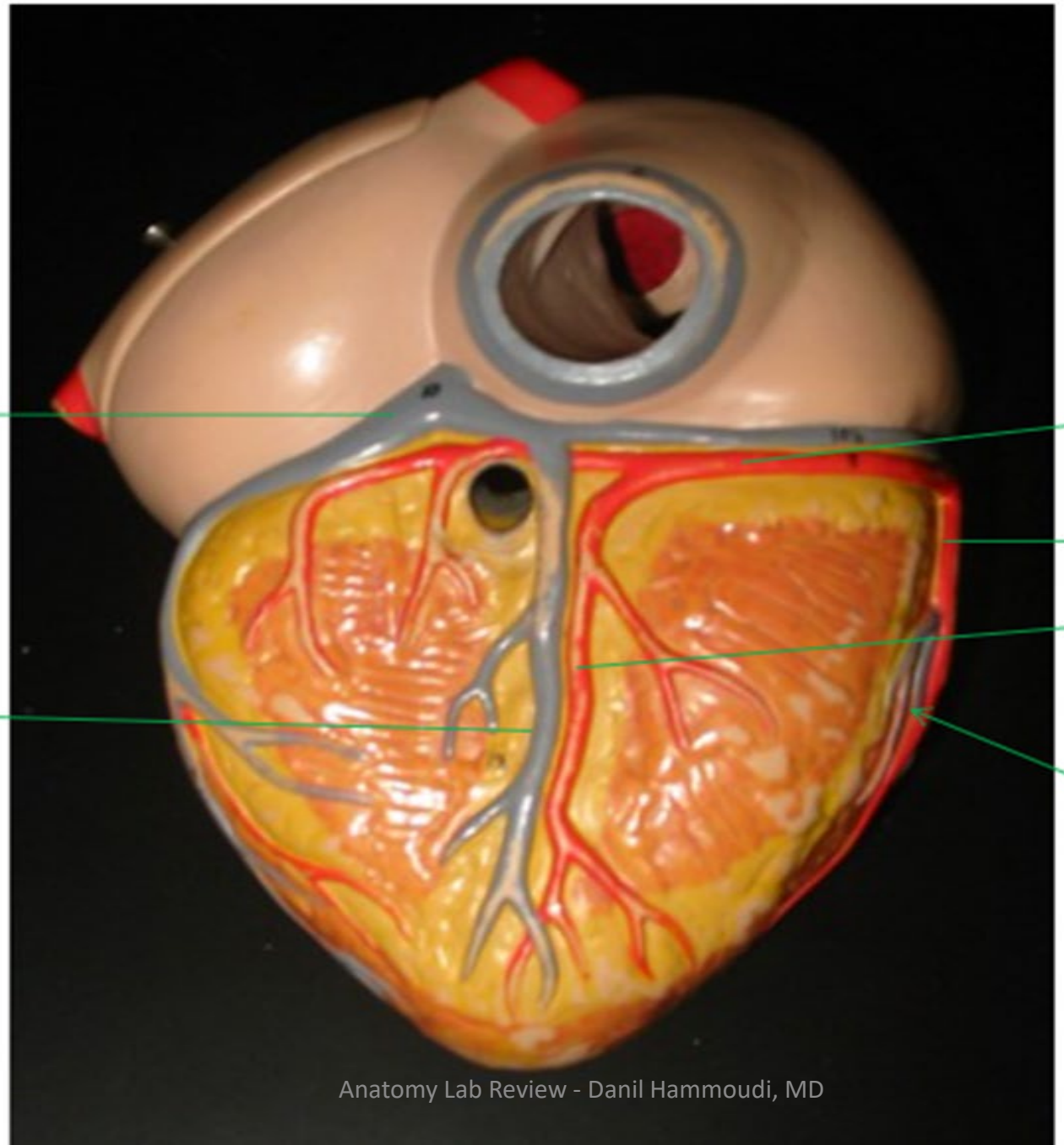
Right

Left


Right Coronary Artery
Right Marginal Artery
Left Coronary Artery (Under the Pulmonary Trunk)
Circumflex Artery
Great Cardiac Vein
Anterior Interventricular Artery



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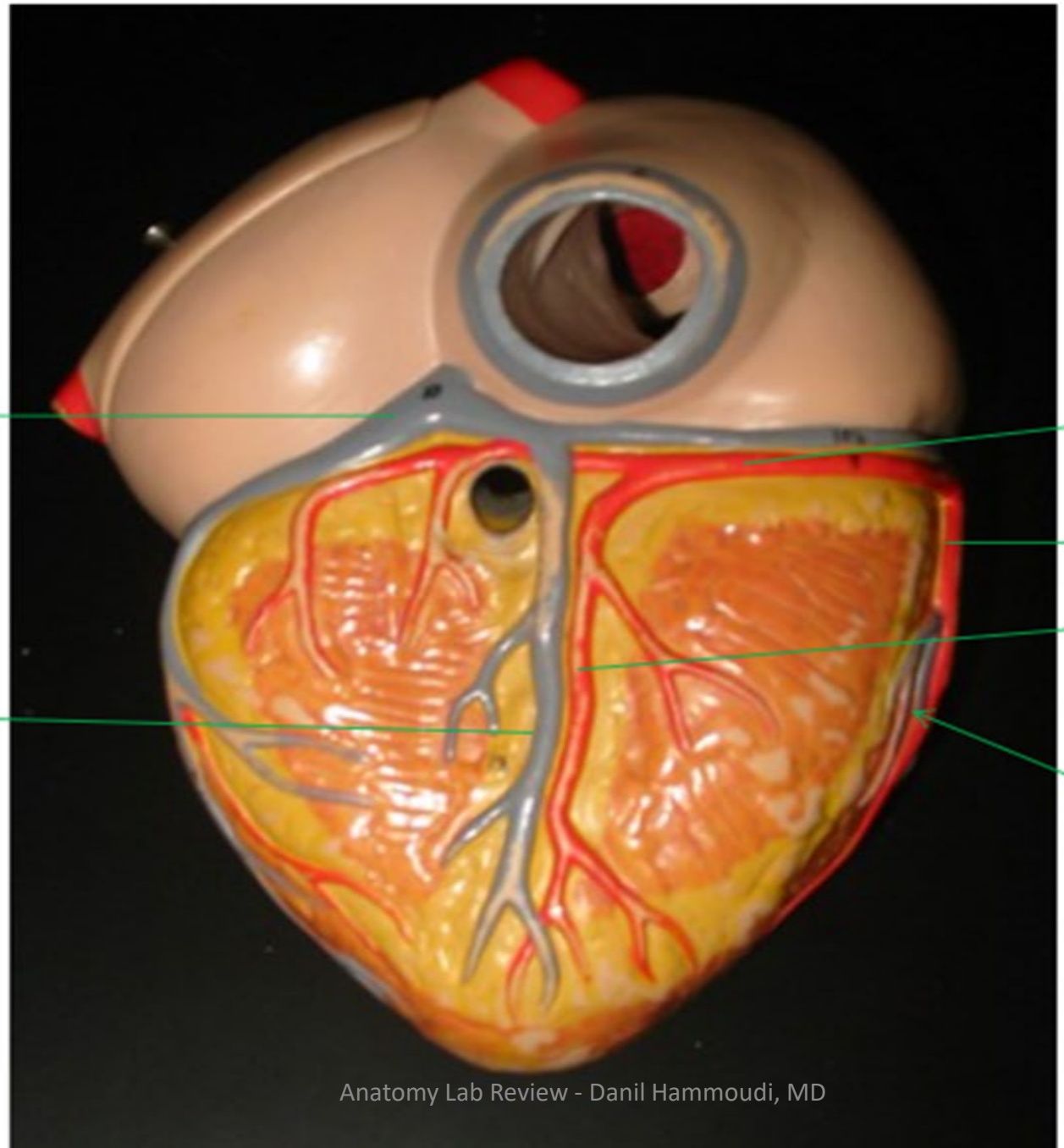
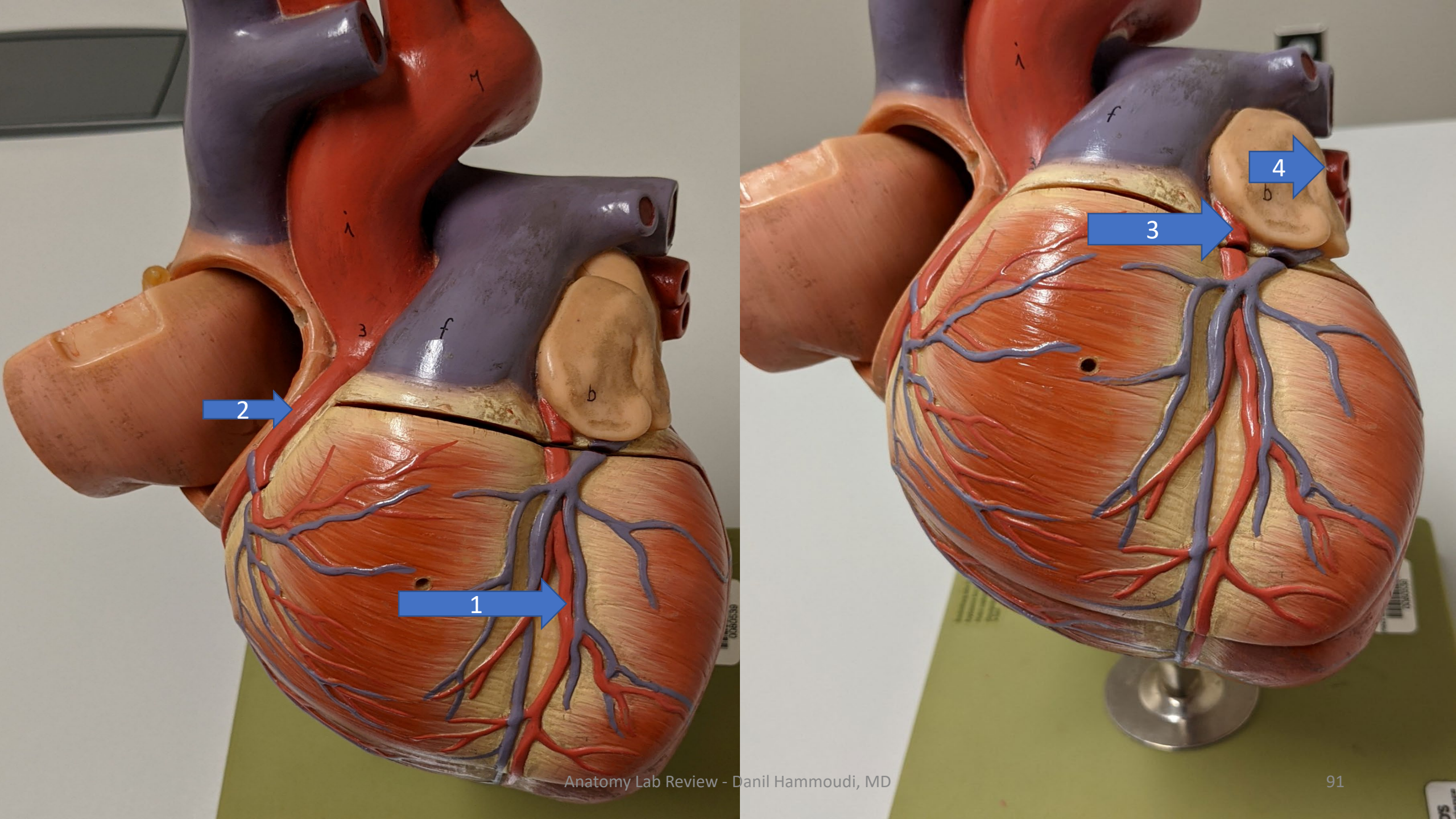

Left
Right
Coronary Sinus
Middle Cardiac Vein
Right Coronary Artery
Right Marginal Artery
Posterior Interventricular Artery
Small Cardiac Vein (beside the Right Marginal Artery)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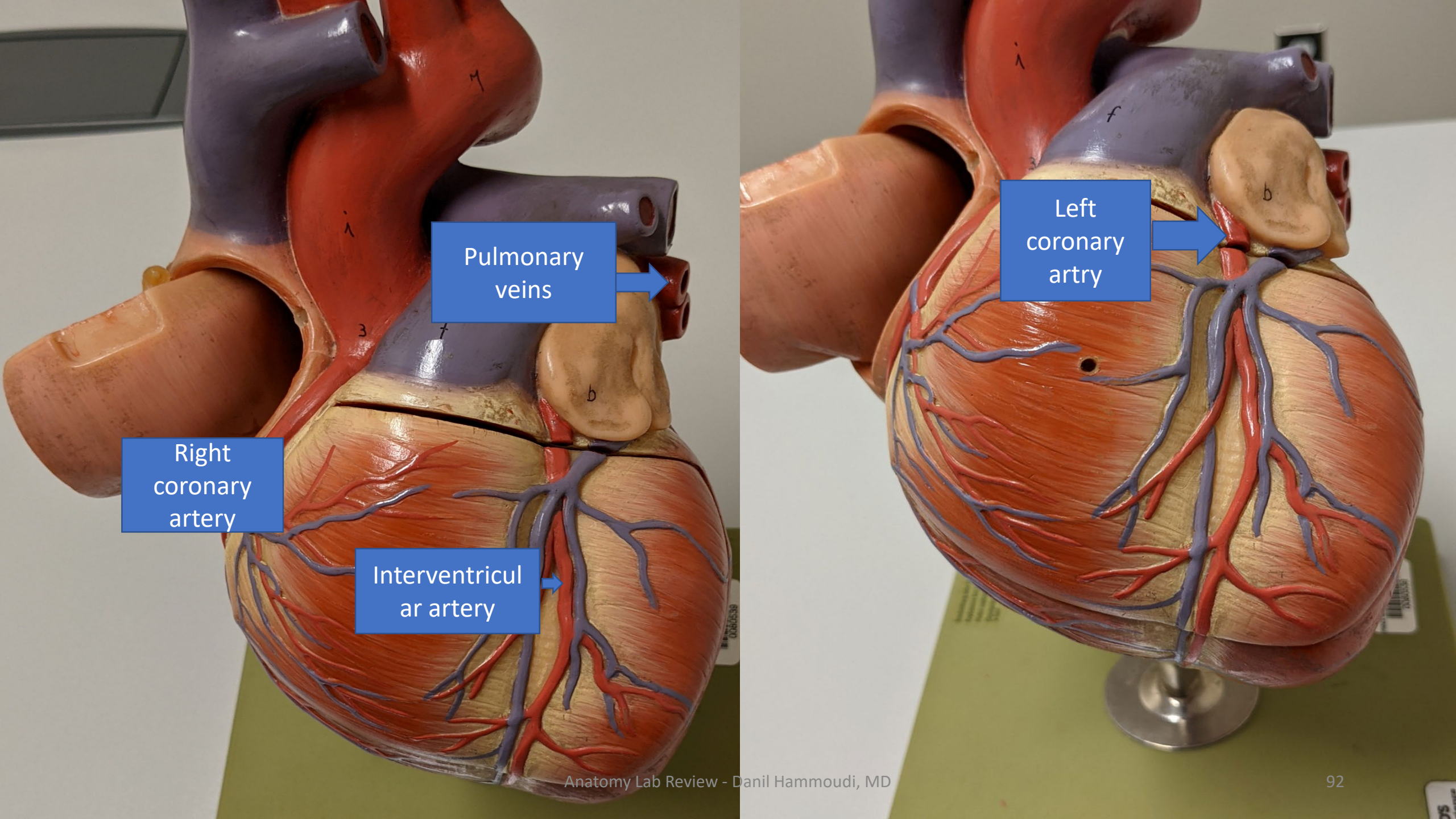
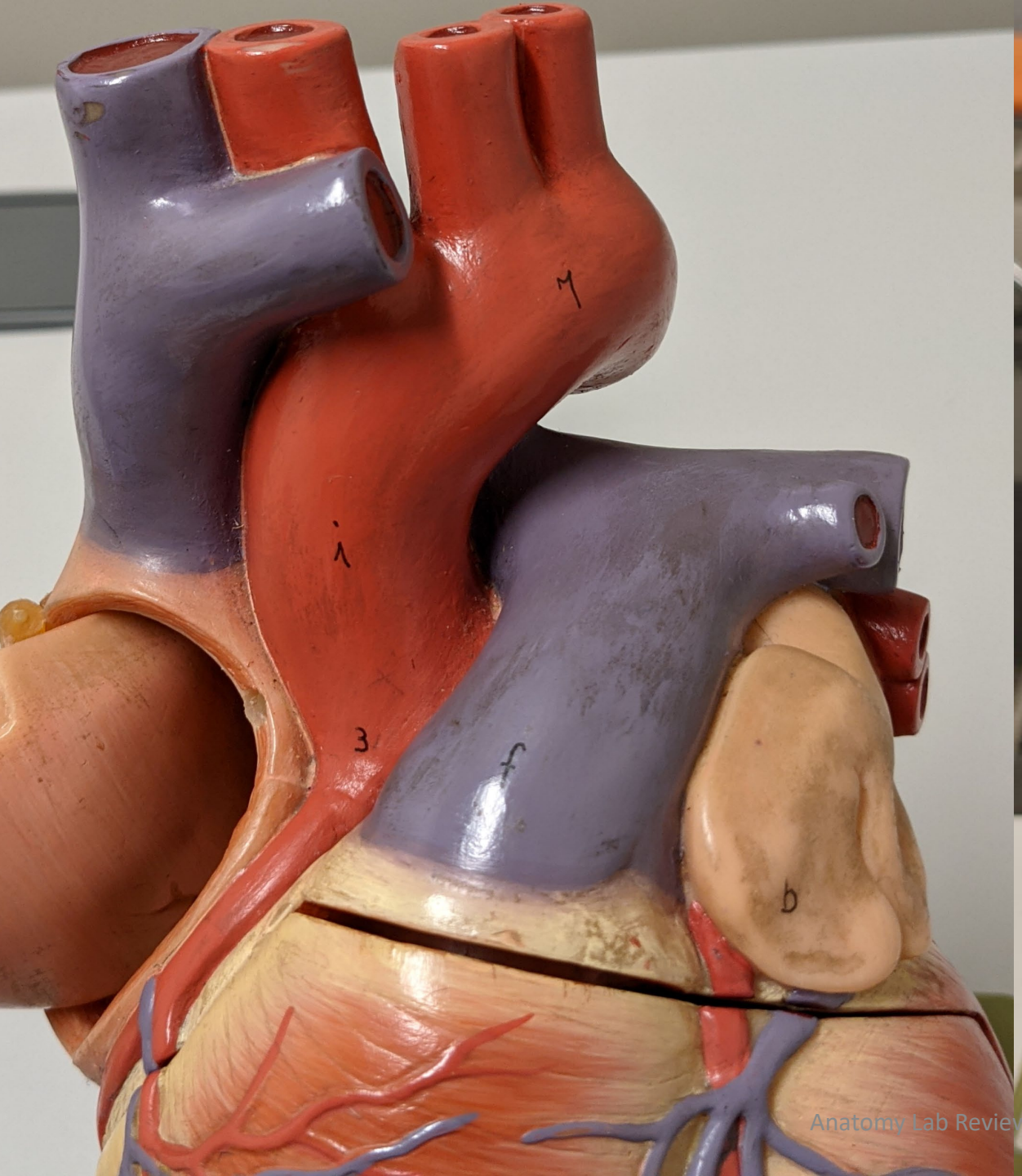
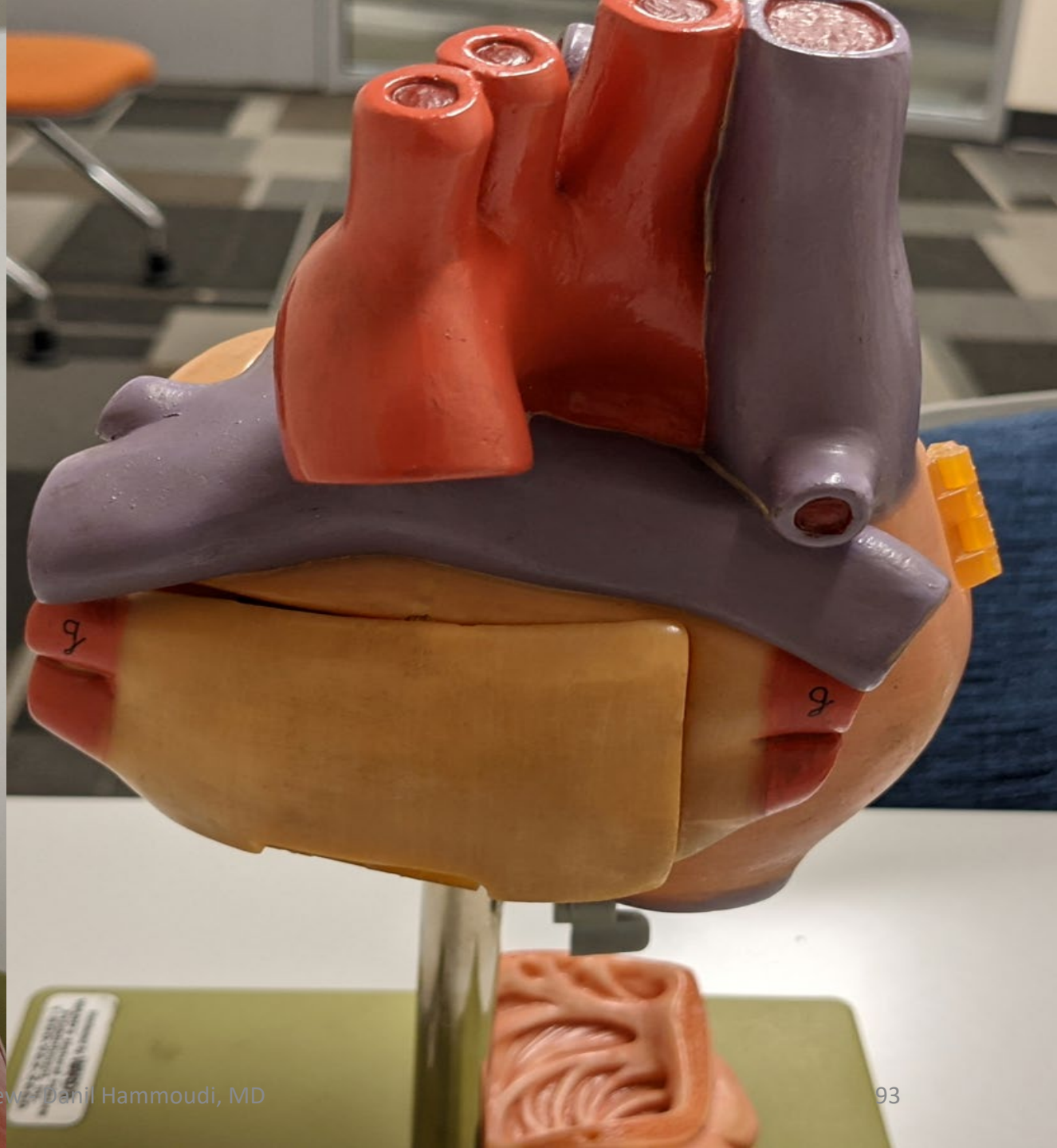
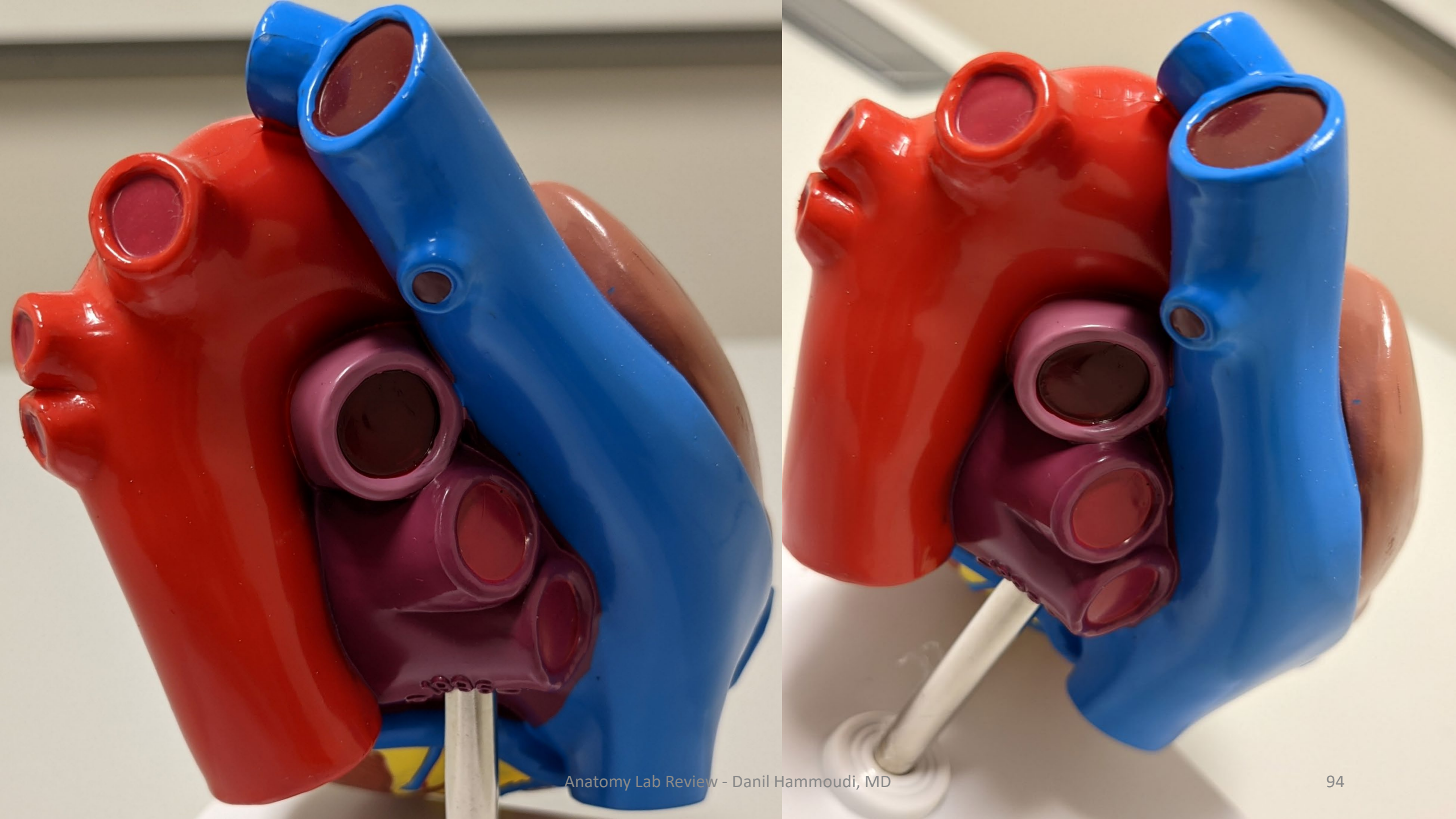
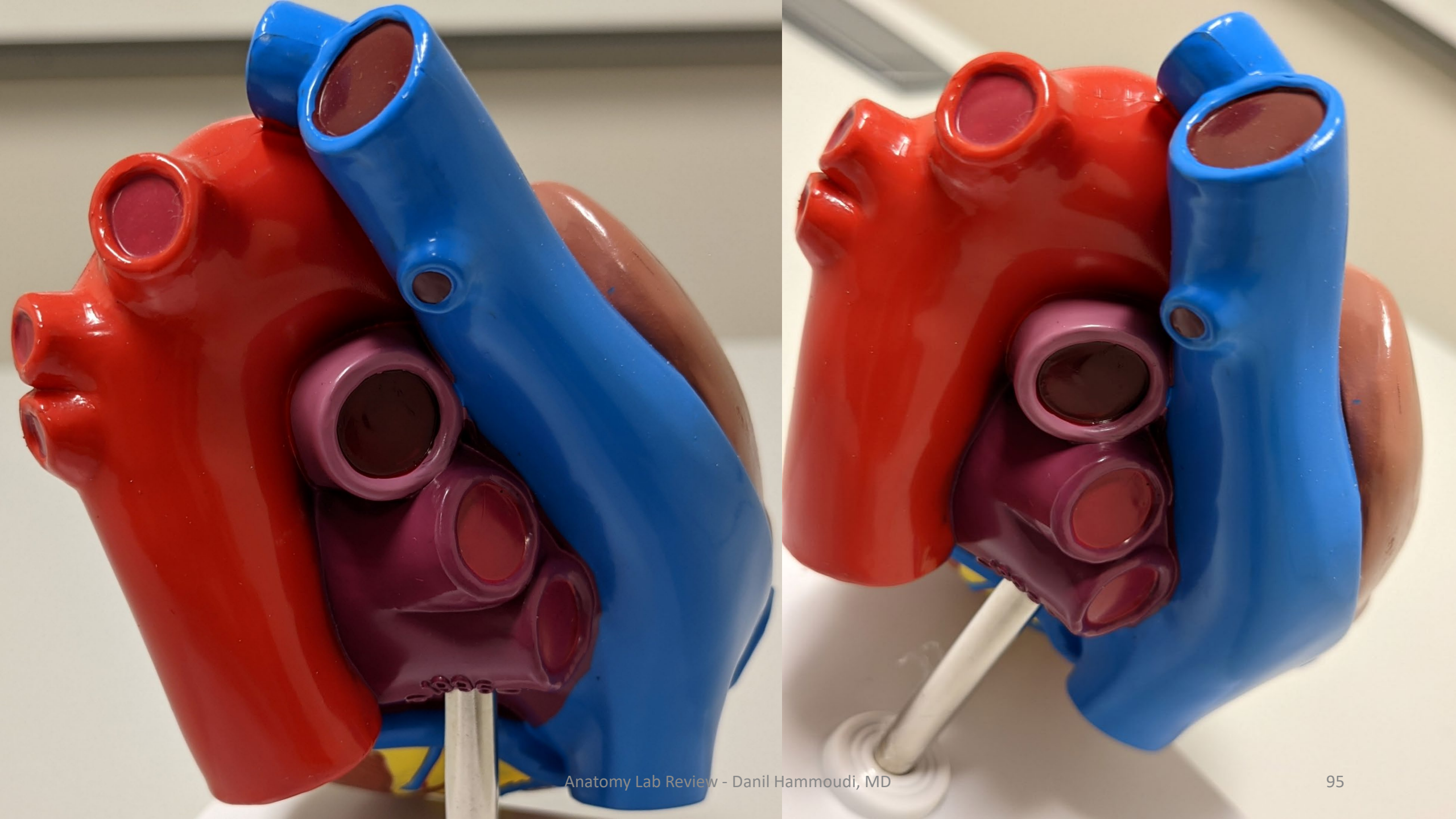
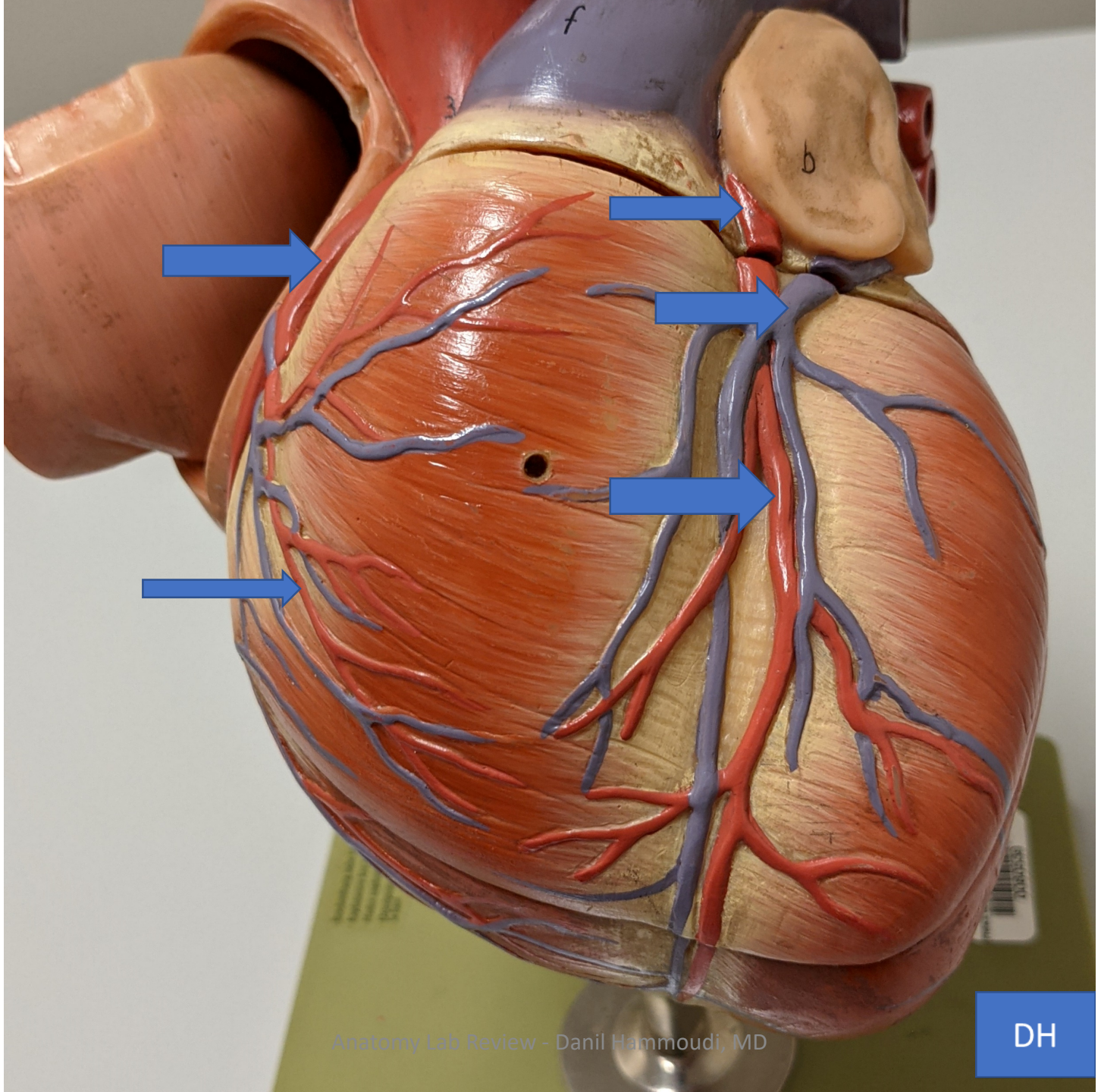

Pulmonary veins
Right coronary artery
Interventricul ar artery
Left coronary artry







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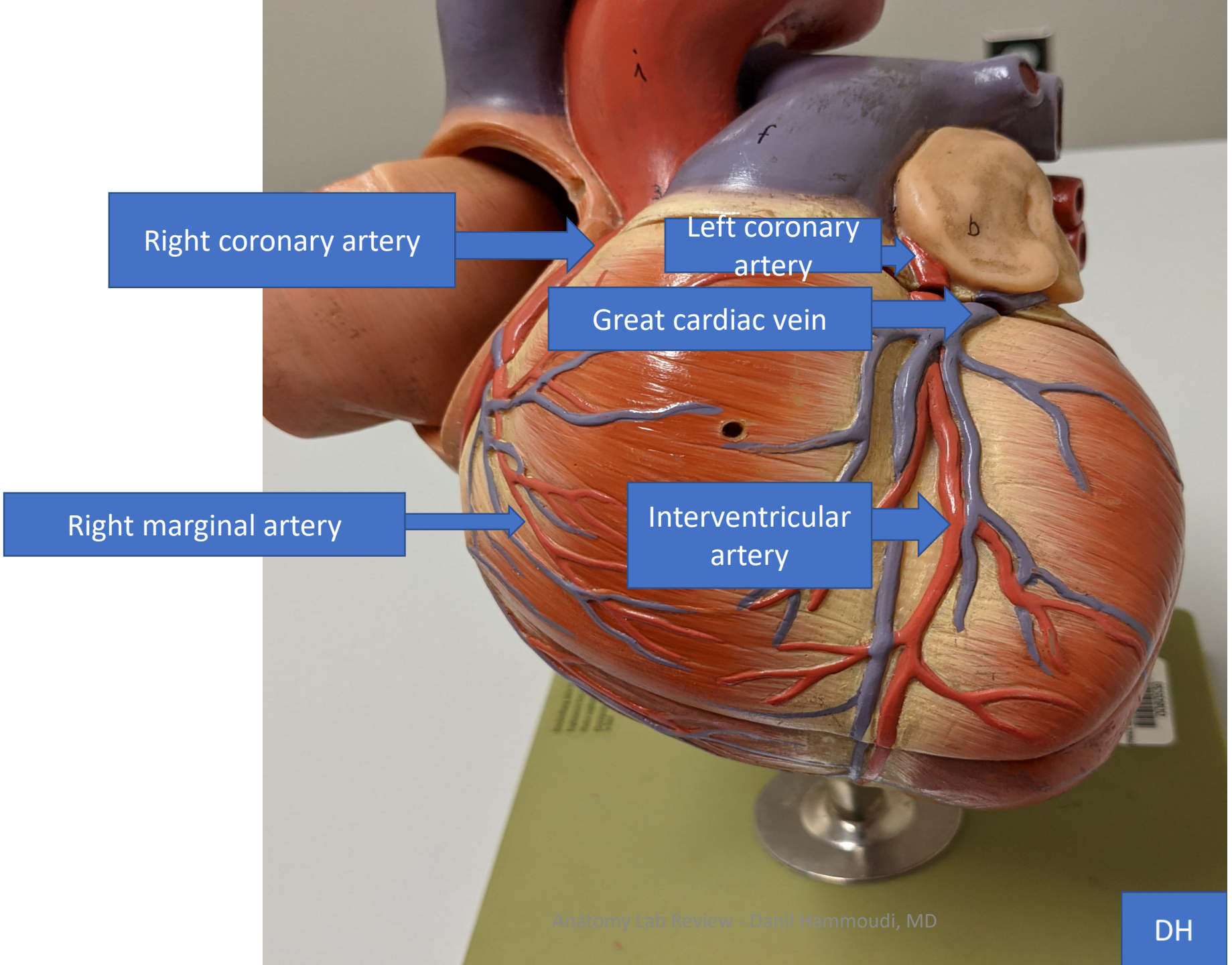
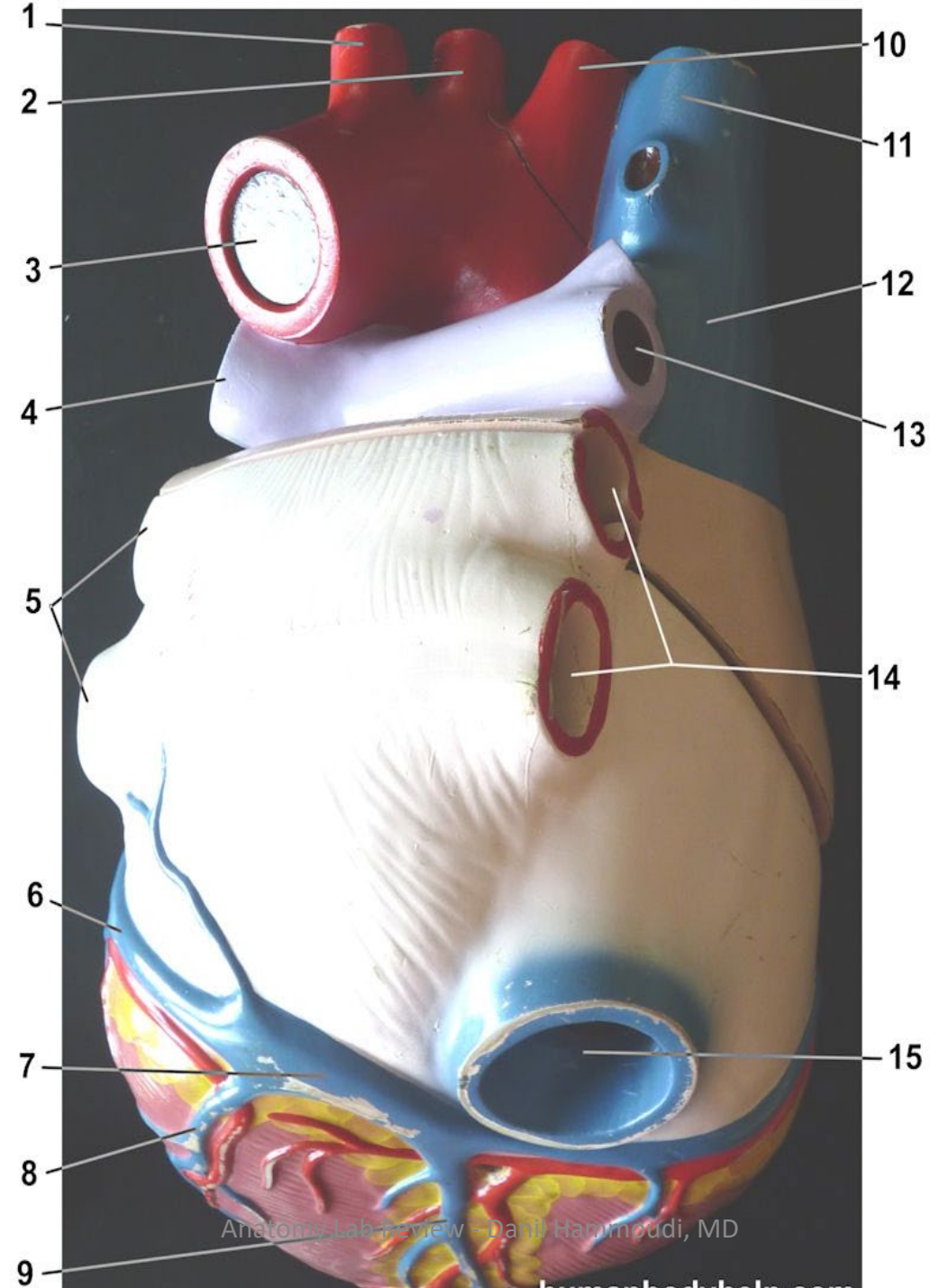
DH


Right coronary artery
Left coronary artery
Great cardiac vein
Right marginal artery
Interventricular artery
DH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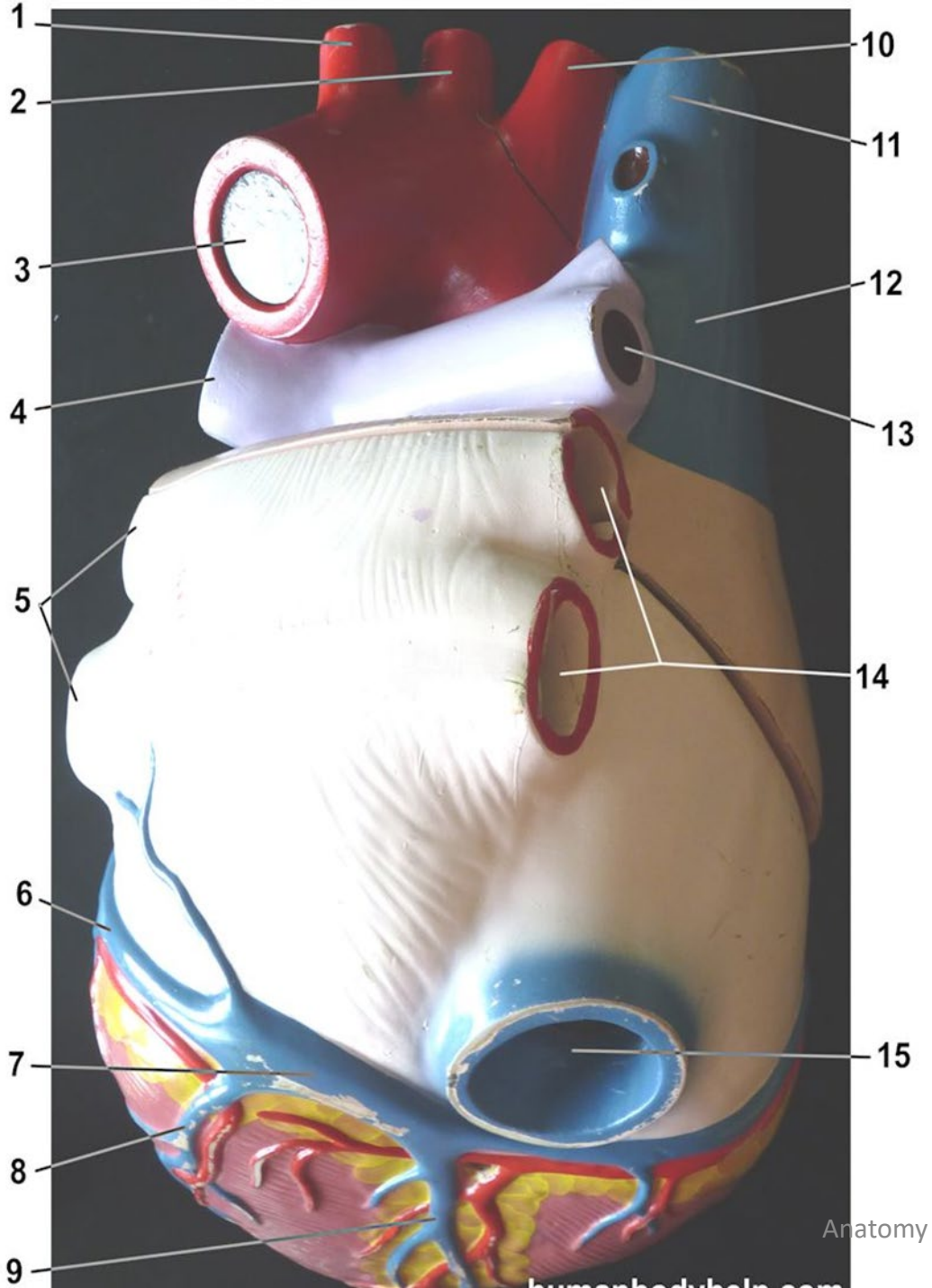
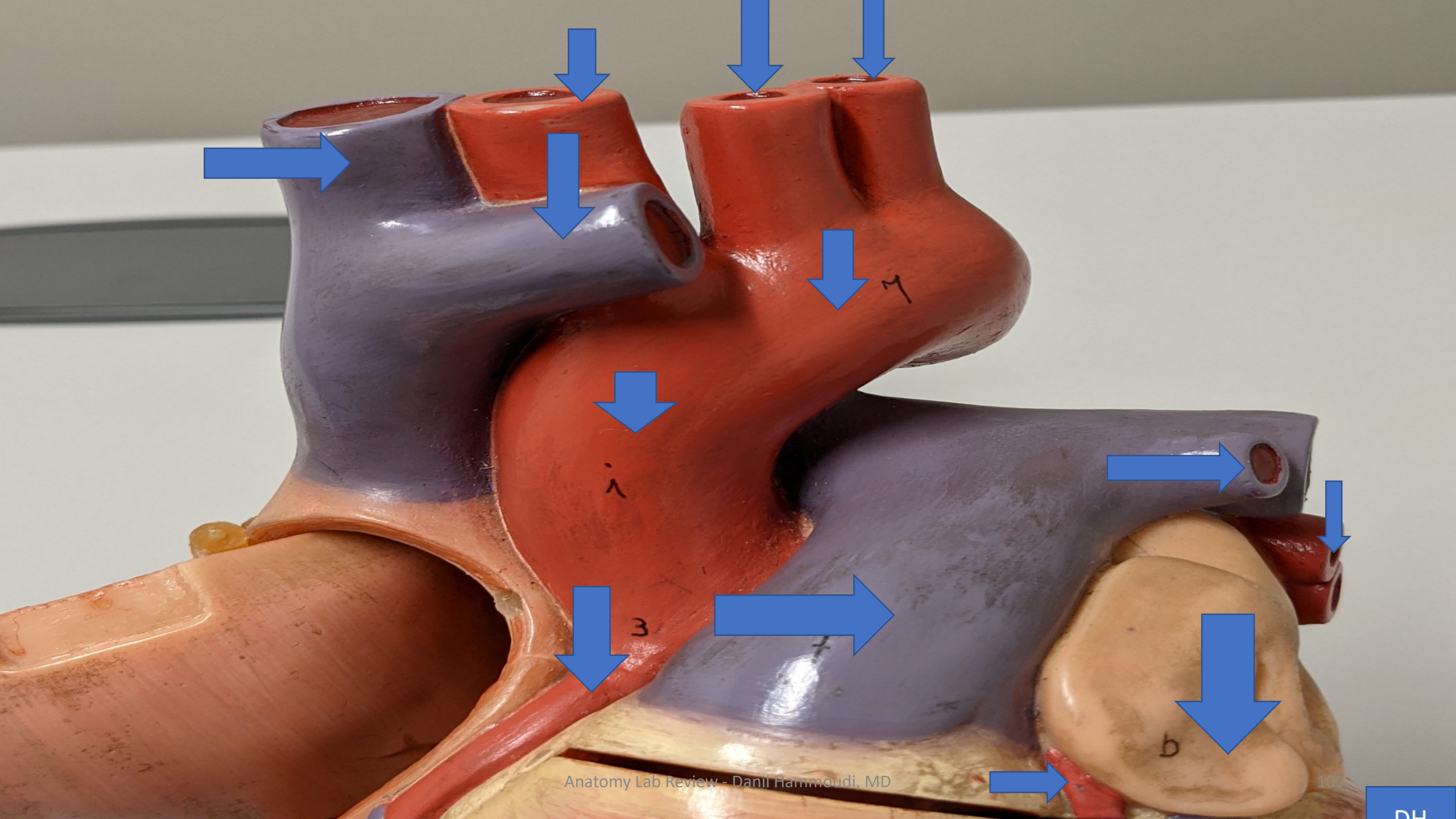


1.Left subclavian artery
2.Left common carotid artery
3.Aortic arch
4.Left pulmonary artery
5.Left pulmonary veins
6.Great cardiac vein
7.Coronary sinus
8.Posterior vein of left ventricle
9.Middle cardiac vein
10.Brachiocephalic trunk
11.Right brachiocephalic vein
12.Superior vena cava
13.Right pulmonary artery
14.Right pulmonary veins
15.Inferior vena cava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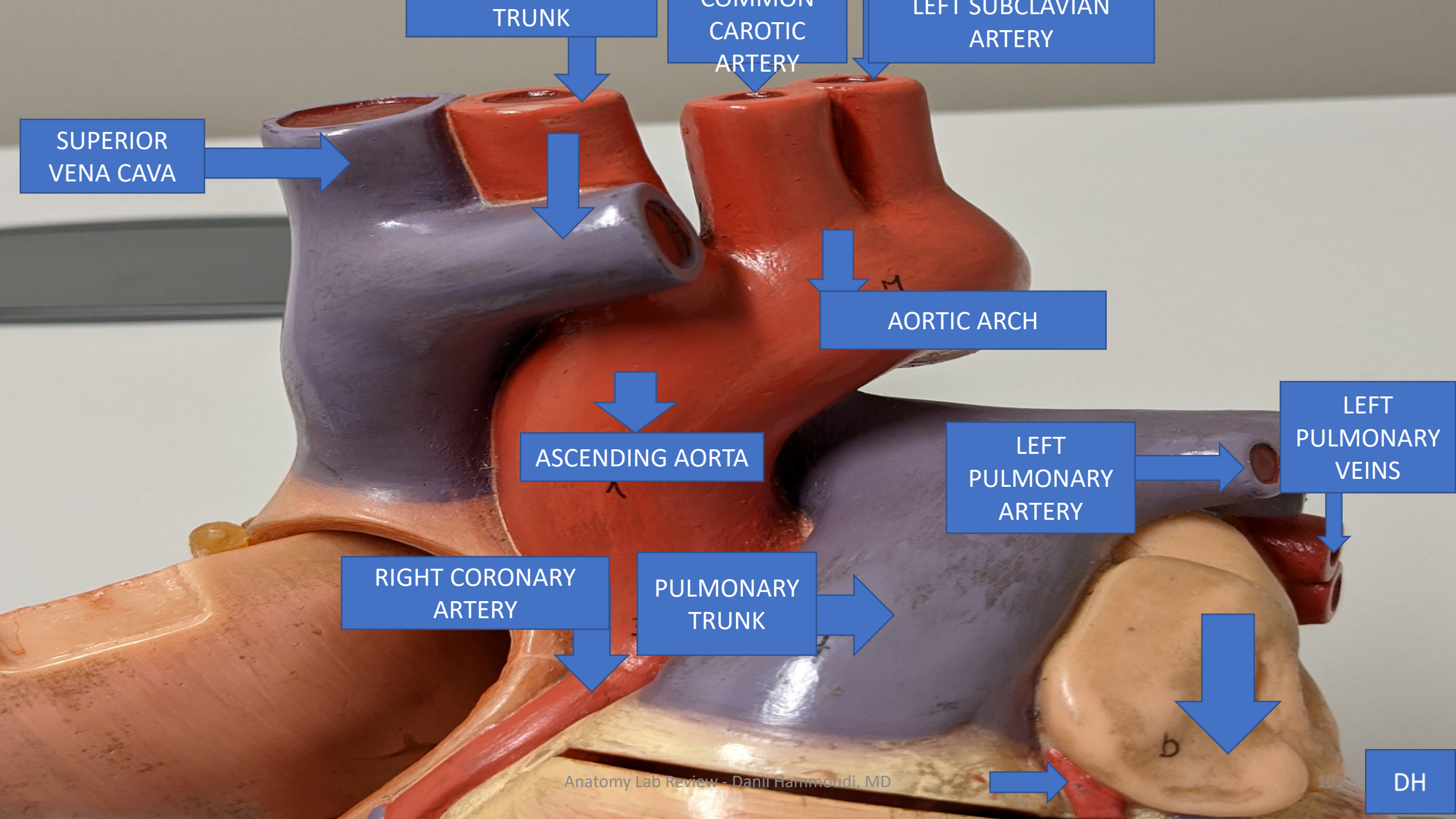
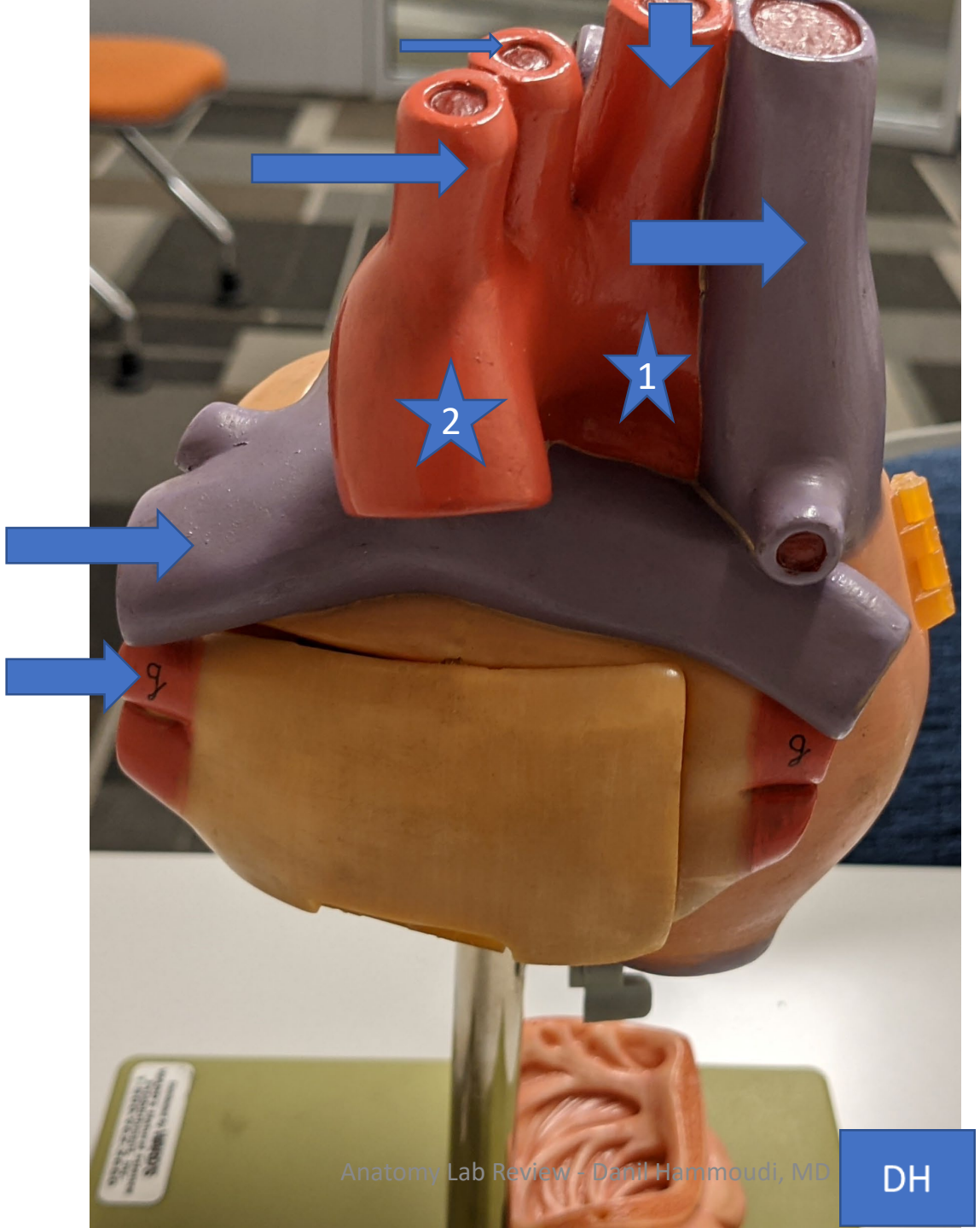

TRUNK
COMMON CAROTIC ARTERY
LEFT SUBCLAVIAN ARTERY
SUPERIOR VENA CAVA
AORTIC ARCH
ASCENDING AORTA
LEFT PULMONARY ARTERY
LEFT PULMONARY VEINS
RIGHT CORONARY ARTERY
PULMONARY TRUNK
DH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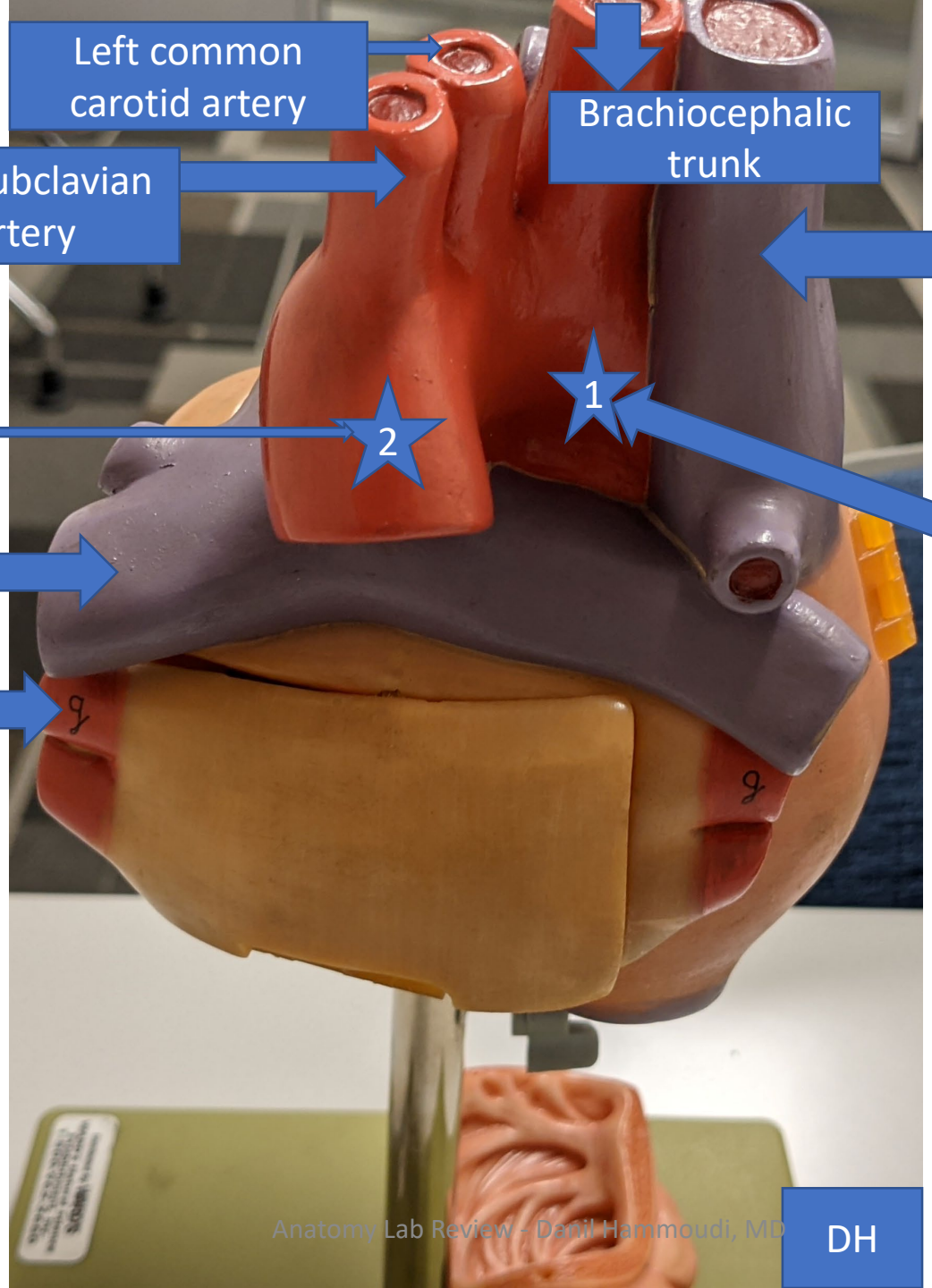
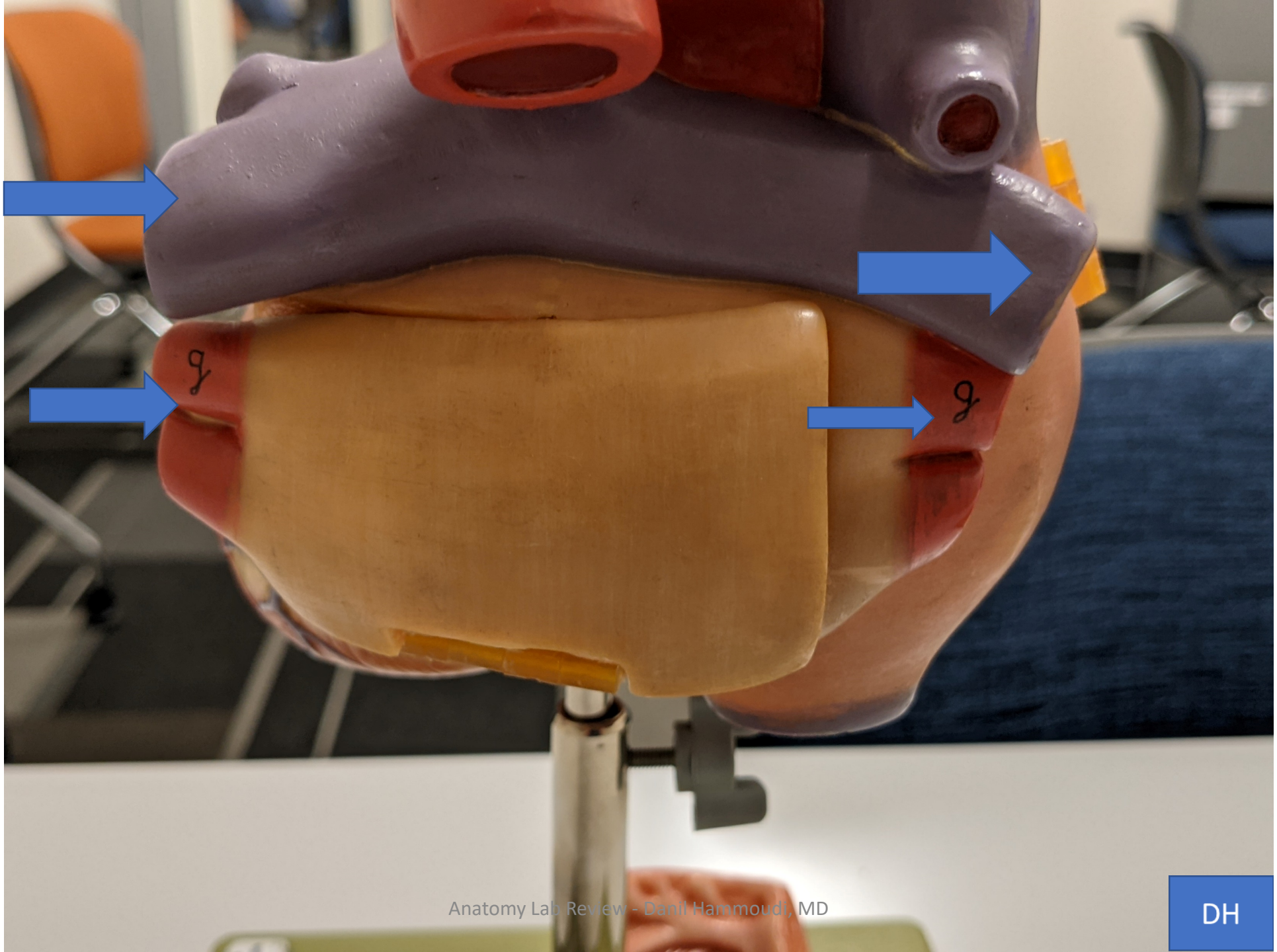
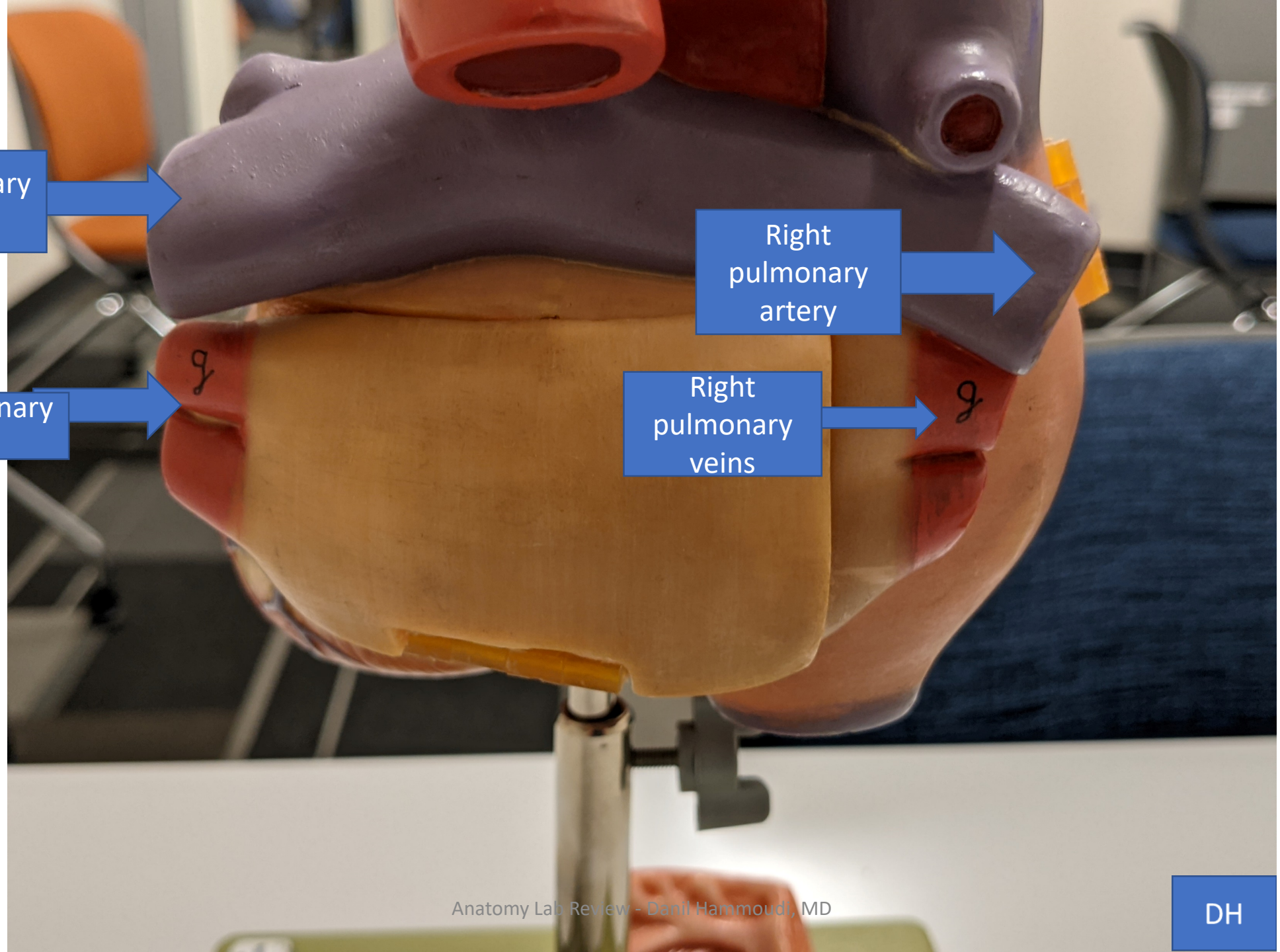
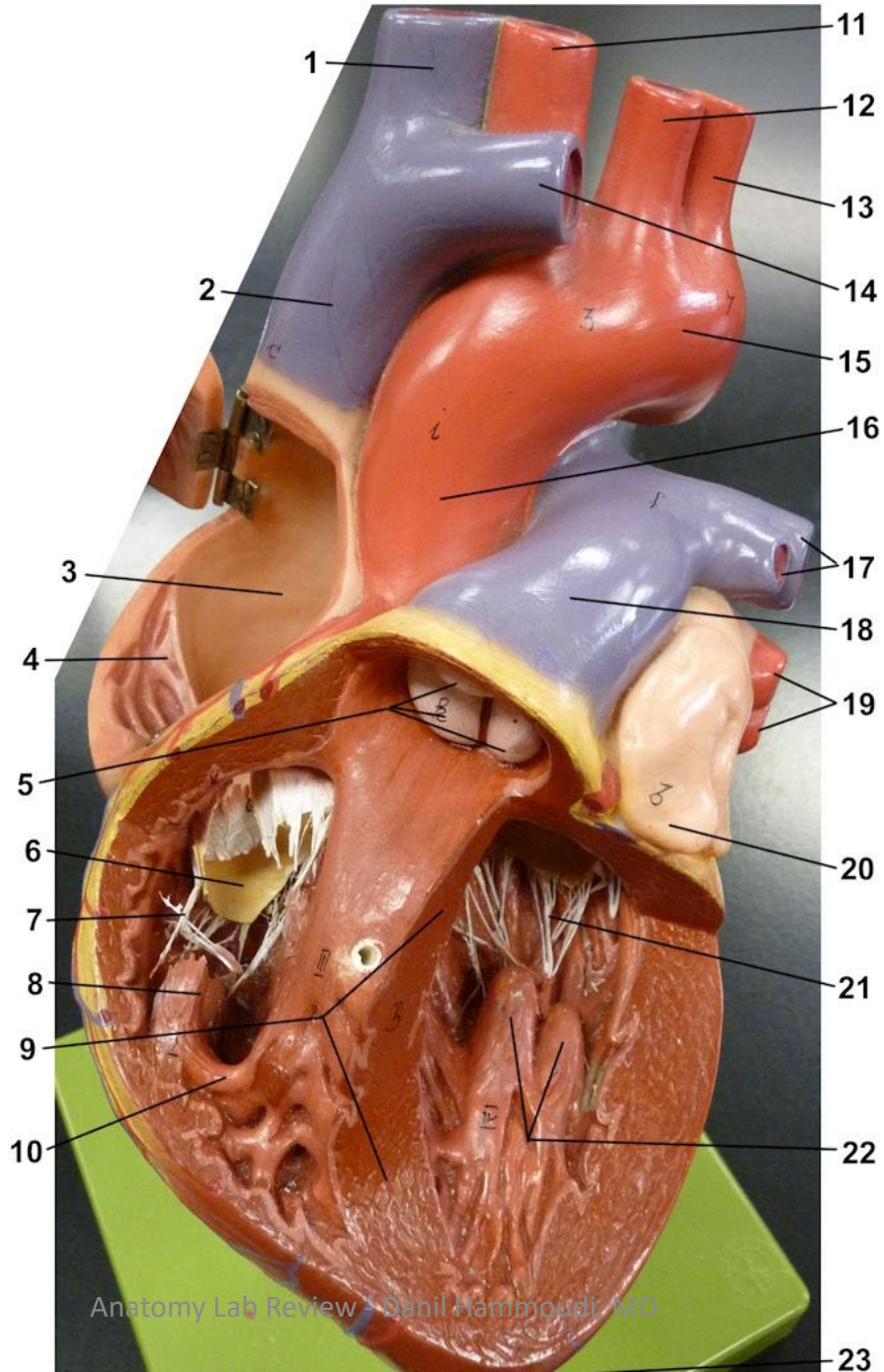

Left common carotid artery
Brachiocephalic trunk
Left subclavian artery
Superior vena cava
1
Decending aorta
2
Aortic arch
Left pulmonary artery
Left Pulmonary vein
DH




Left pulmonary artery
Left pulmonary veins
Right pulmonary artery
Right pulmonary veins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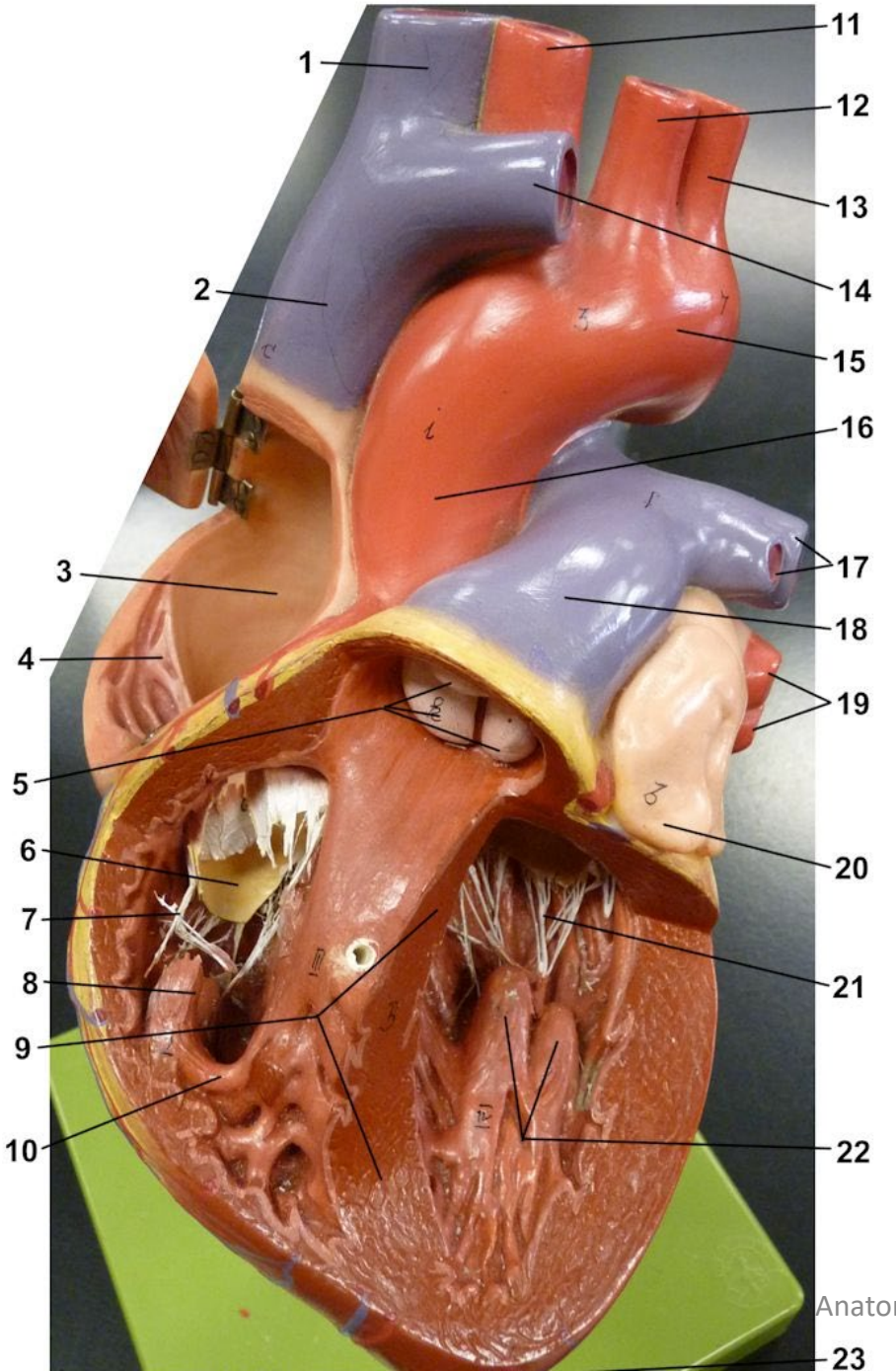
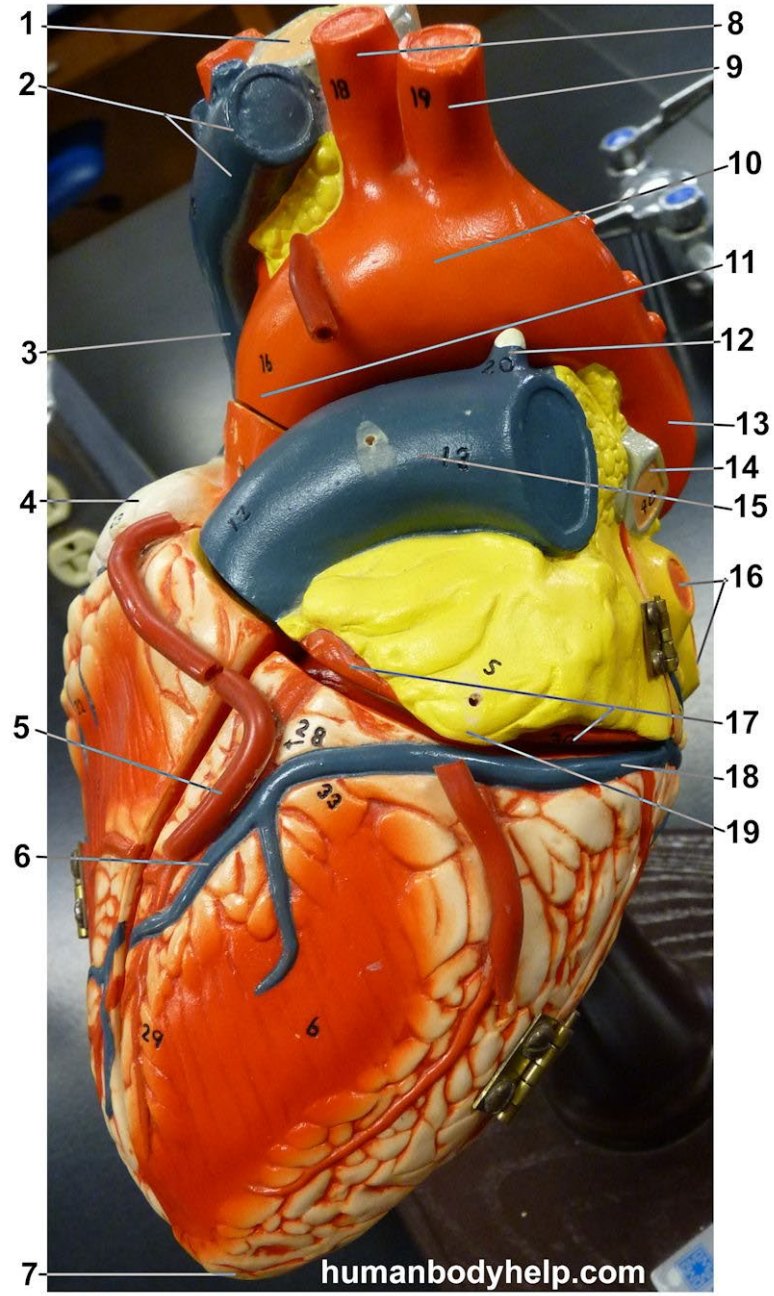


1.Right brachiocephalic vein
2.Superior vena cava
3.Right atrium
4.Pectinate muscles (musculi pectinati) of the right atrium
5.Pulmonary semilunar valve
6.Right Atrioventricular valve (Aka: Tricuspid valve or Right AV valve)
7.Chordae tendineae
8.Papillary muscle
9.Interventricular septum
10.Moderator band
11.Brachiocephalic trunk
12.Left common carotid
13.Left subclavian
14.Left brachiocephalic vein
15.Arch of the Aorta
16.Ascending Aorta
17.Pulmonary arteries
18.Pulmonary trunk
19.Left pulmonary veins
20.Auricle of the left atrium
21.Chordae tendineae
22.Papillary muscles
23.Apex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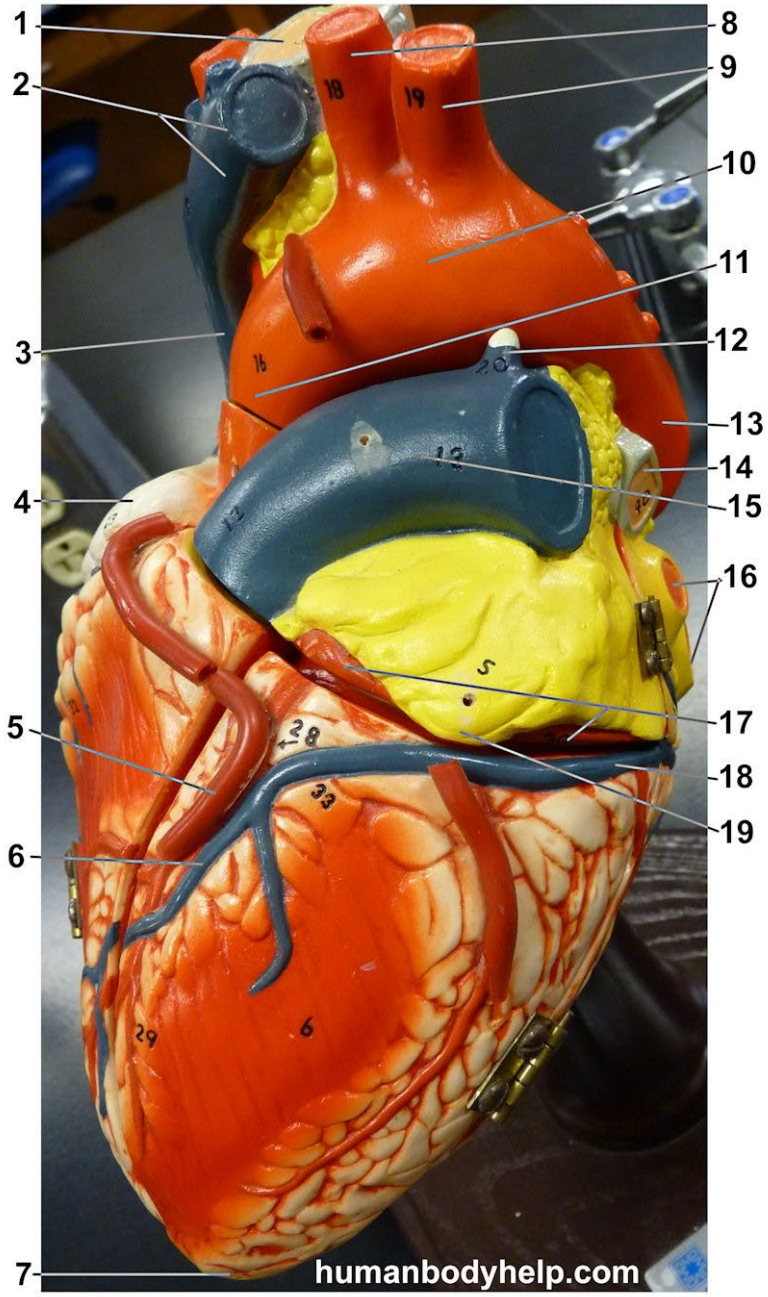
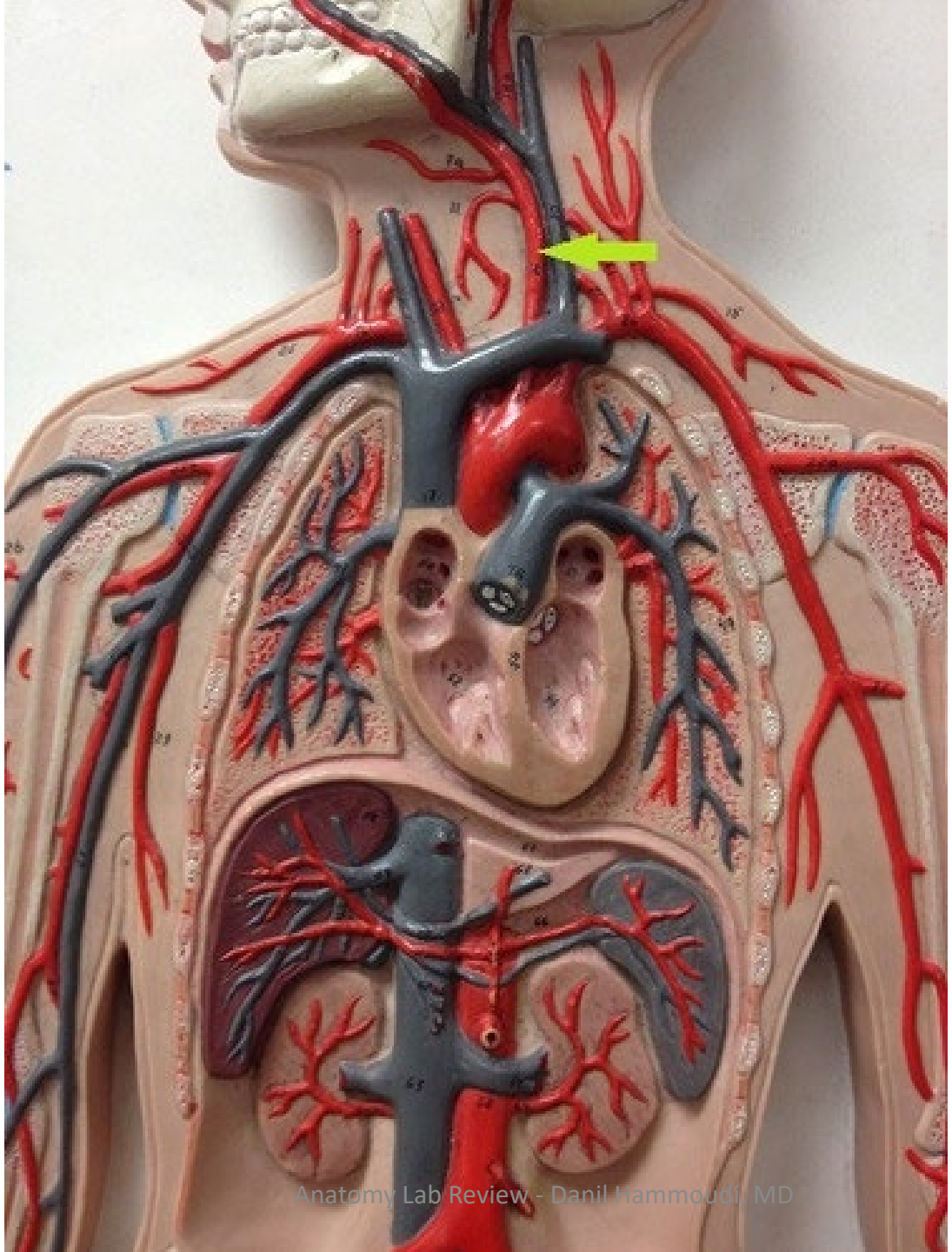
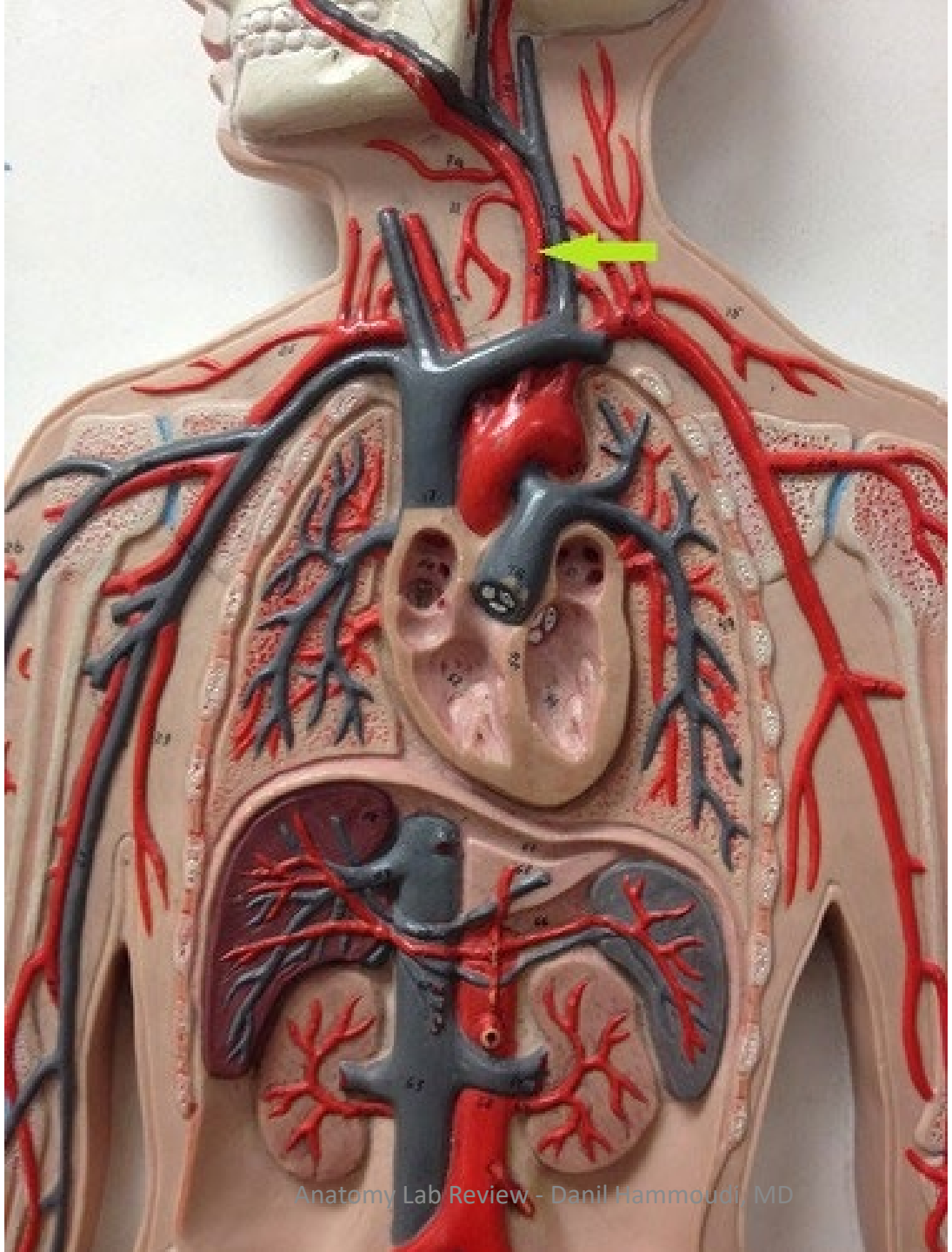
humanbodyhelp.com

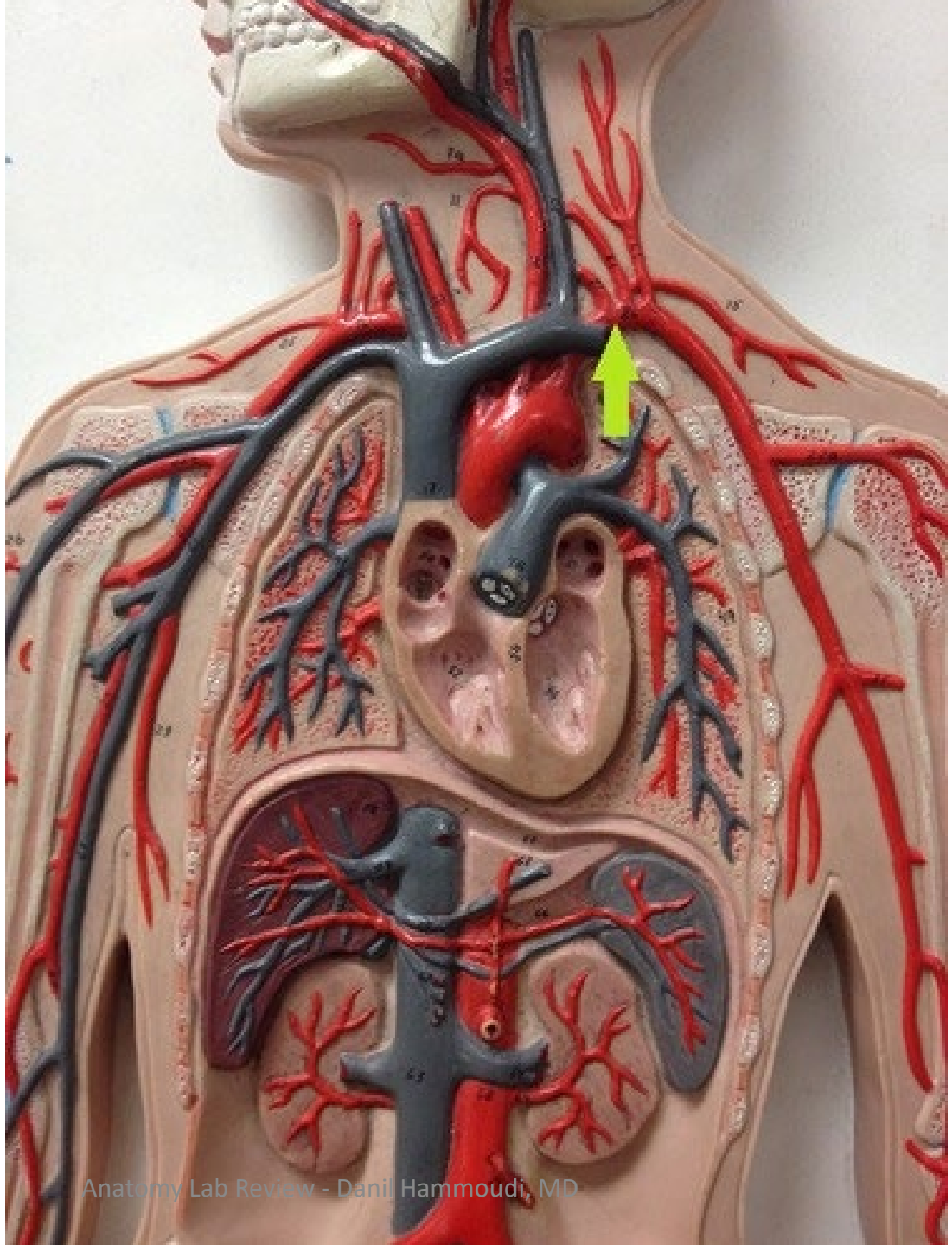


1. Trachea
2. Left brachiocephalic vein
3. Superior vena cava
4. Right atrium
5. Left Anterior descending artery
6. Great cardiac vein
7. Apex
8. Left Common carotid artery
9. Left Subclavian artery
10. Arch of the Aorta
11. Ascending Aorta
12. Ligamentum arteriosum
13. Descending Aorta
14. Left primary bronchus
15. Pulmonary trunk
16. Left pulmonary veins
17. Left Coronary artery
18. Great Cardiac vein
19. Auricle (left) with adipose

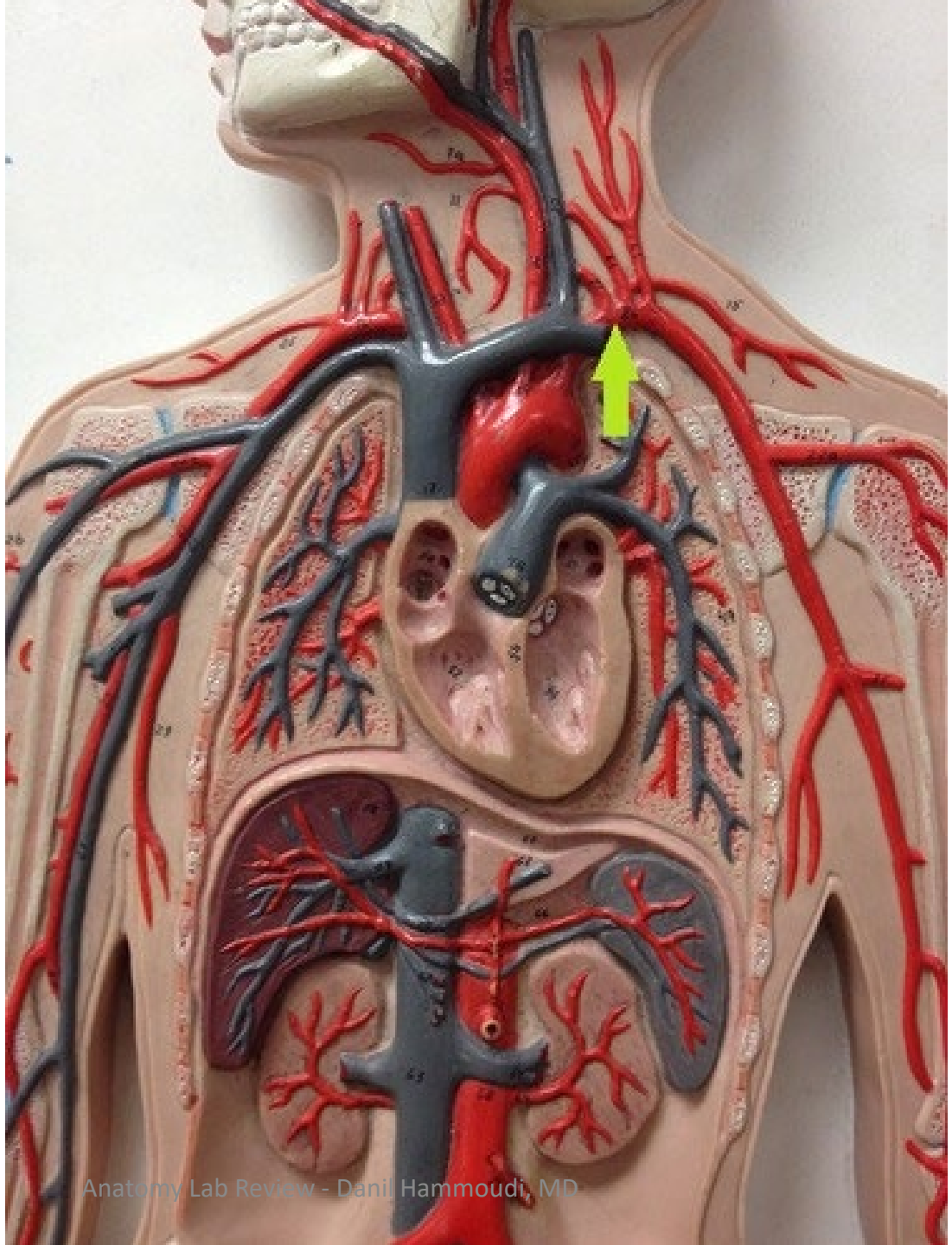


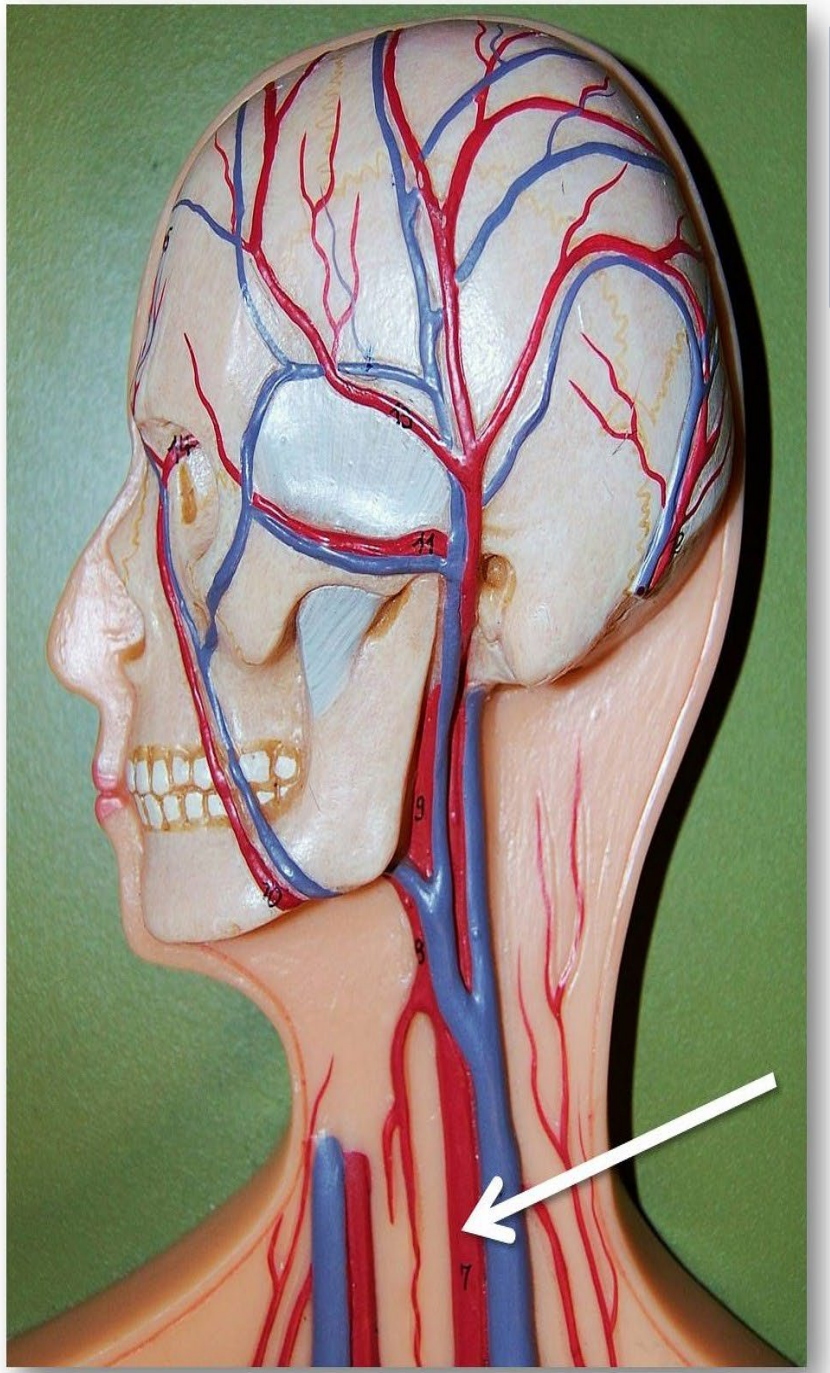
Common carotid artery





Left Subclavian artery





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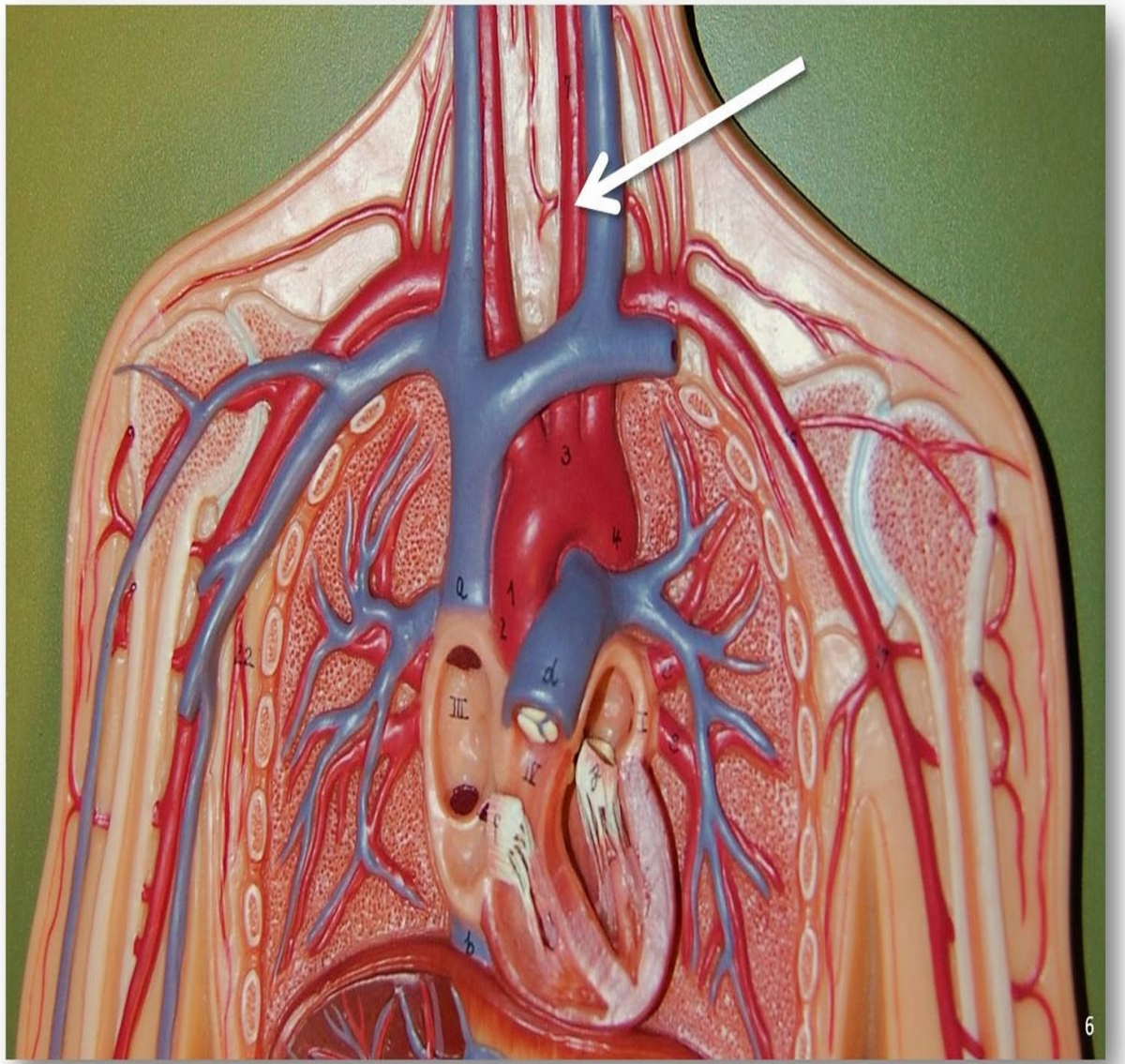

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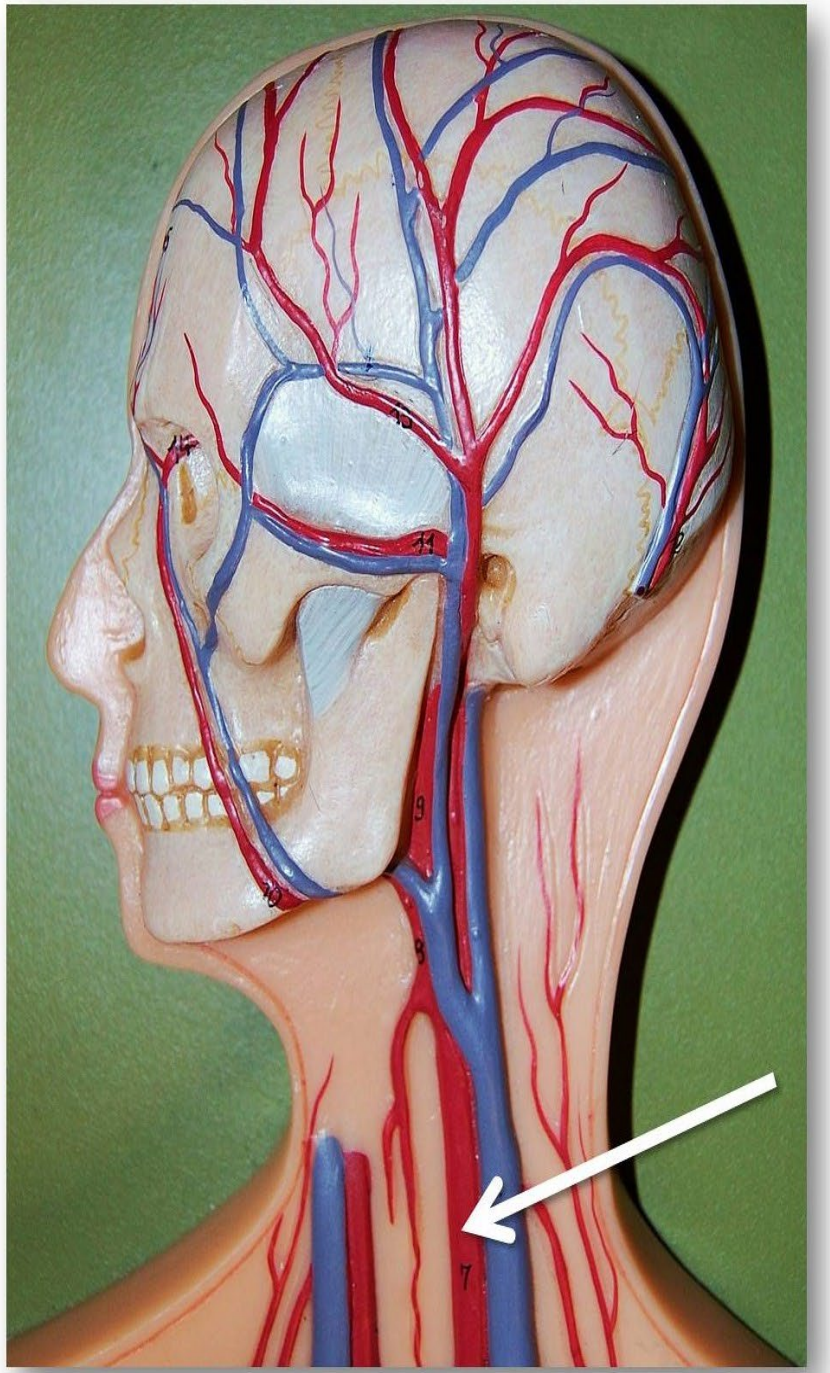
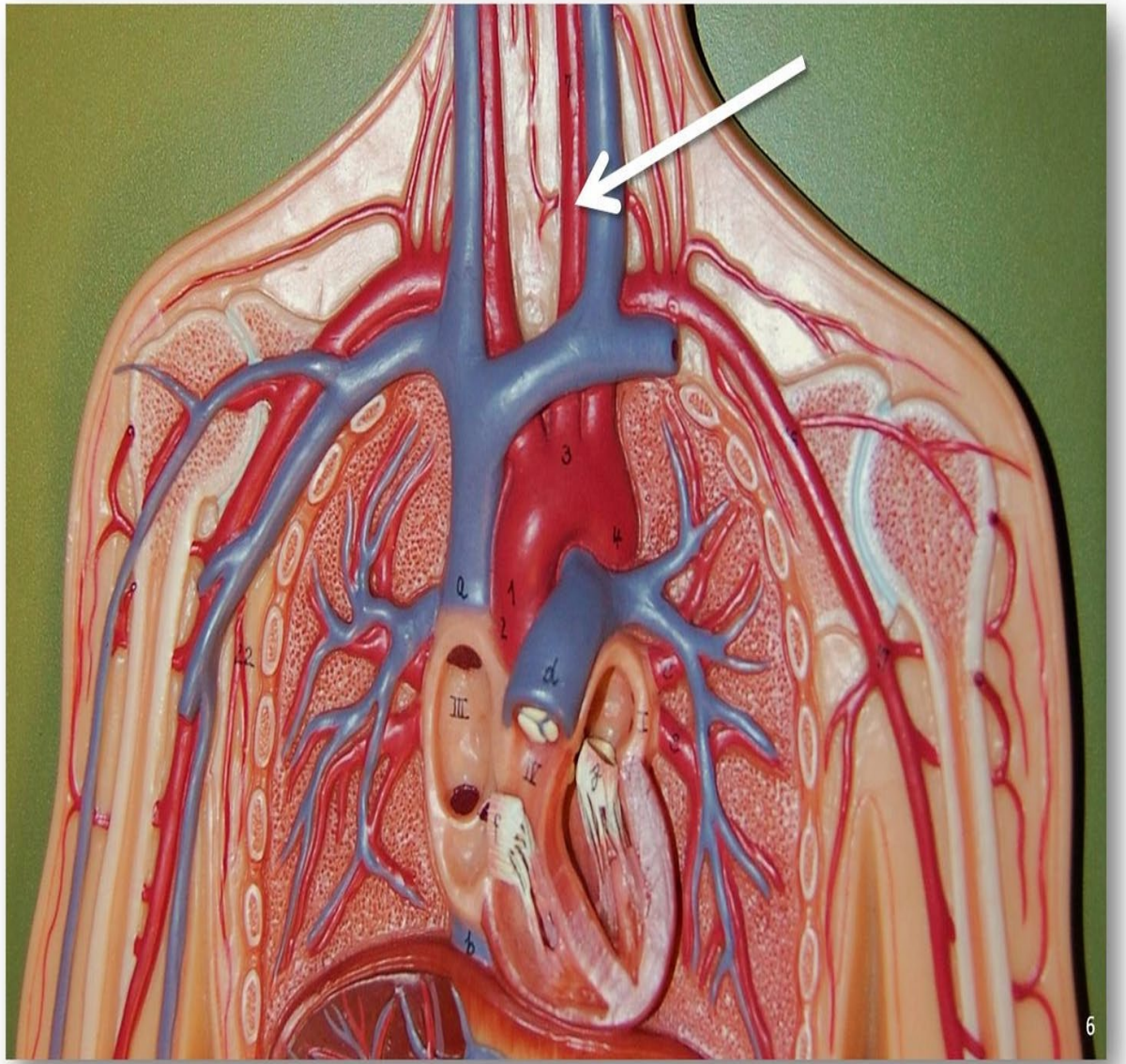
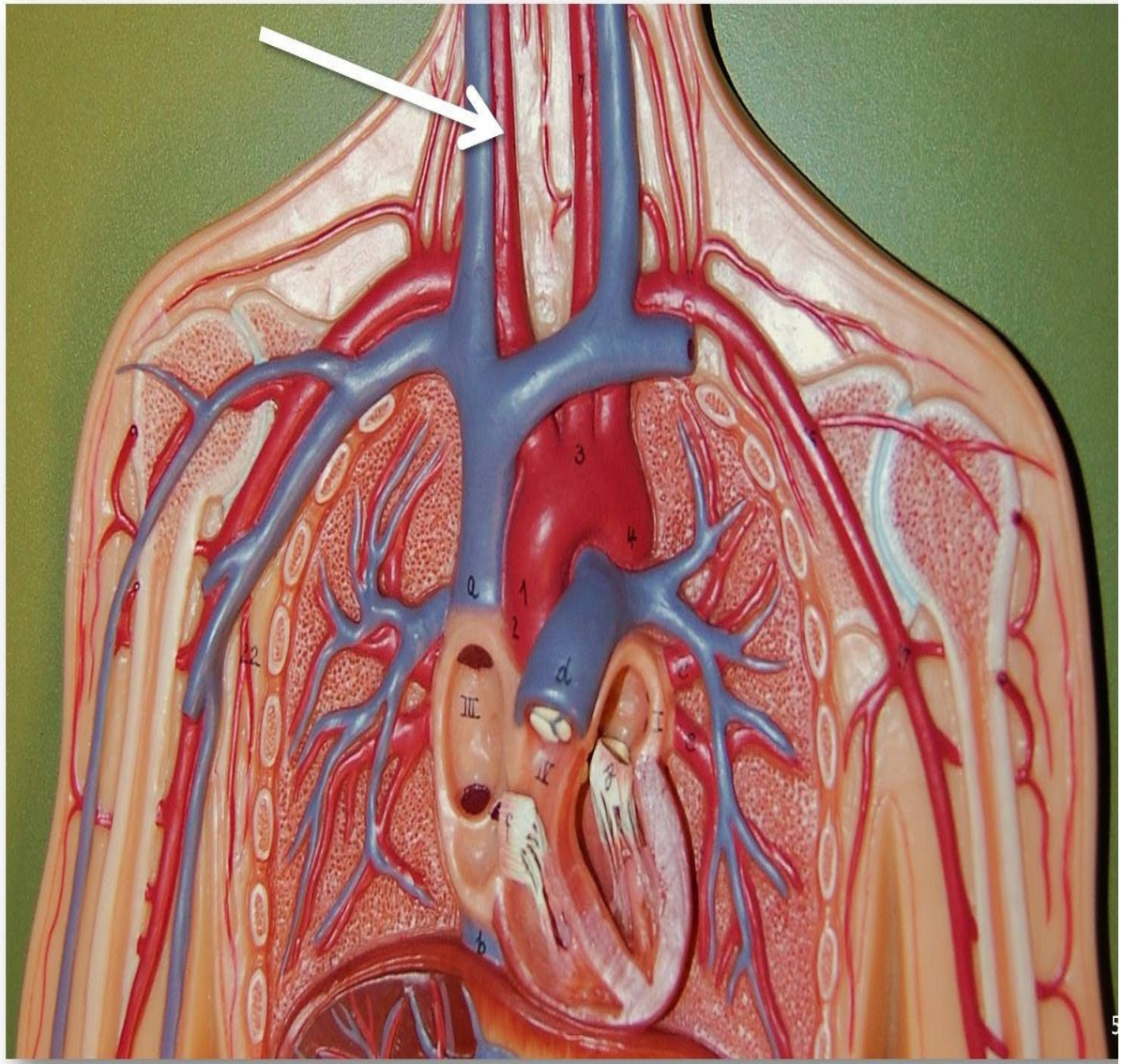
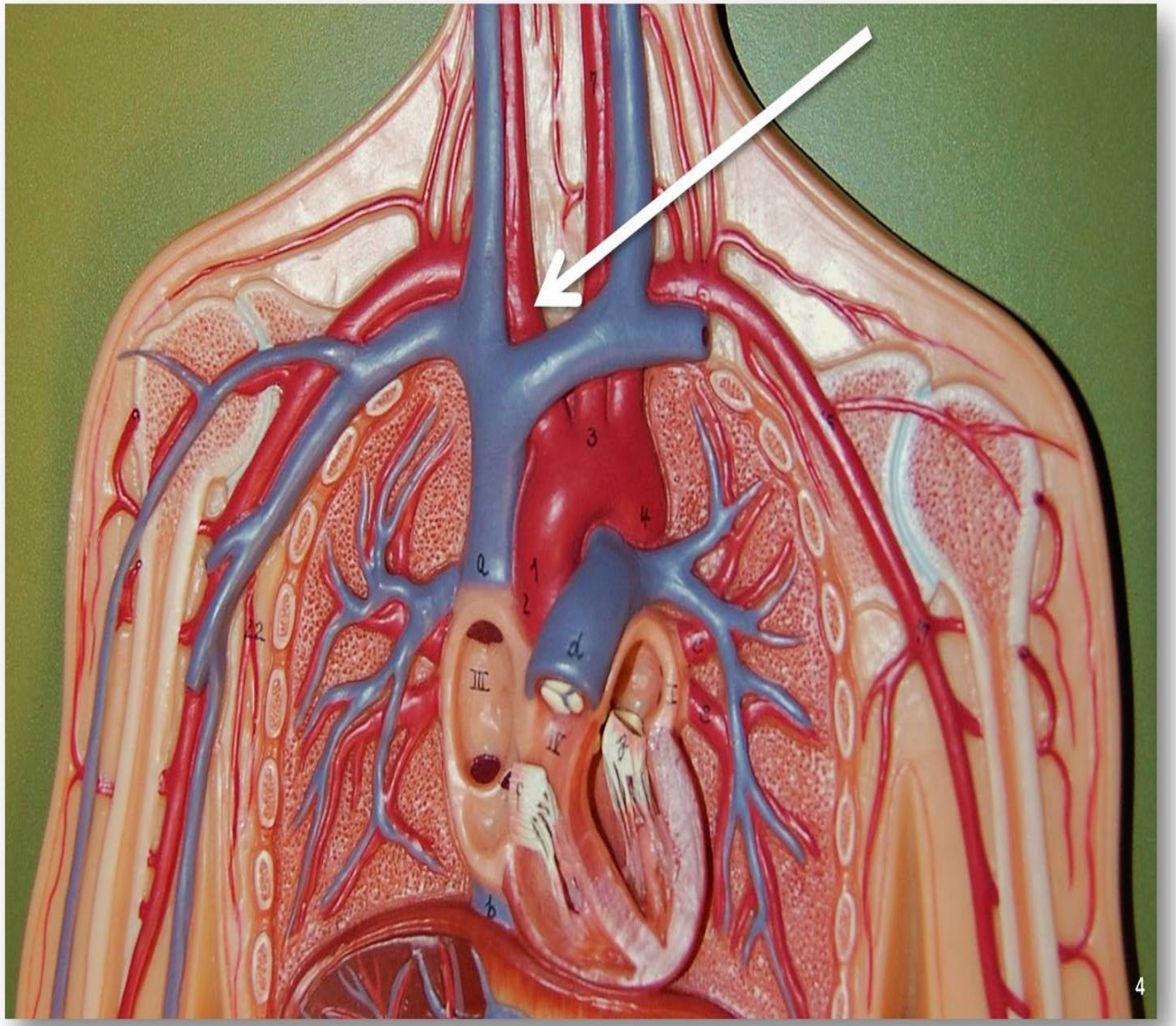


Left Common Carotid Artery

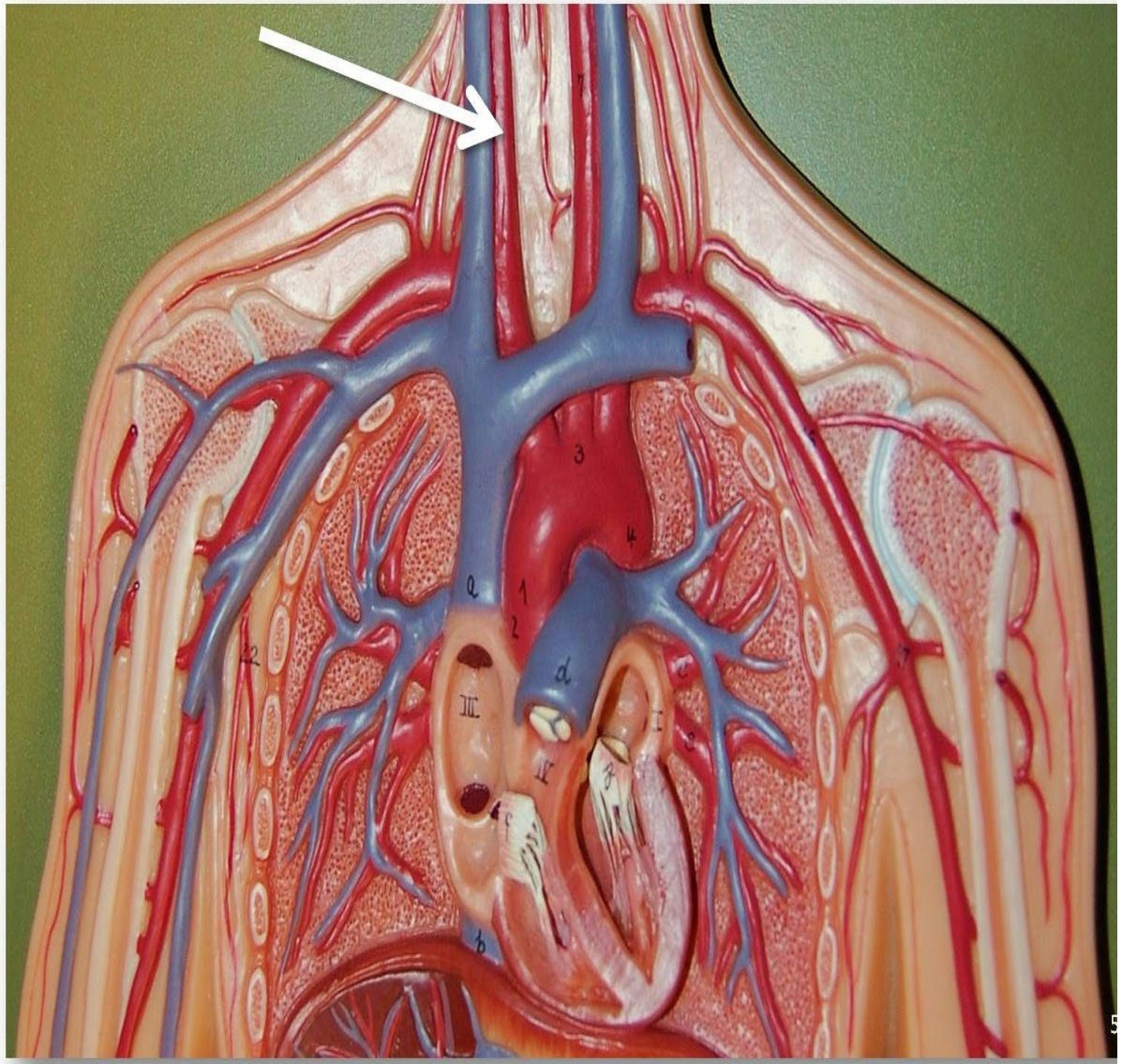
Left Common Carotid Artery



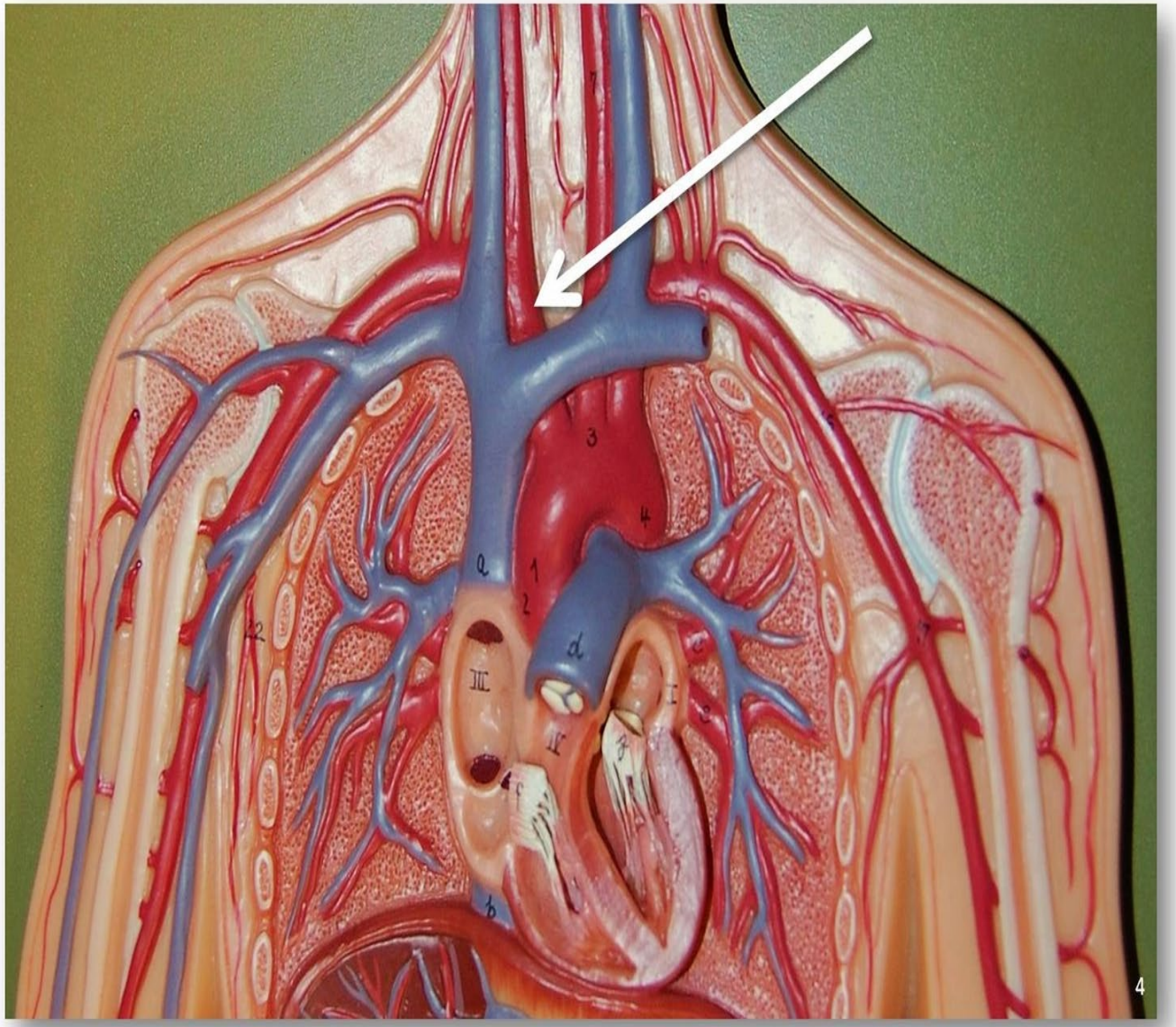


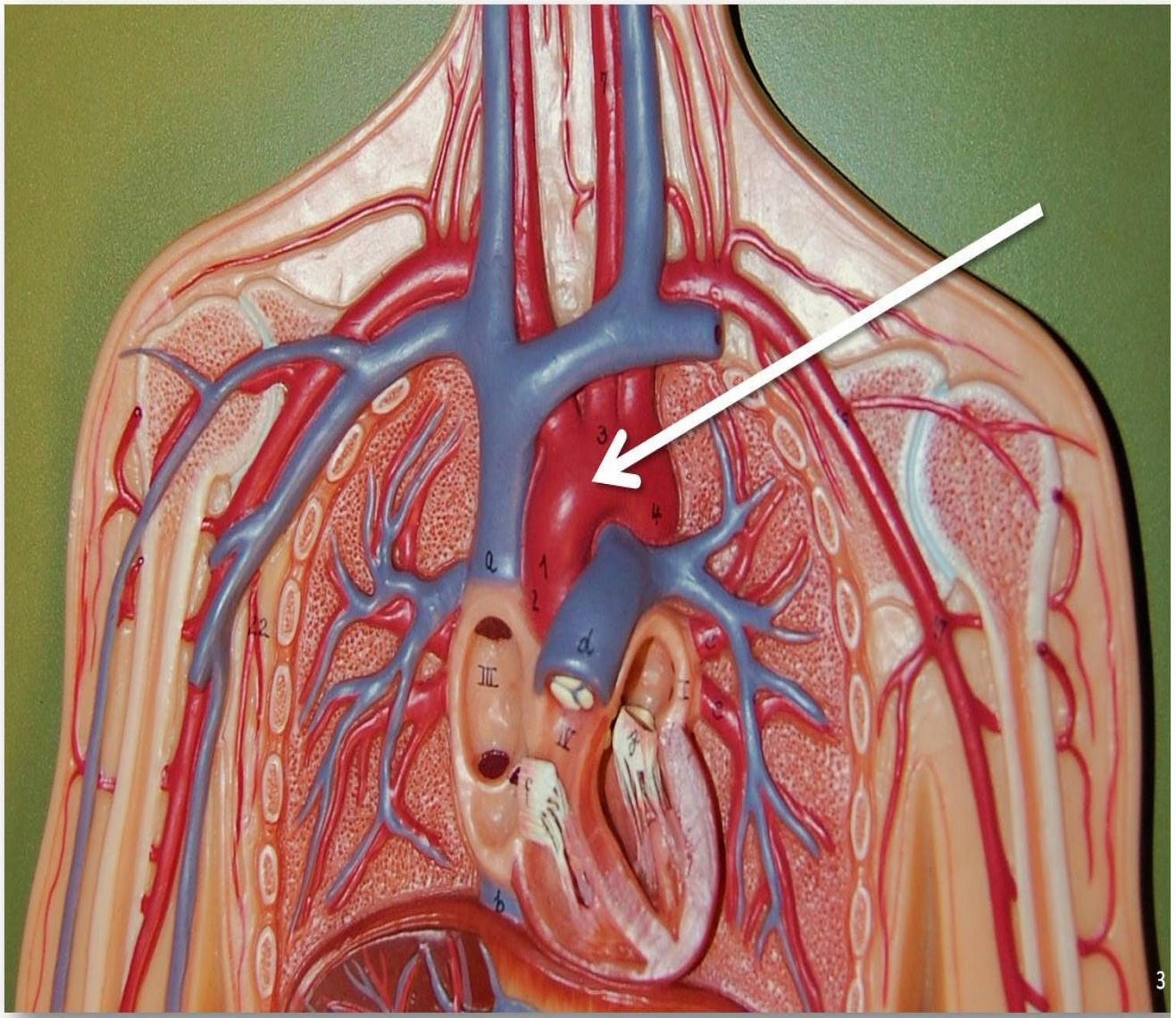


Right Common Carotid Artery



Brachiocephalic Trunk (Innominate Artery)

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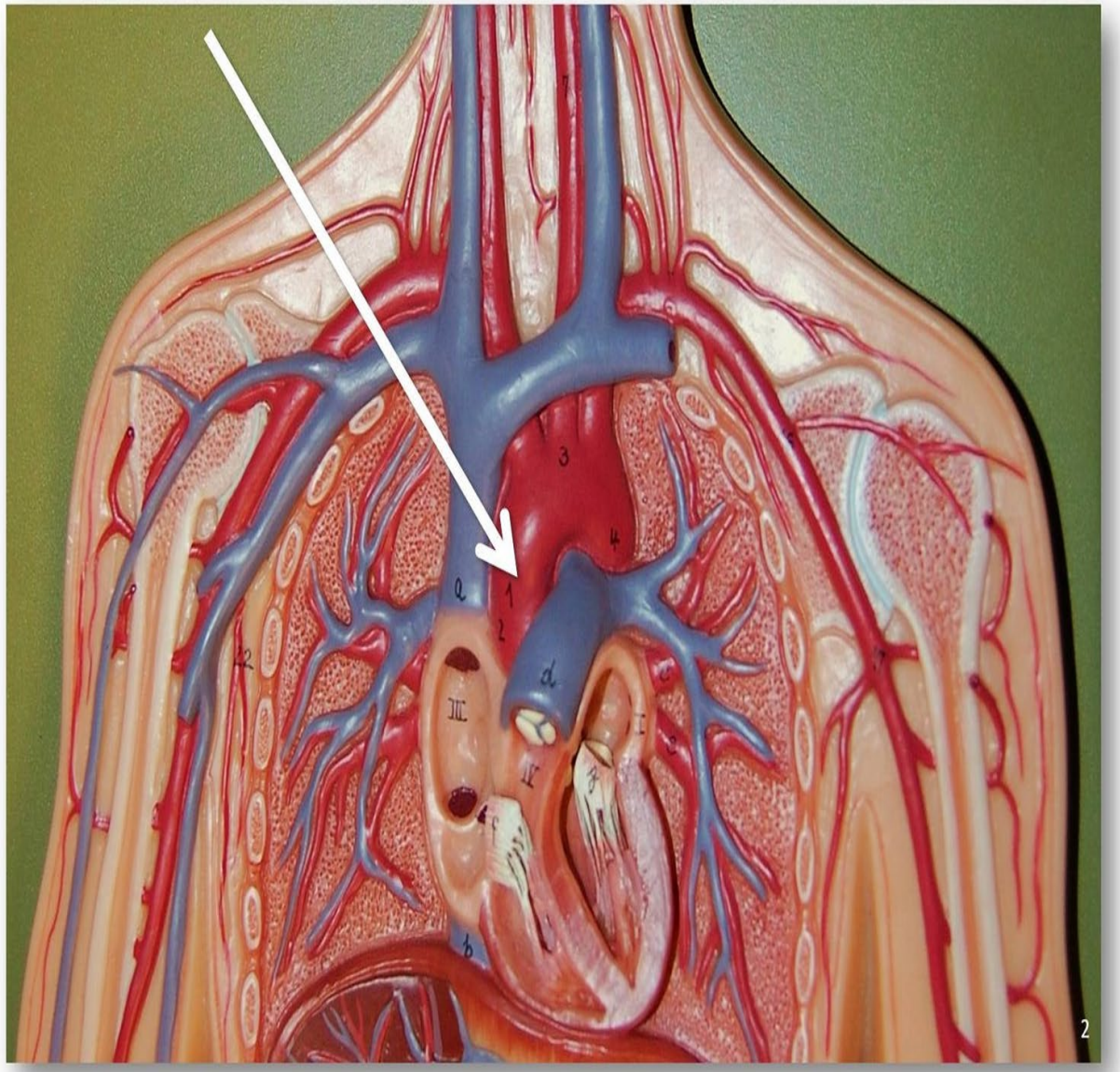
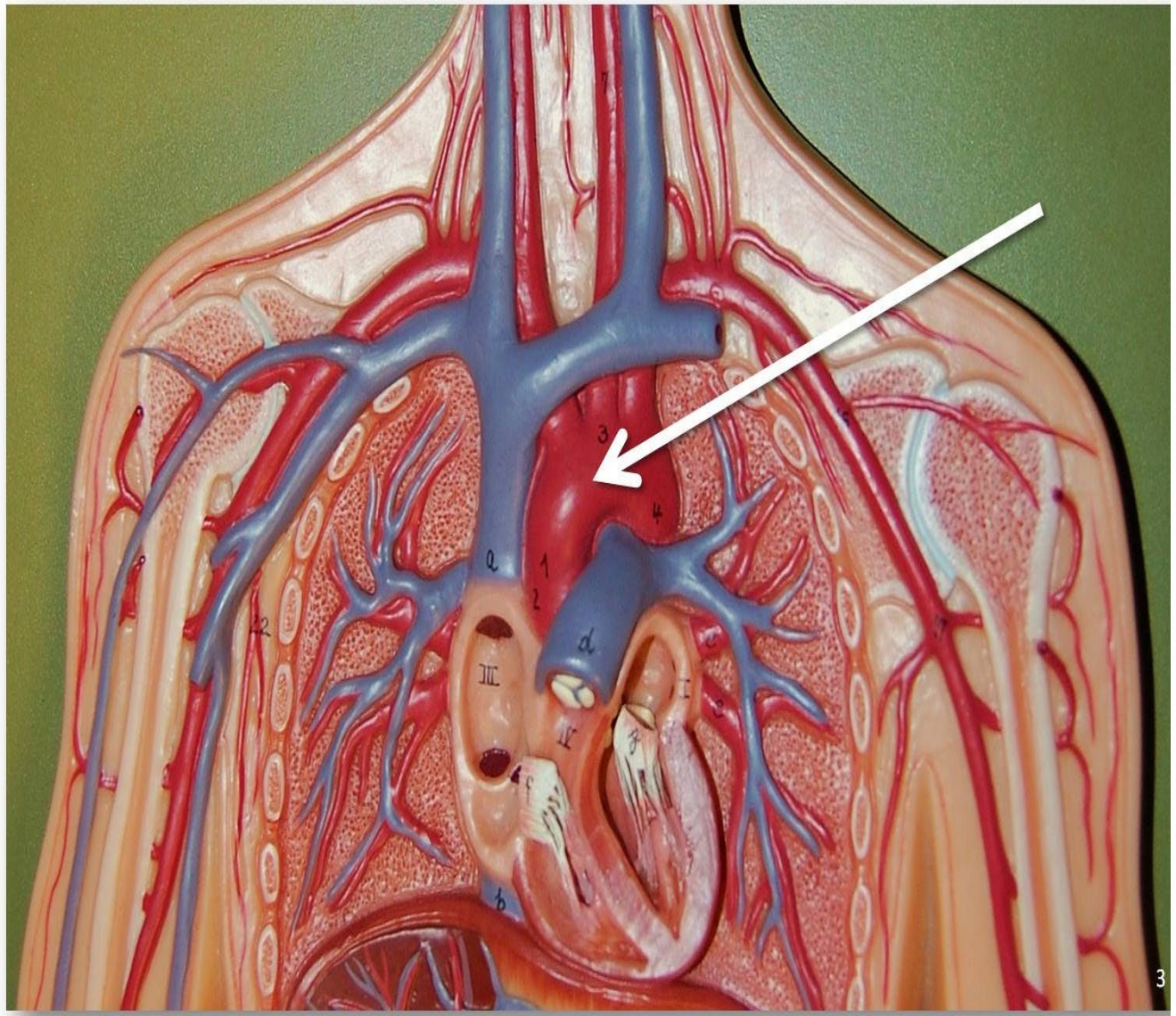
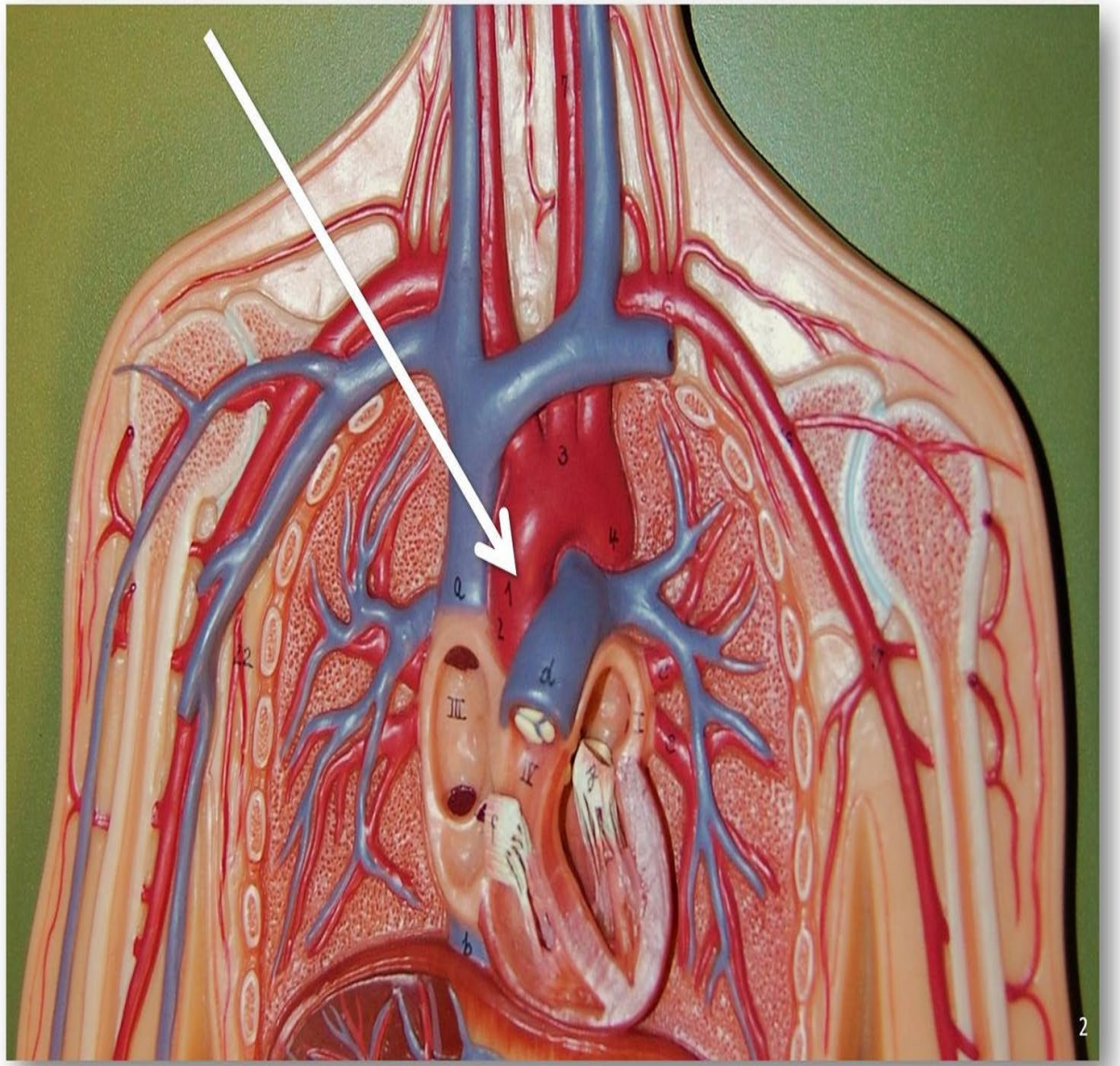
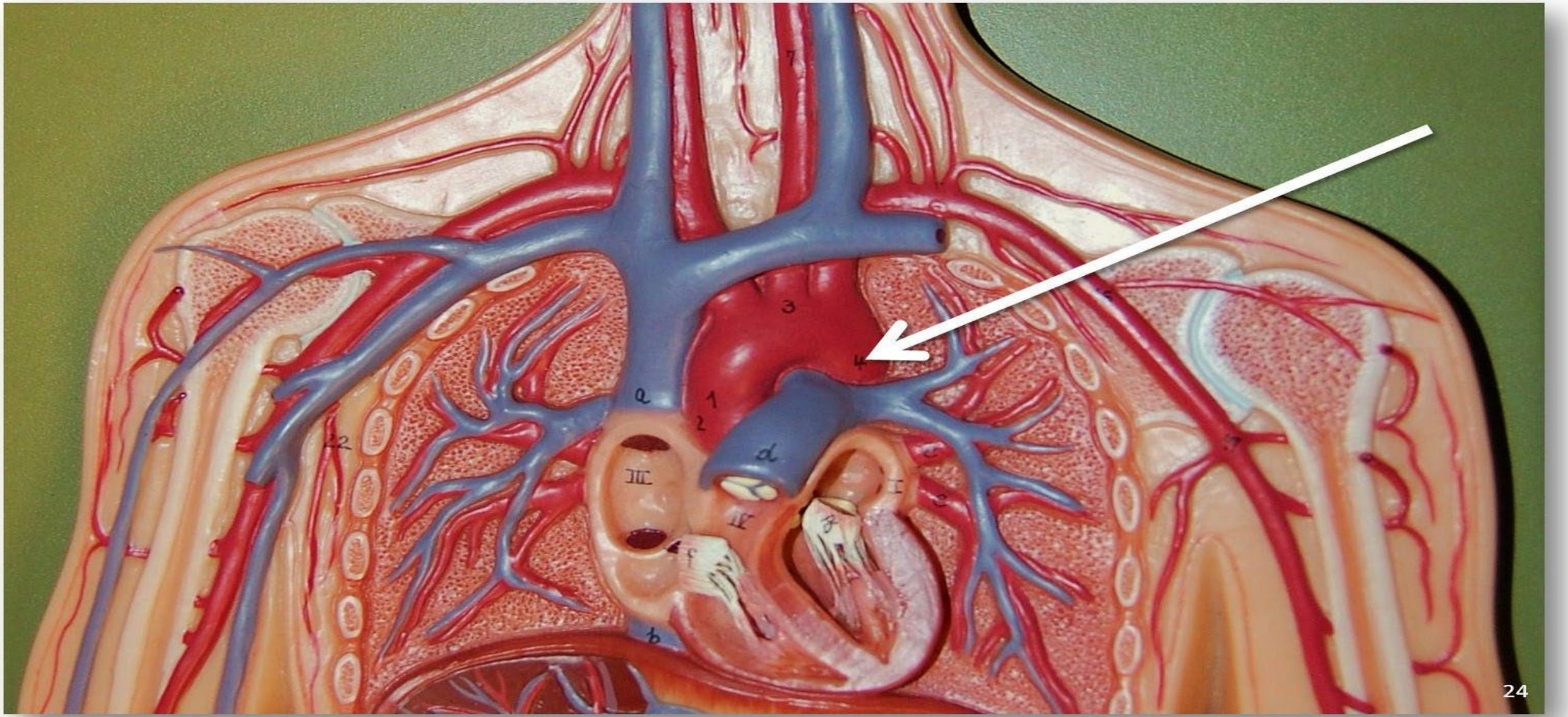

2

Arch of the Aorta

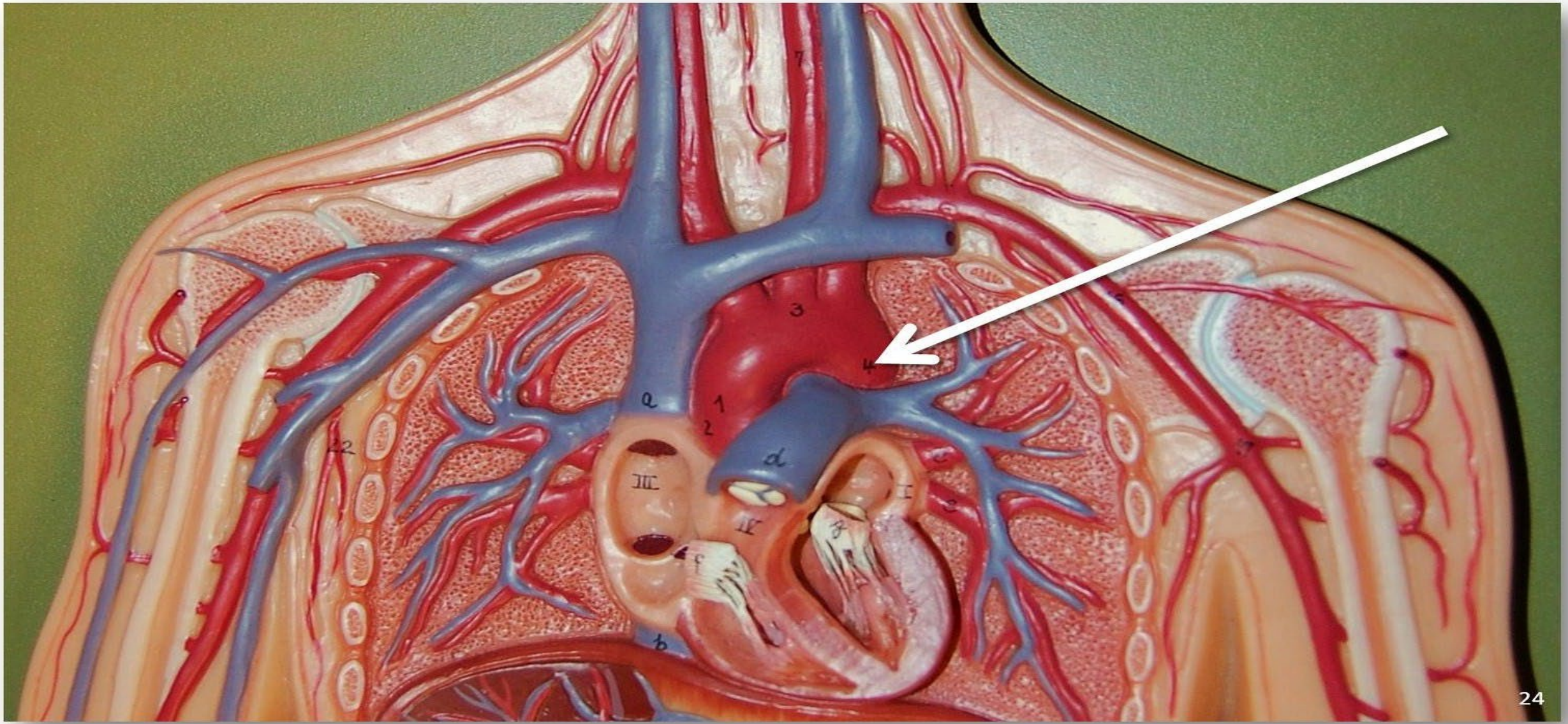


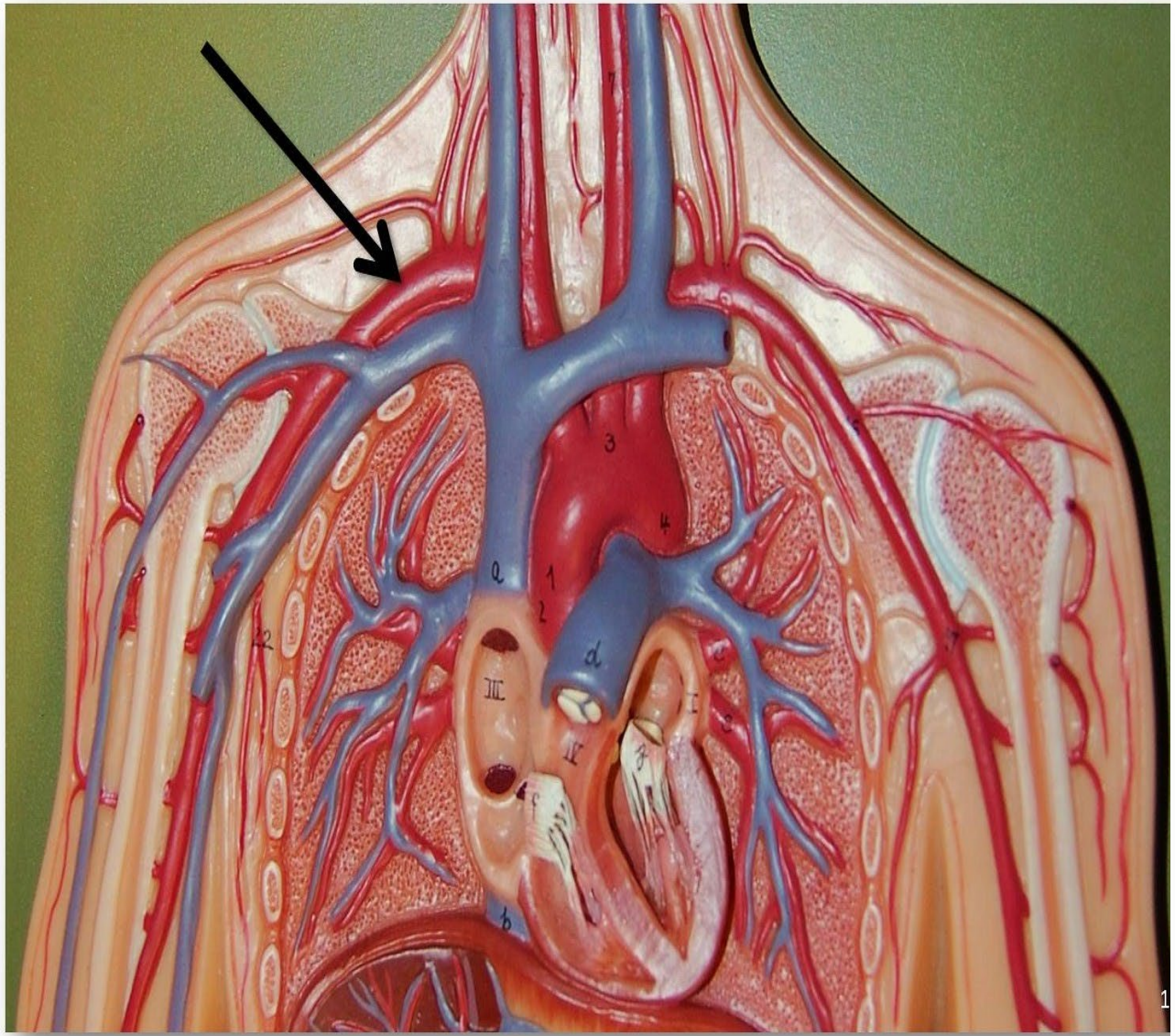
Ascending Aorta

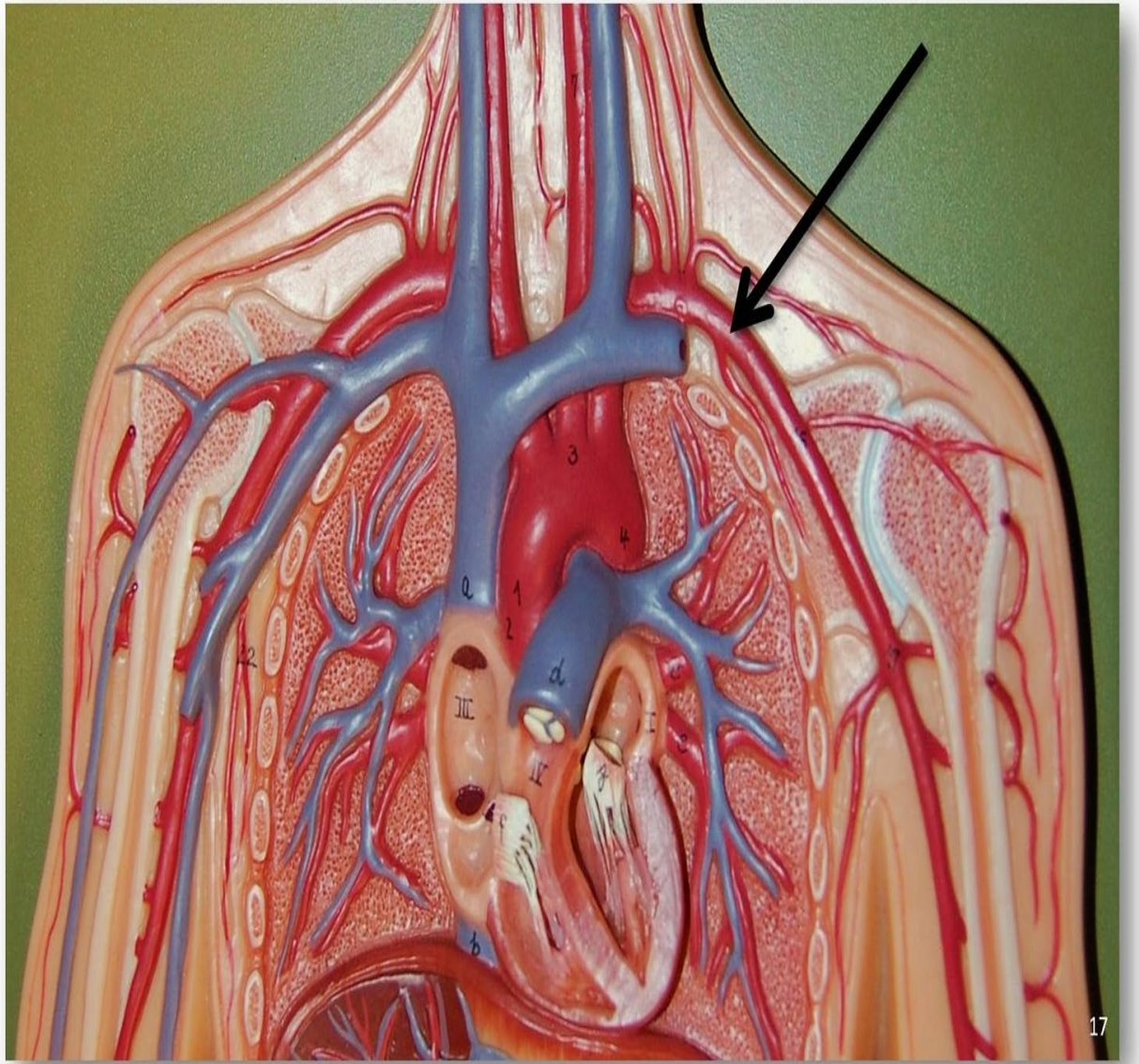



7
3
4
a
1
2
22
d
III
II
I
c
b

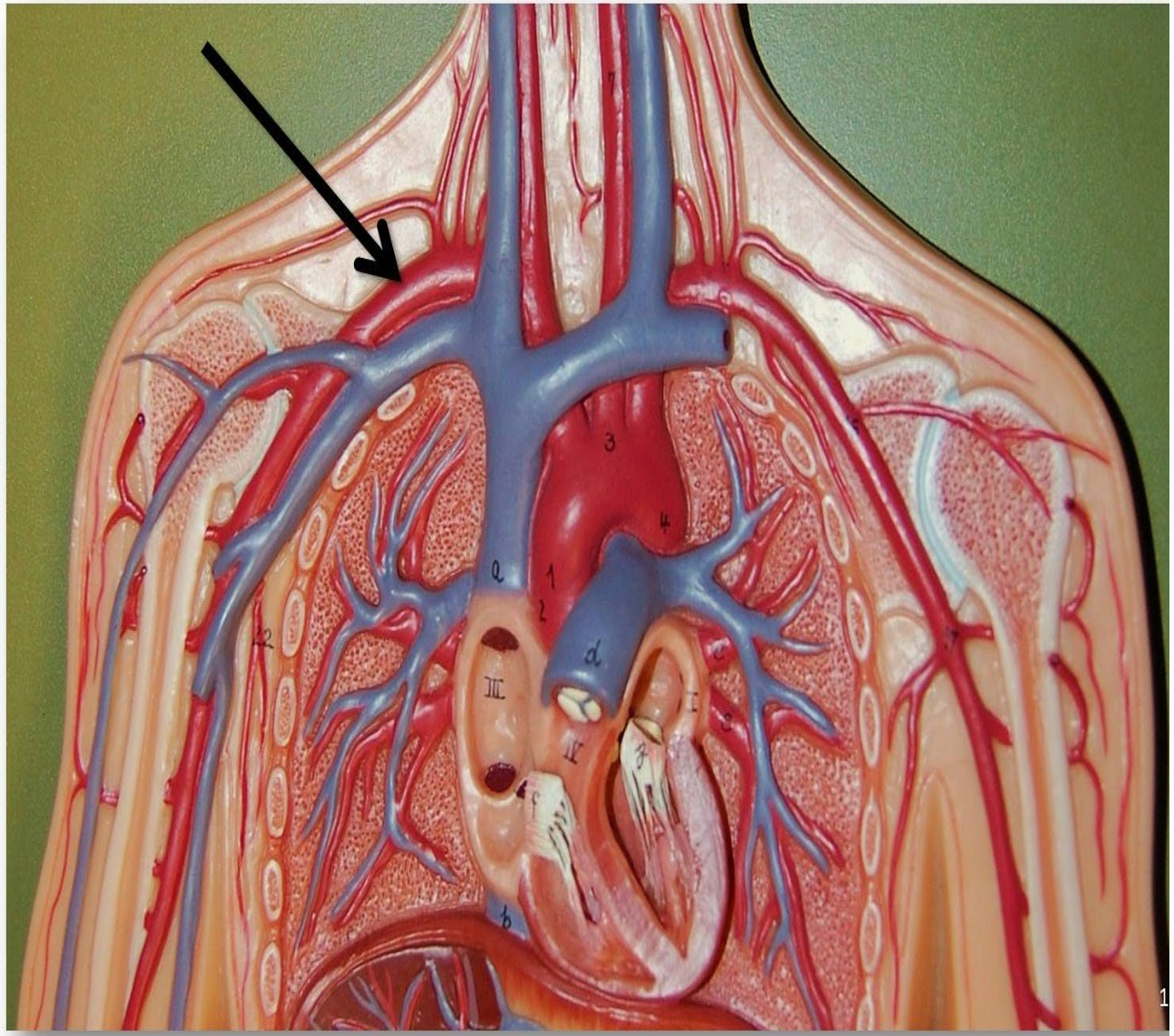
Descending (Thoracic) Aorta



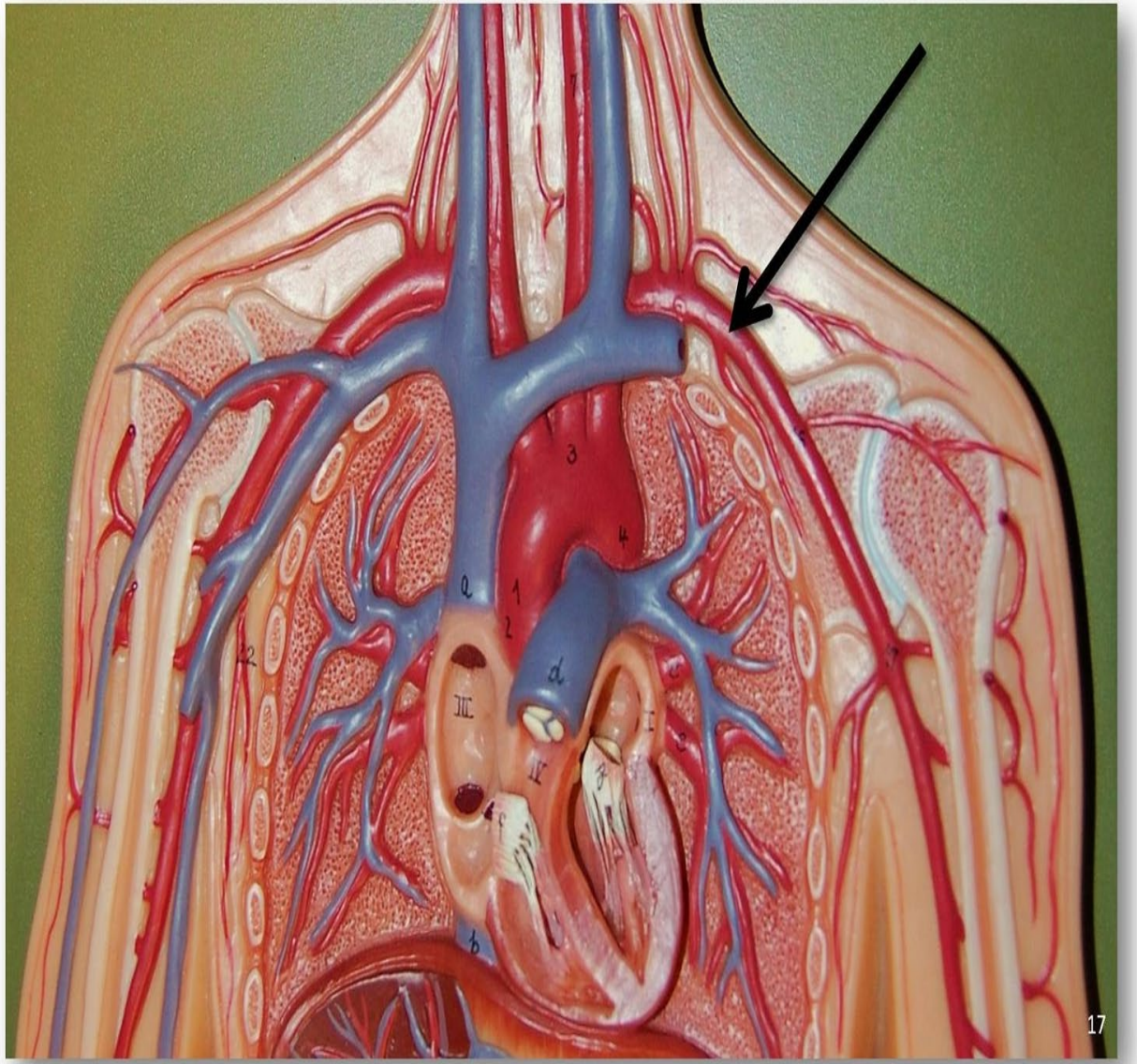


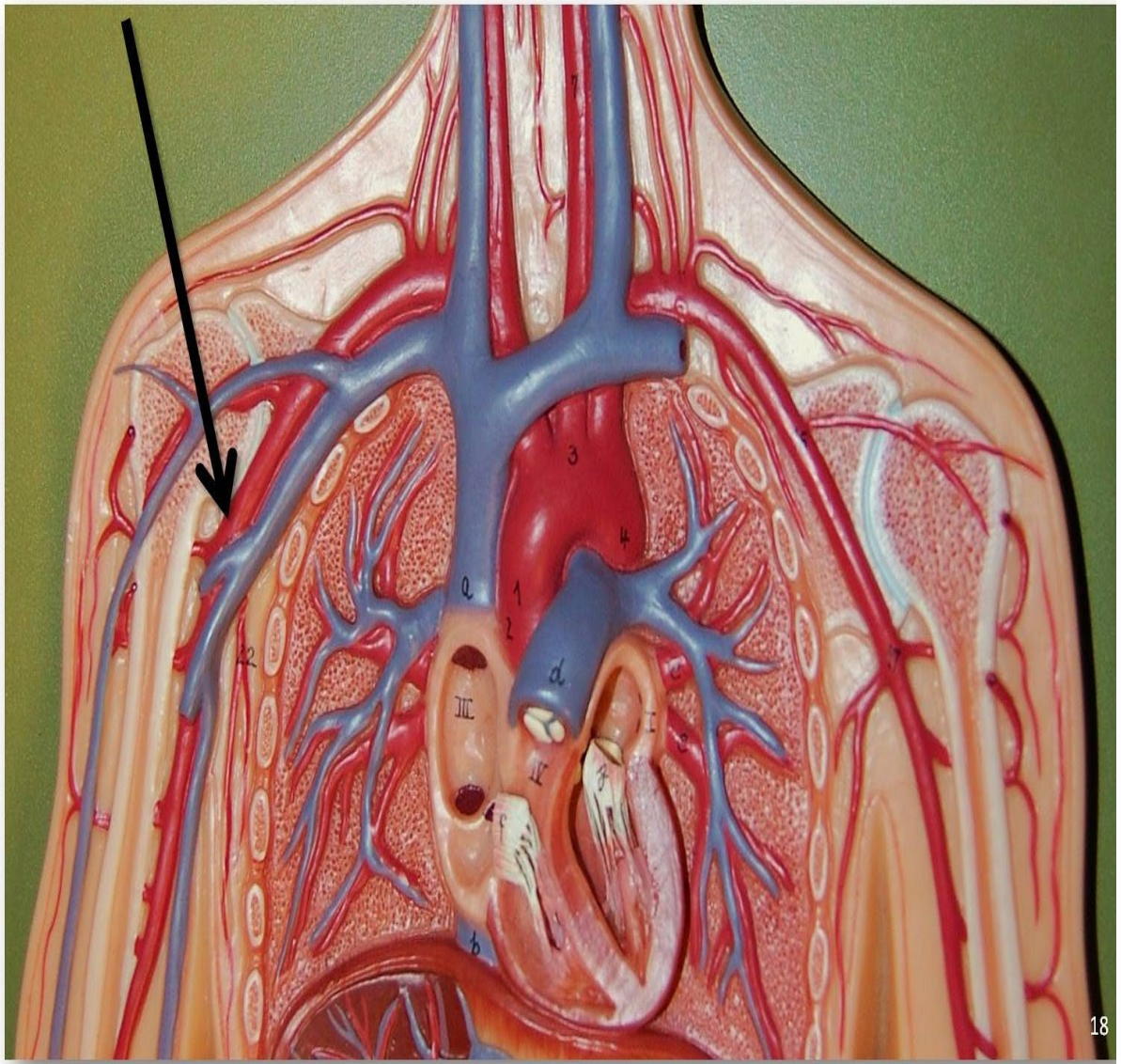


Right Subclavian Artery



Left Subclavian Artery

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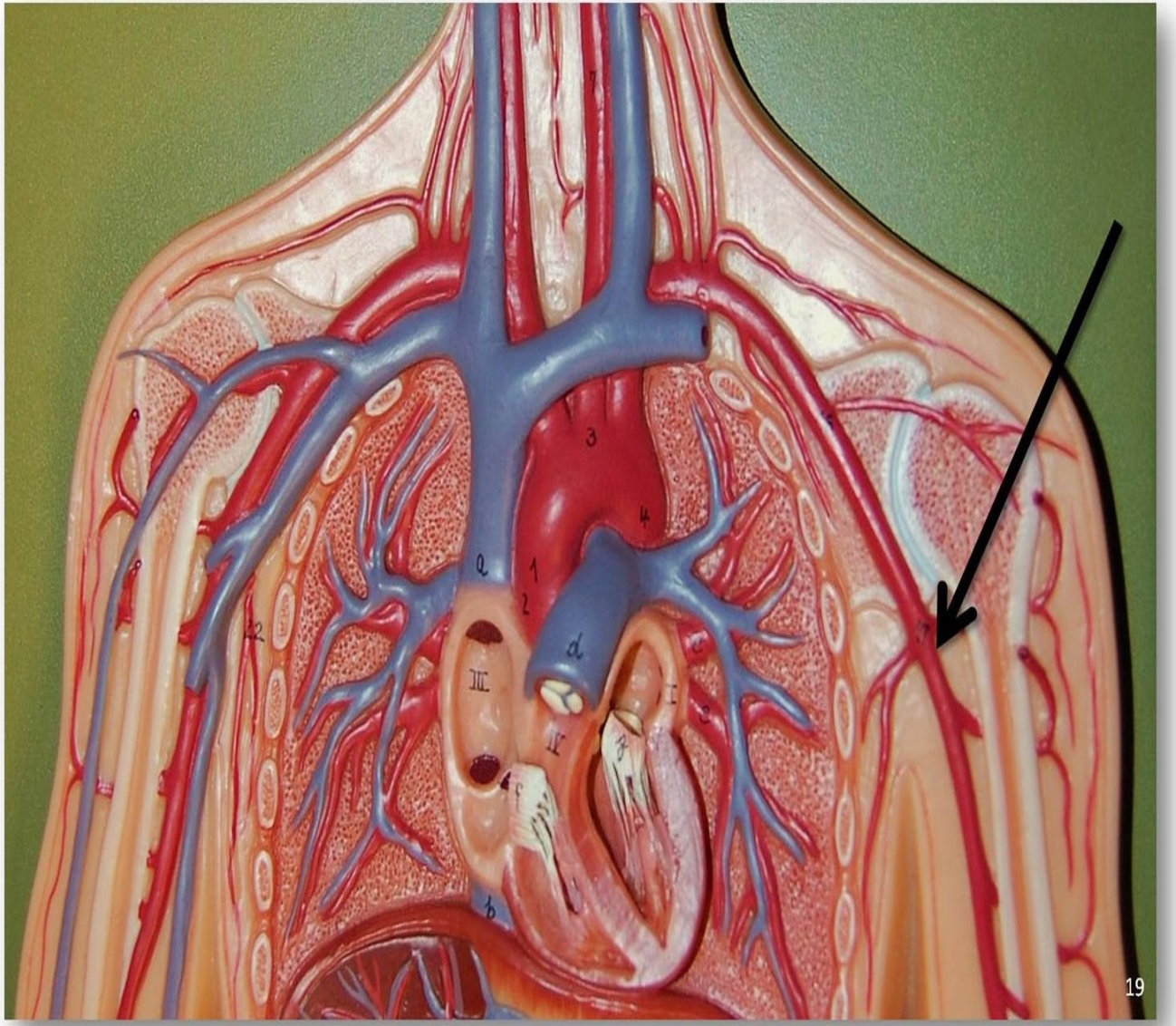
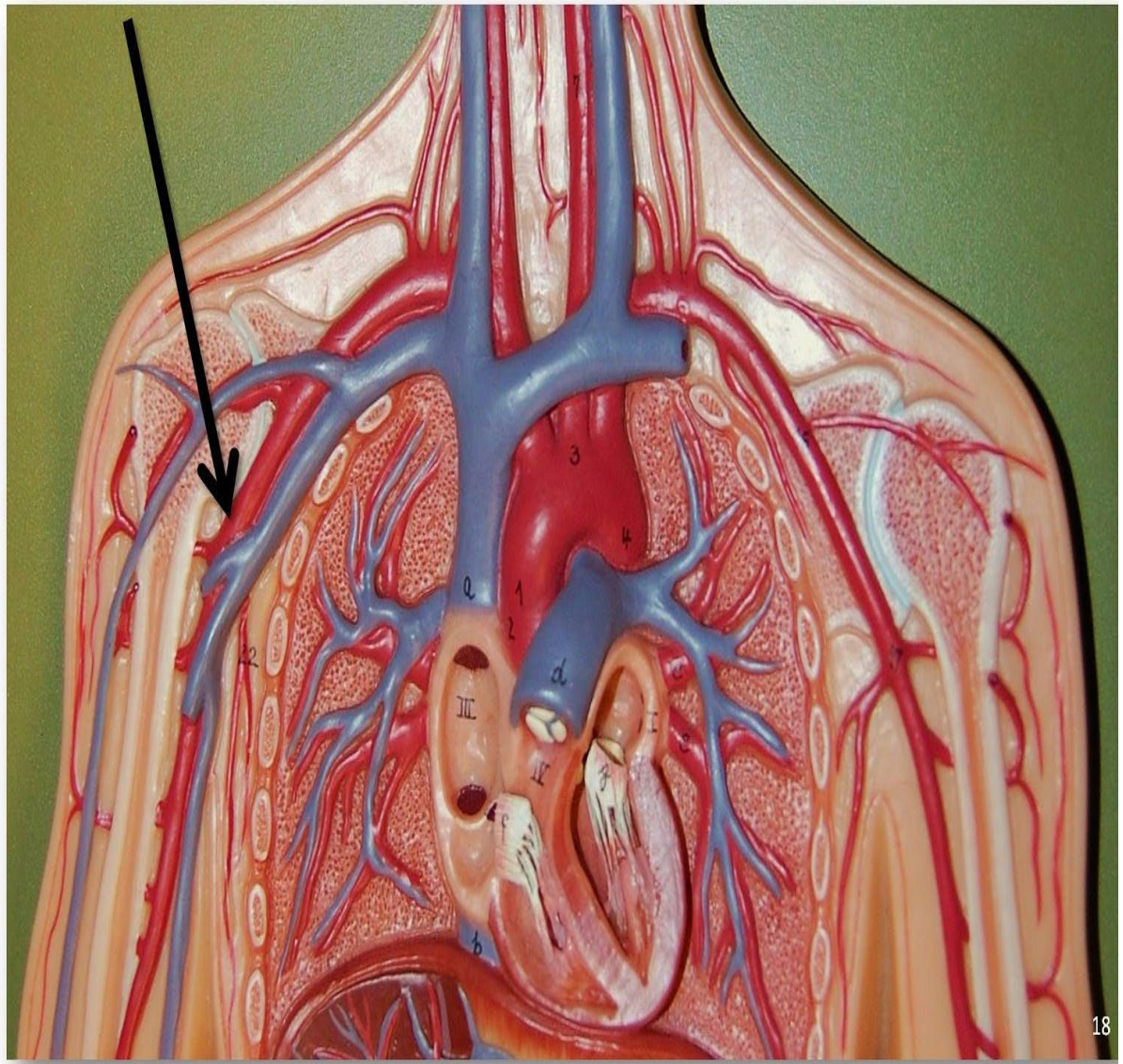
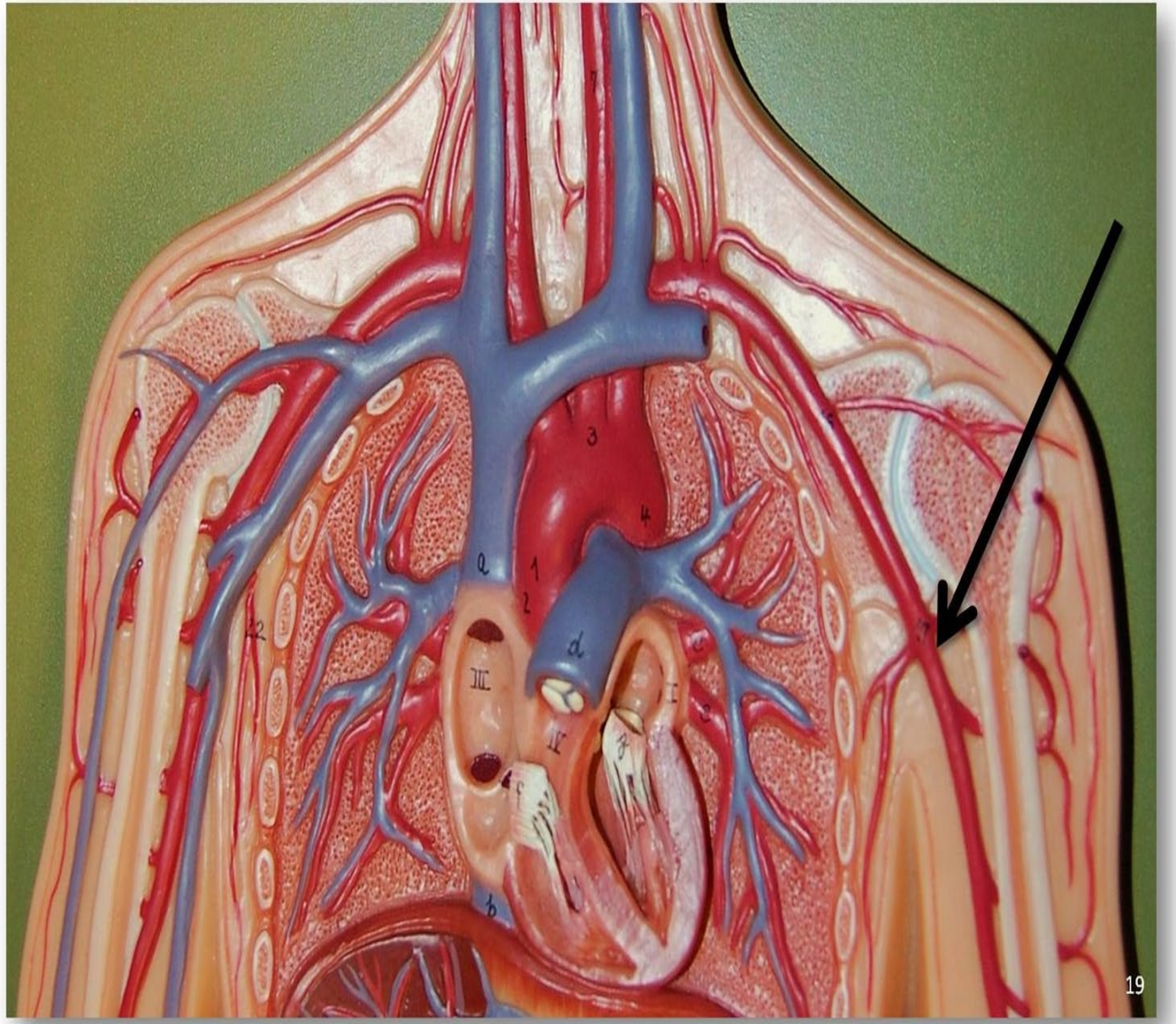
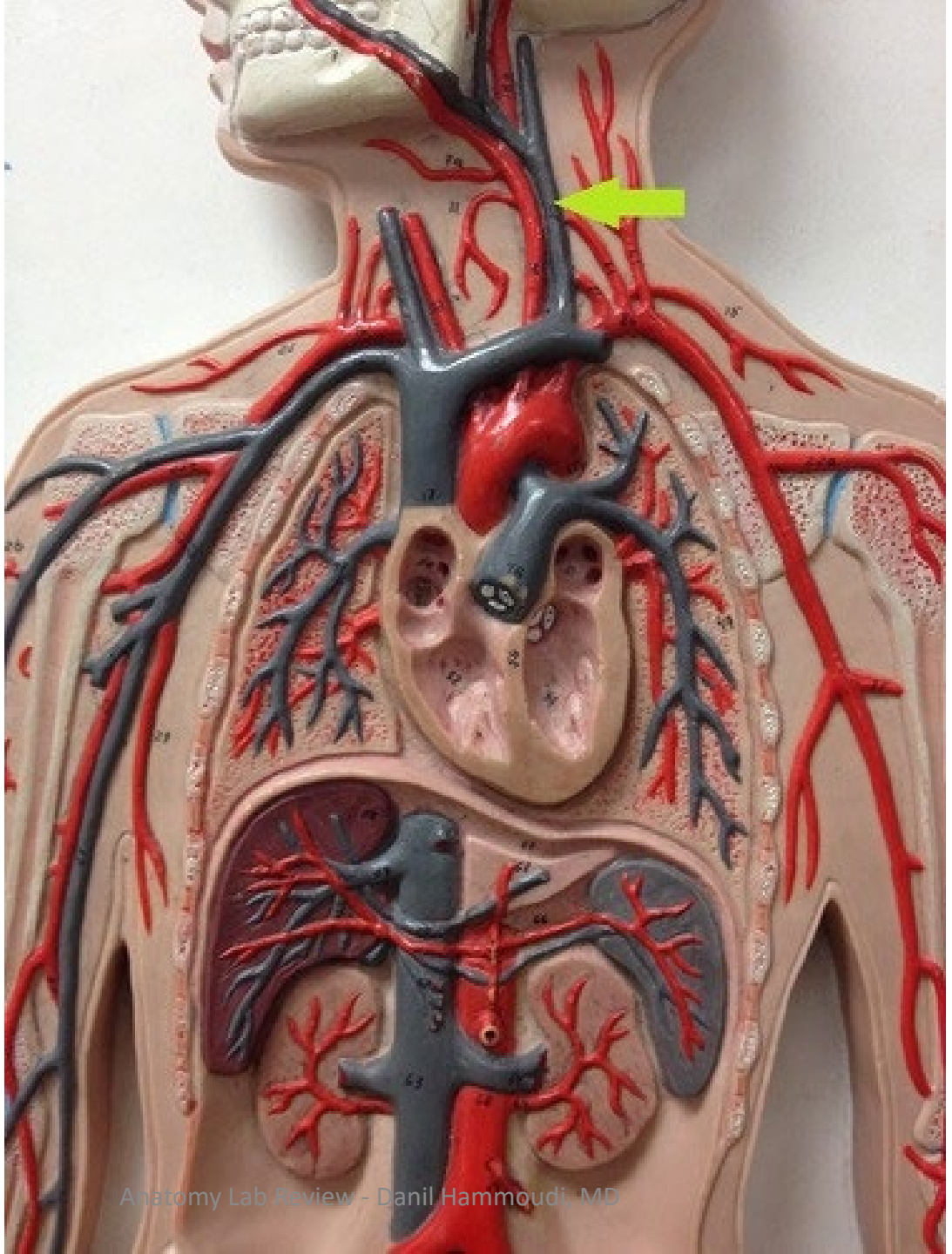

19

Right Axillary Artery

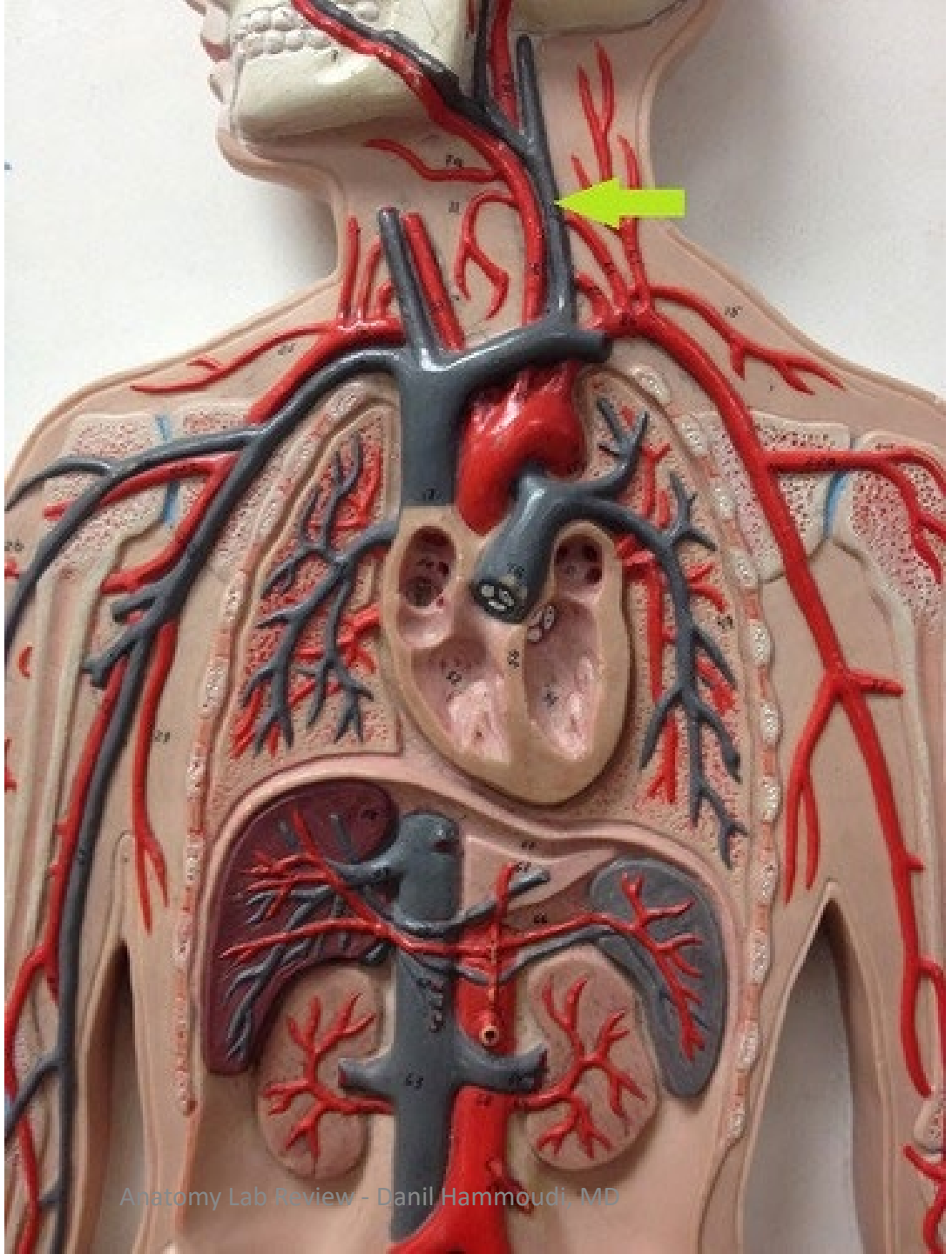


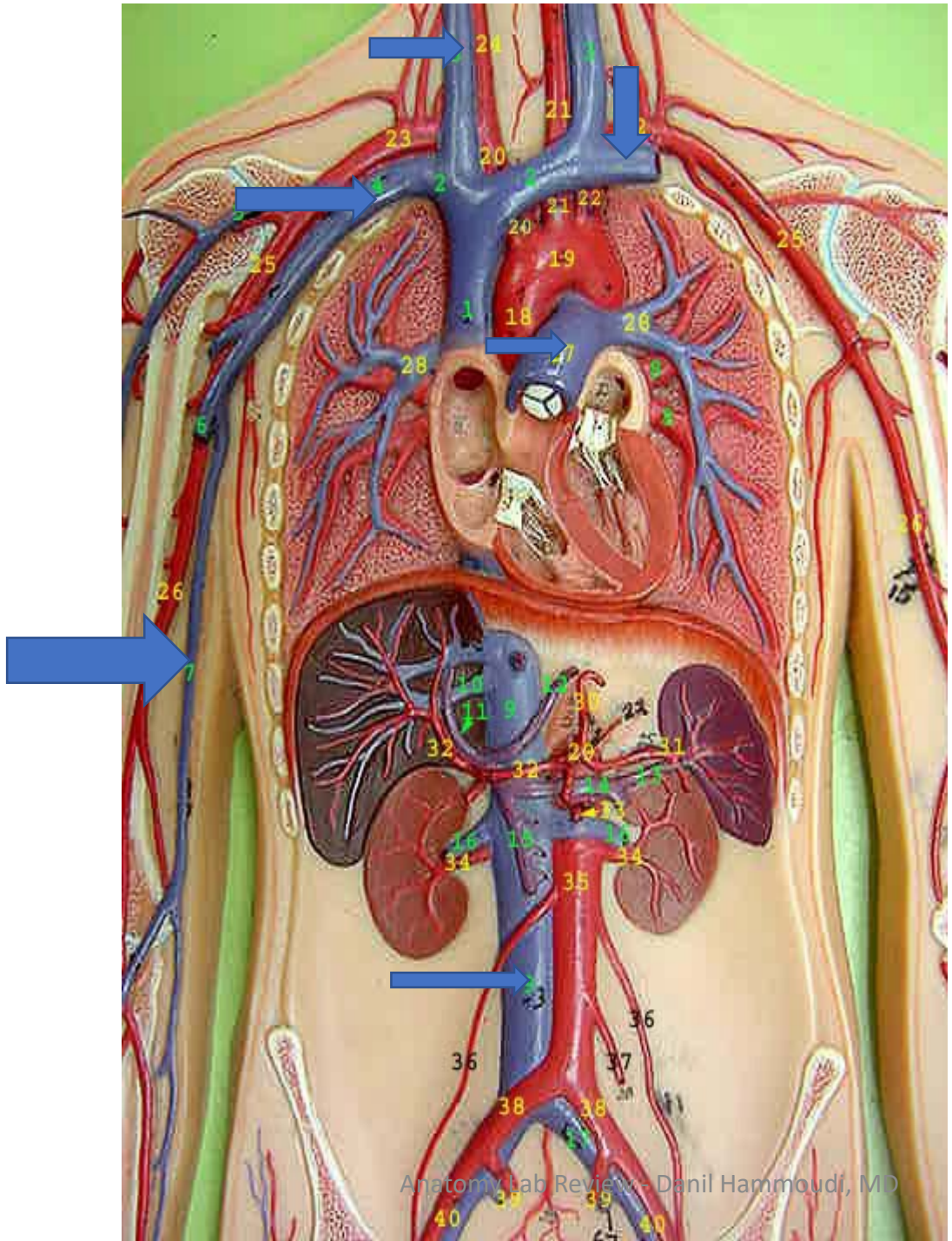
Left Axillary Artery





Internal left jugular vein

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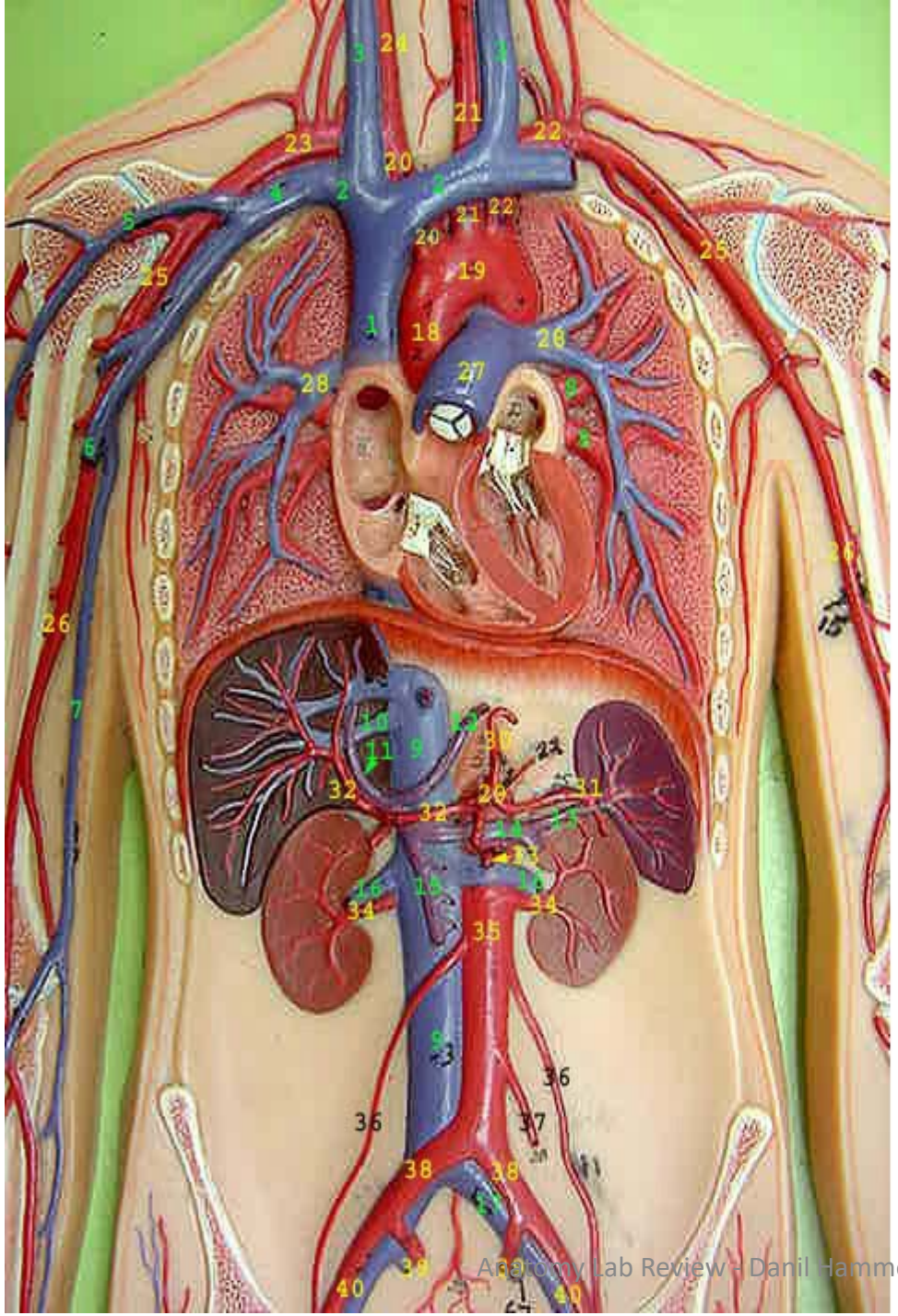
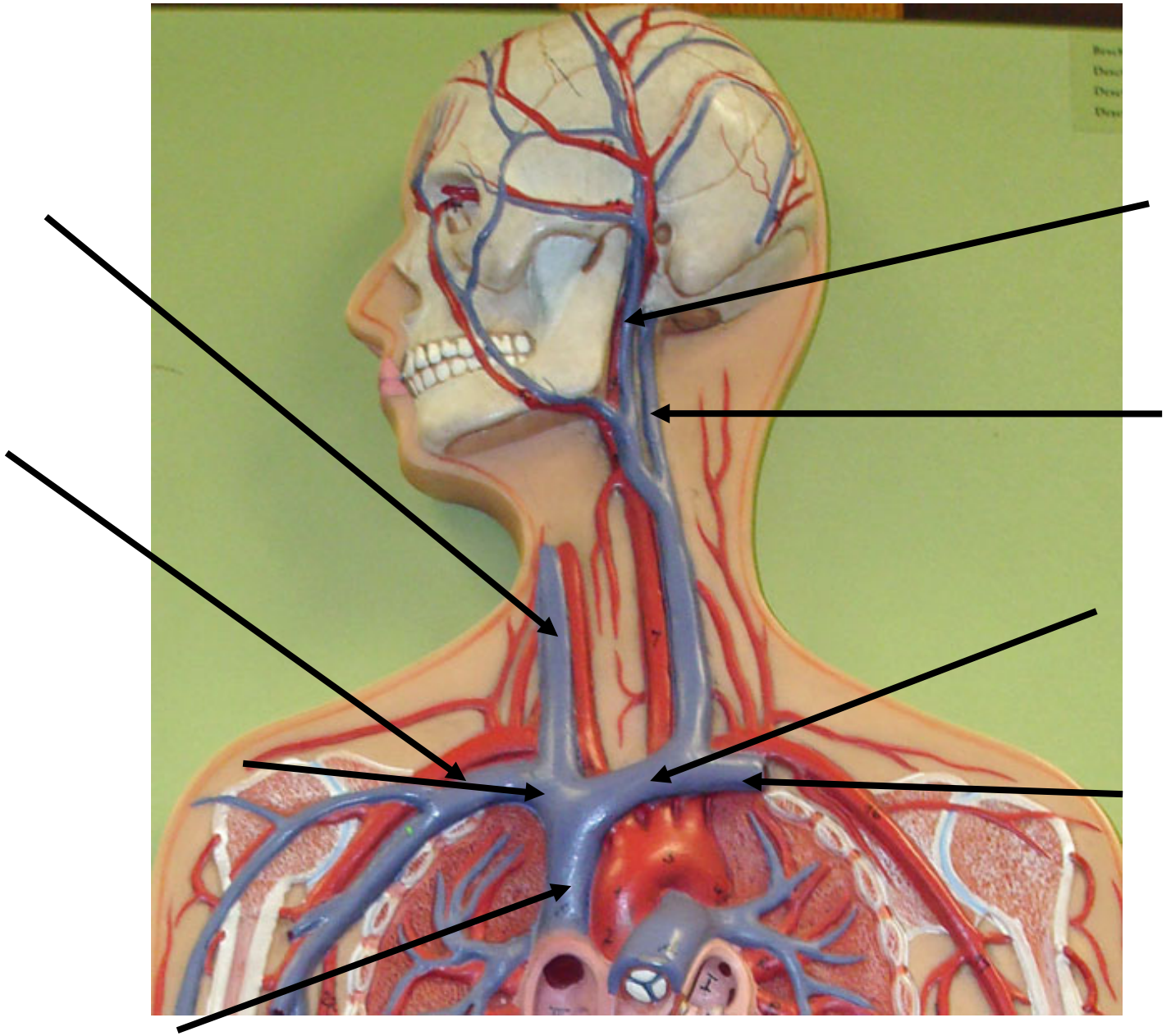
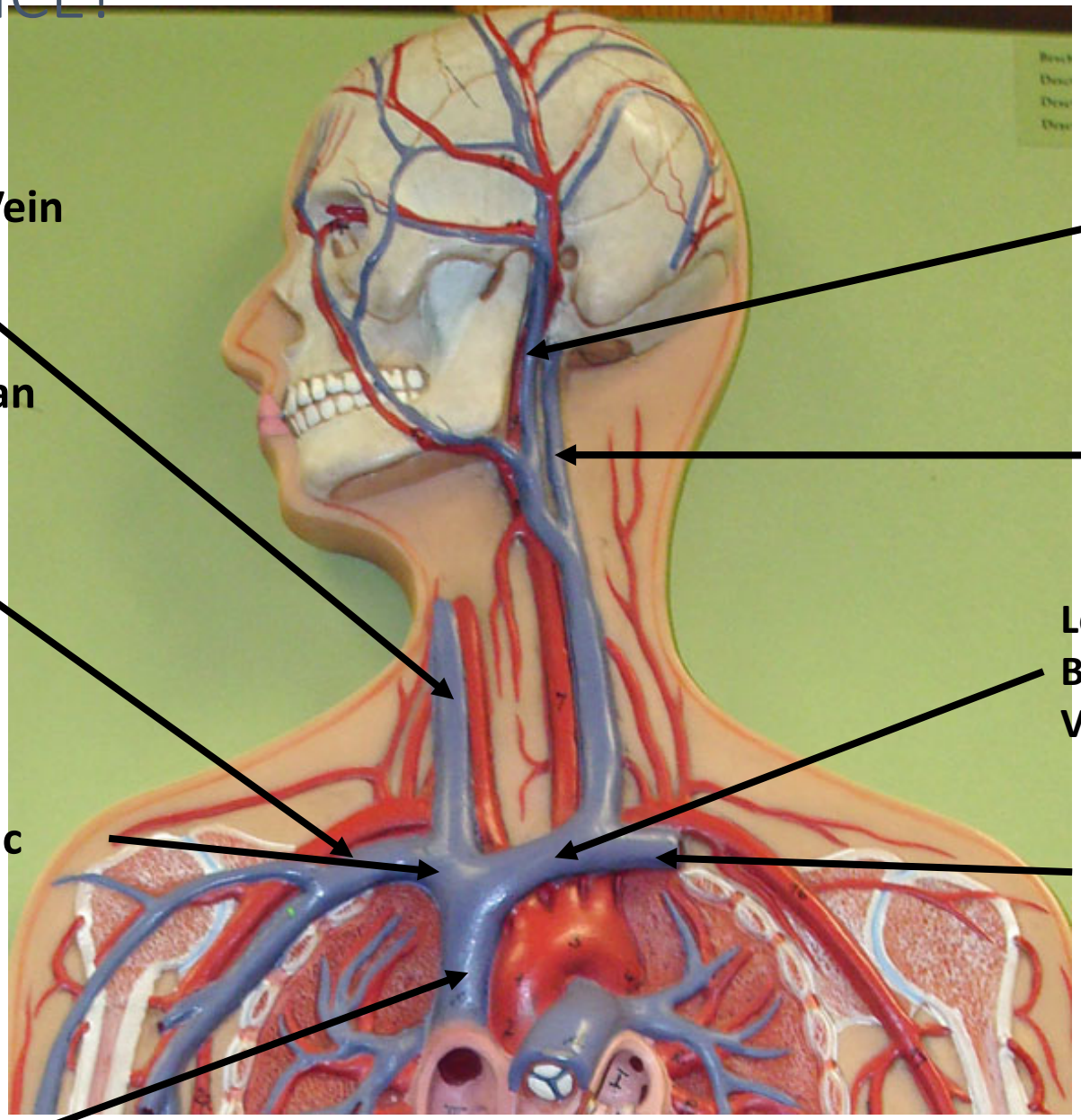


1. SVC
2. Brachiocephalic Vv.
3. Internal Jugular Vv.
4. Subclavian V.
5. Cephalic V.
6. Brachial V.
7. Basilic V.
8. Pulmonary Vv.
9. IVC
10. Hepatic V.
11. Hepatic Portal V.
12. Lt. Gastric V.
13. Splenic V.
14. Inferior Mesenteric V.
15. Superior Mesenteric V.
16. Renal Vv.
17. Common Iliac V.
18. Ascending Aorta
19. Aortic Arch
20. Brachiocephalic A.
21. Left Common Carotid A.
22. Left Subclavian A.
23. Right Subclavian A.
24. Right Common Carotid A.
25. Axillary Aa.
26. Brachial Aa.
27. Pulmonary Trunk
28. Lt. & Rt. Pulmonary Aa.
29. Celiac Trunk
30. Left Gastric A.
31. Splenic A.
32. Common Hepatic A.
33. Superior Mesenteric A.
34. Renal Aa.
35. Abdominal Aorta
36. Gonadal (Testicular/Ovarian) Aa.
37. Inferior Mesenteric A.
38. Common Iliac Aa.
39. Internal Iliac A&V
40. External Iliac A&V



PRACTICE!



Right Jugular Vein

External Jugular Vein

Right Subclavian Vein

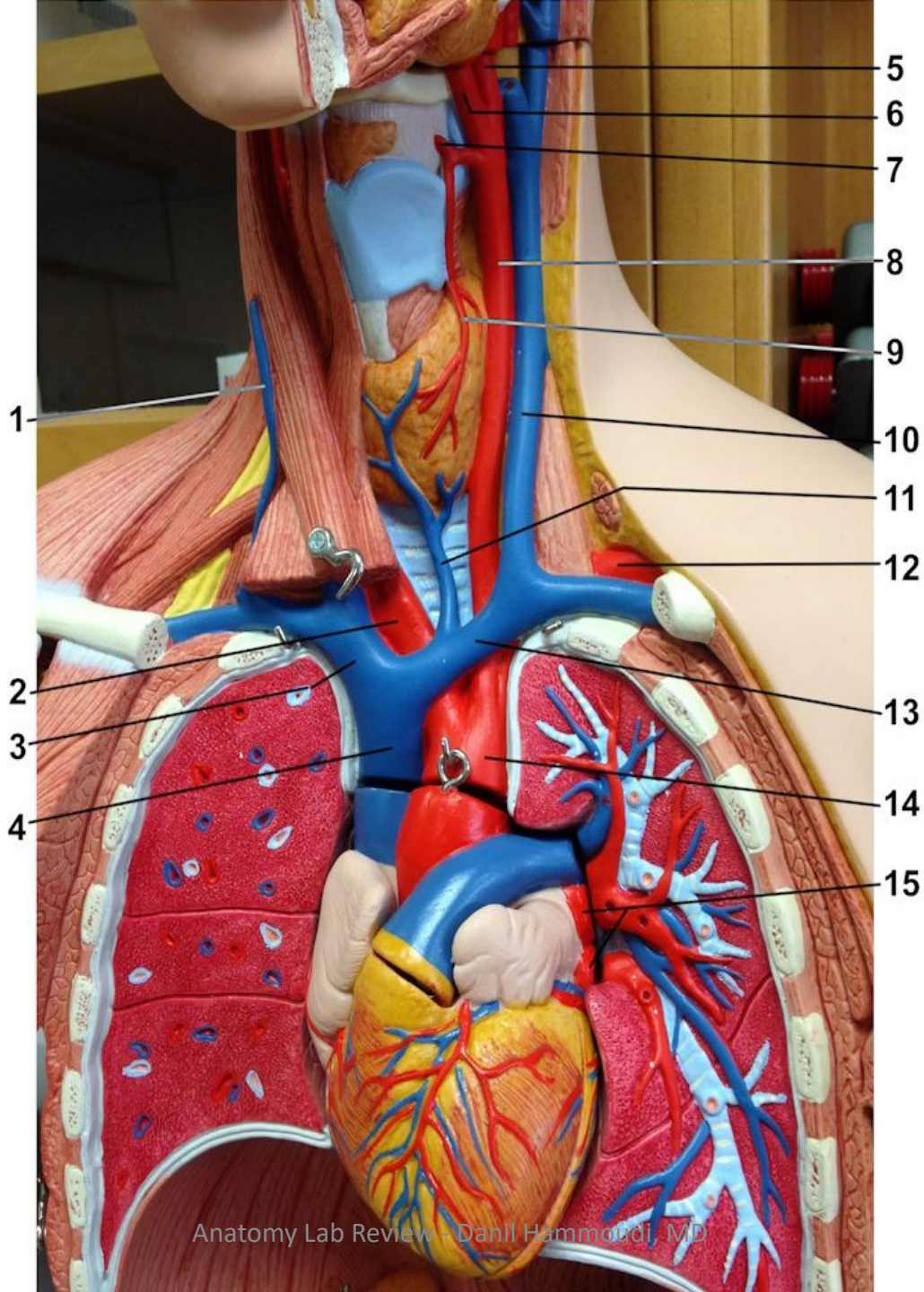
Internal Jugular Vein

Left Brachiocephalic Vein

Right Brachiocephalic Vein

Left Subclavian Vein

Superior Vena Cava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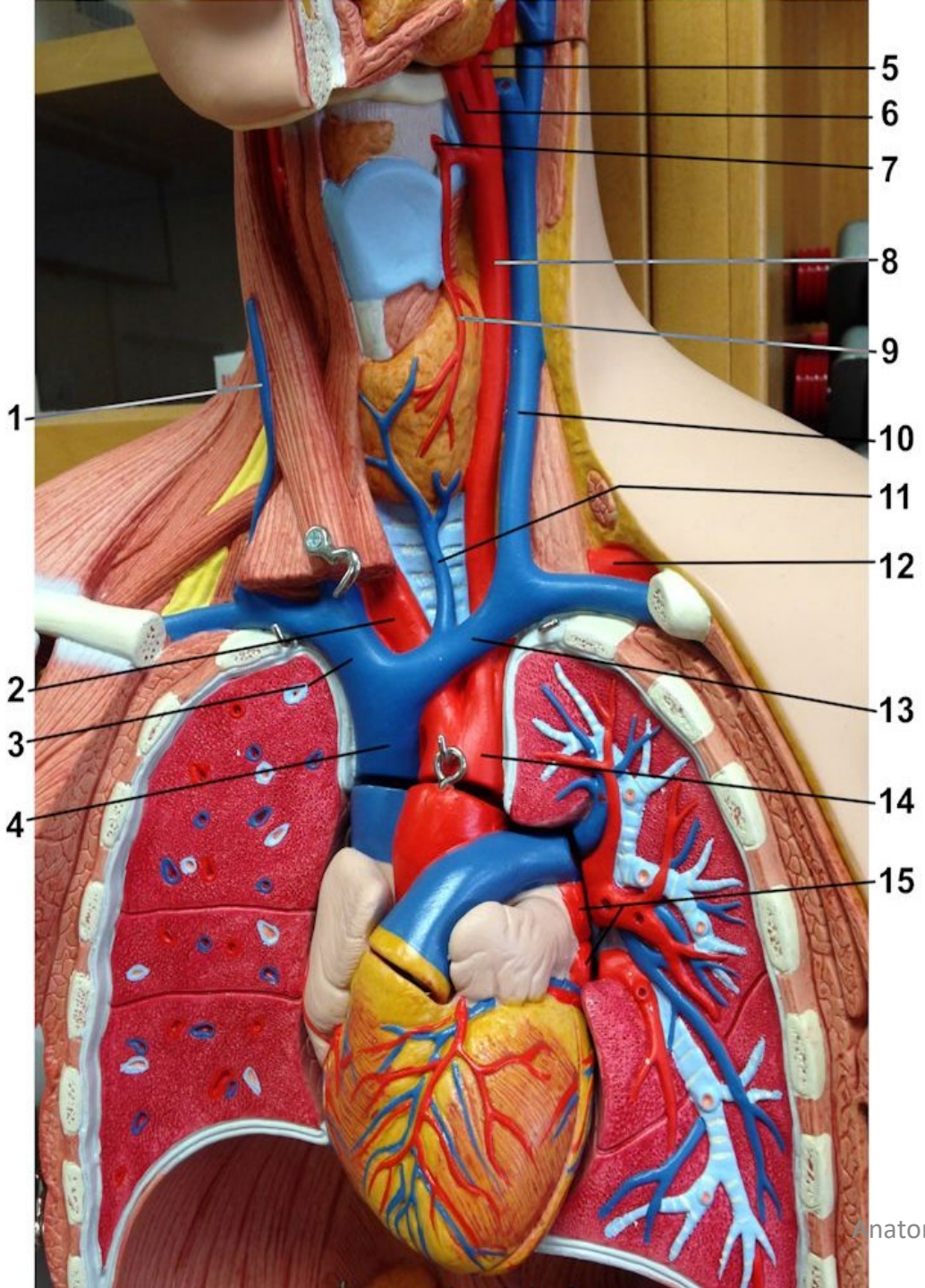
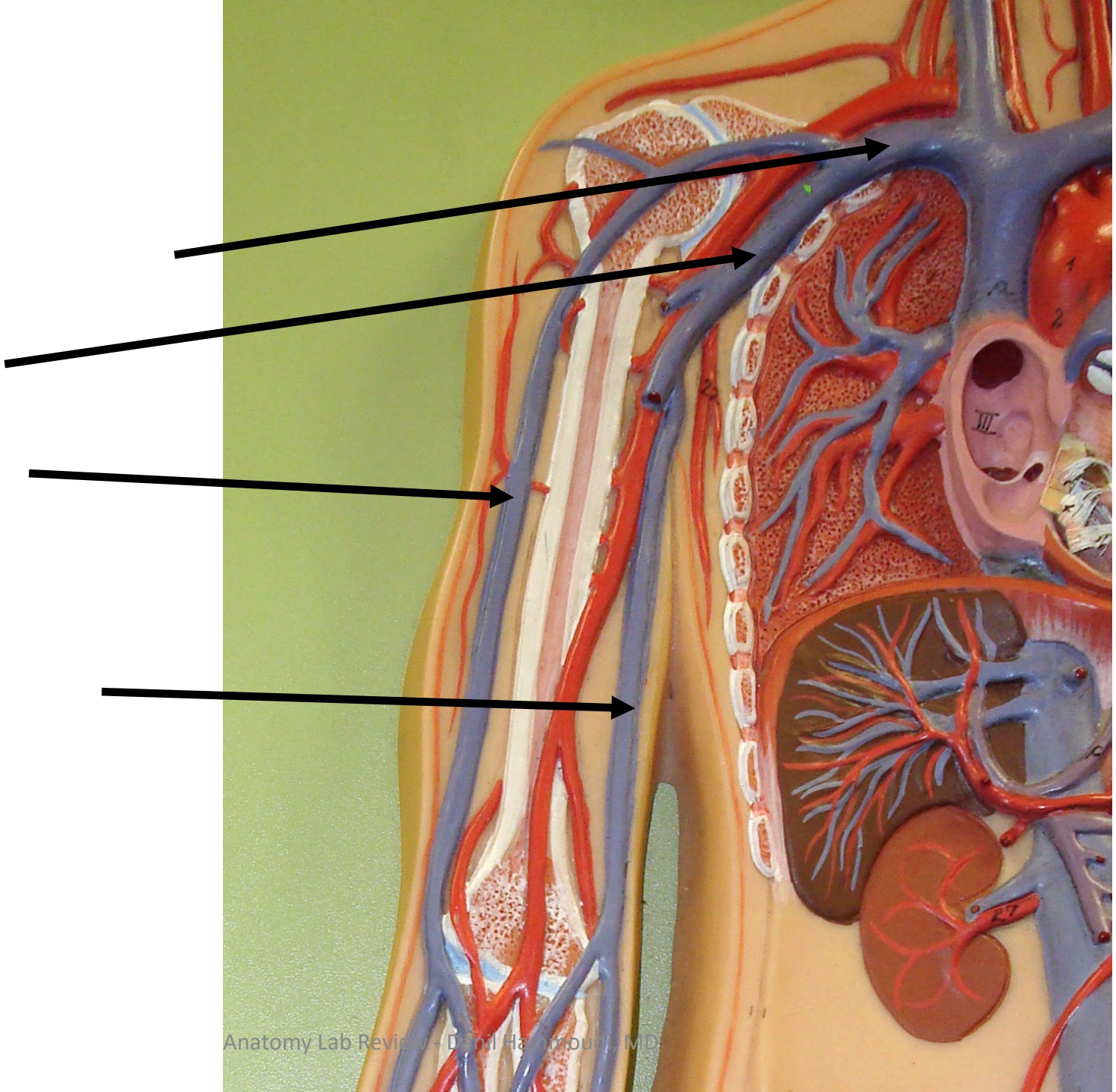
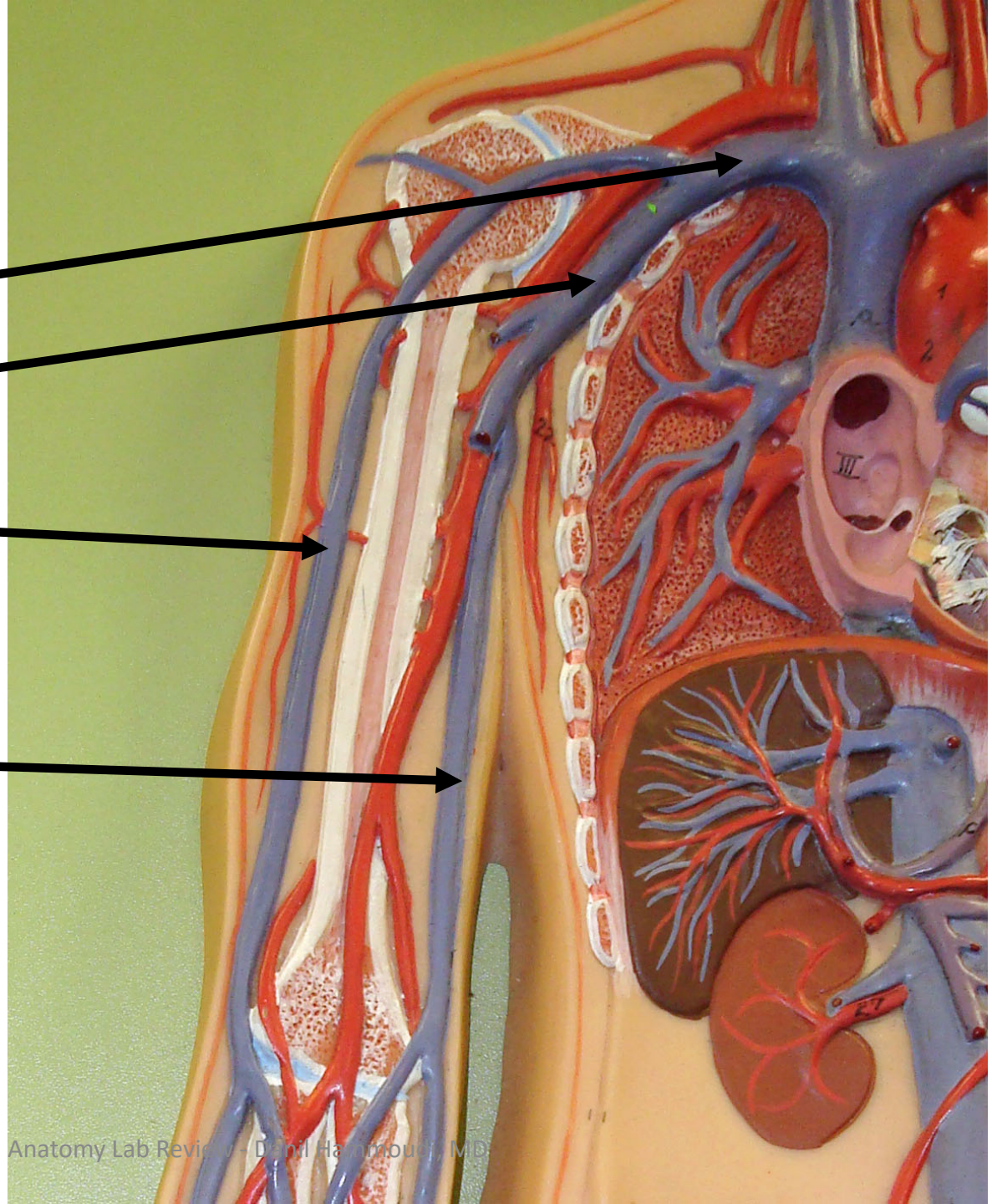
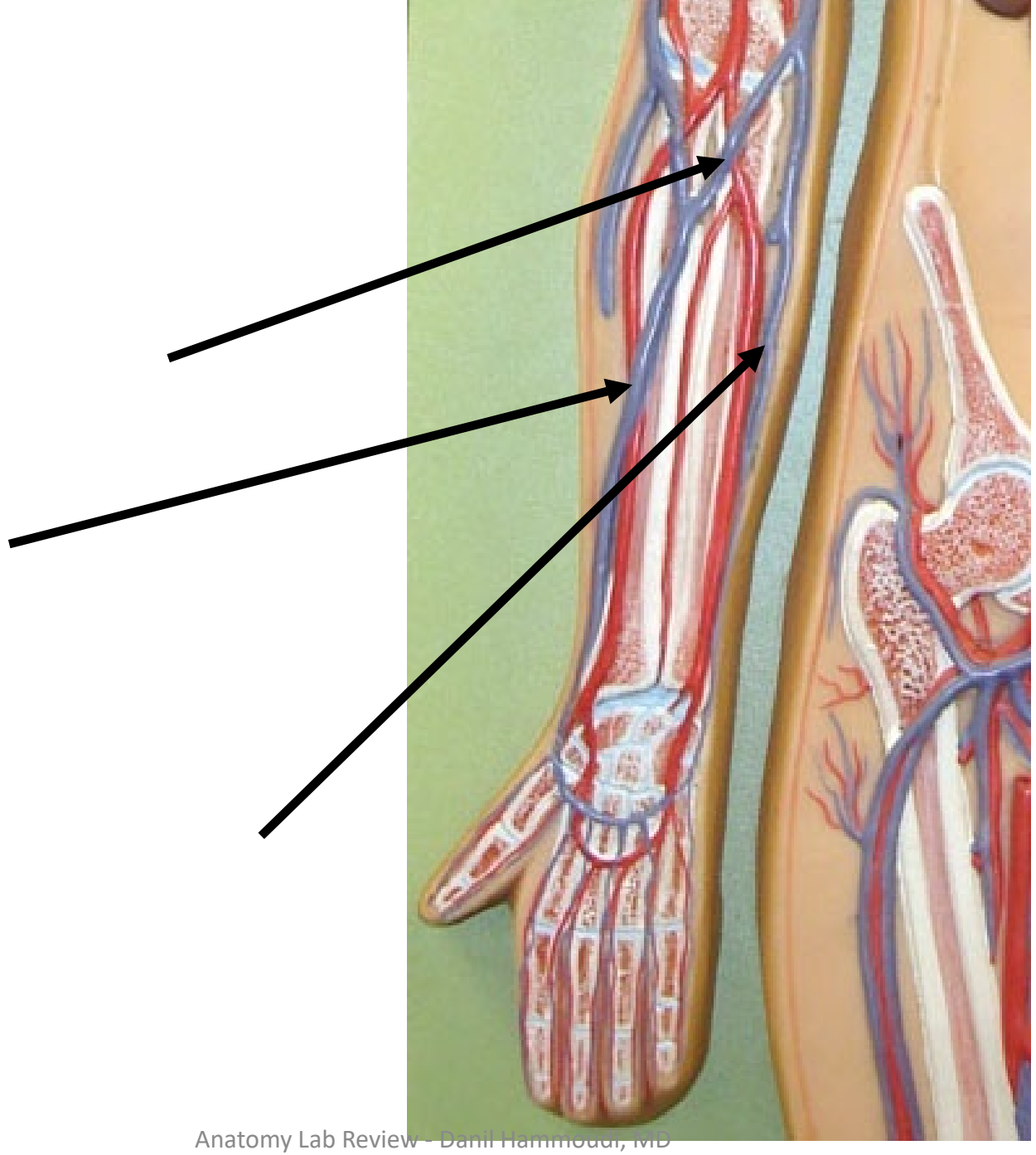


1.External jugular v.
2.Brachiocephalic trunk
3.Right brachiocephalic v.
4.Superior vena cava
5.External carotid a.
6.Internal carotid a.
7.Superior laryngeal a.
8.Left common carotid a.
9.Superior thyroid a.
10.Internal jugular v.
11.Inferior thyroid v.
12.Left subclavian a.
13.Left brachiocephalic v.
14.Aortic arch
15.Left pulmonary veins



PRACTICE!


RIGHT Subclavian Vein
Axillary Vein
Cephalic Vein
Basilic Vein

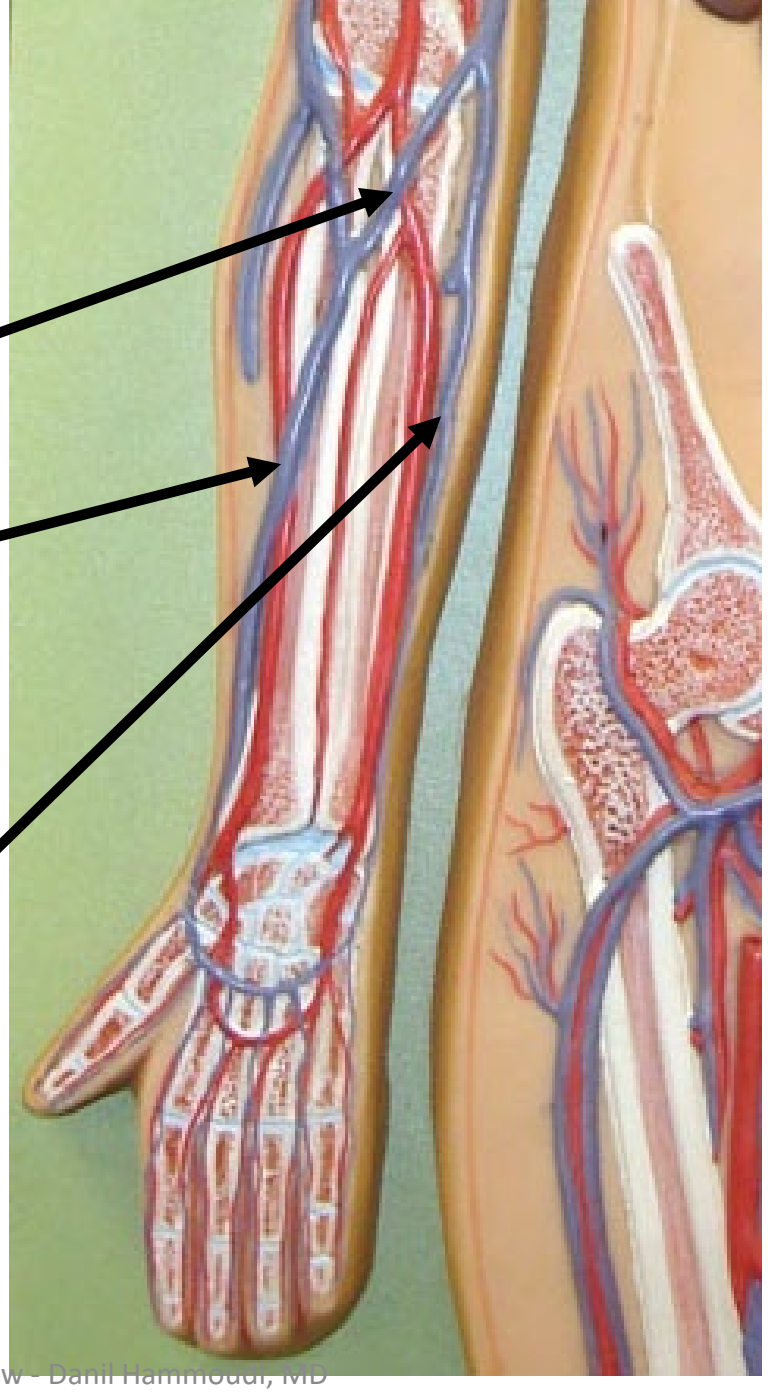


PRACTICE!

Median Cubital Vein

Cephalic Vein

Basilic Vein



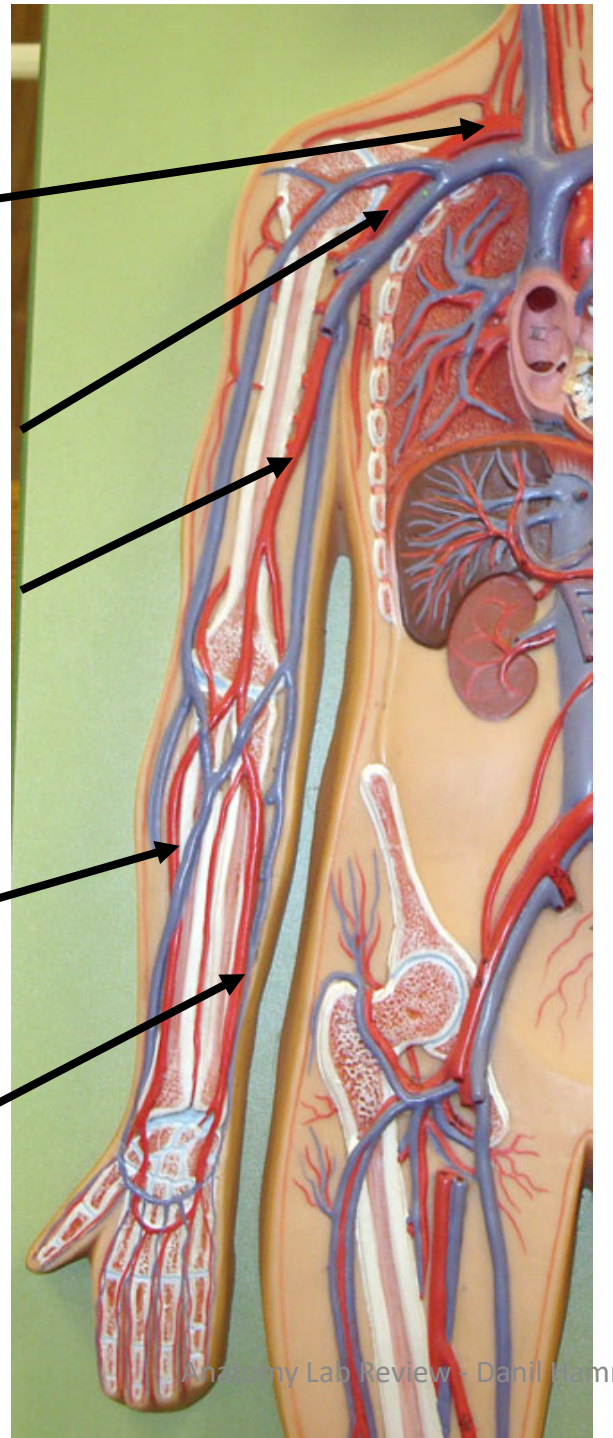
Right Subclavian Artery

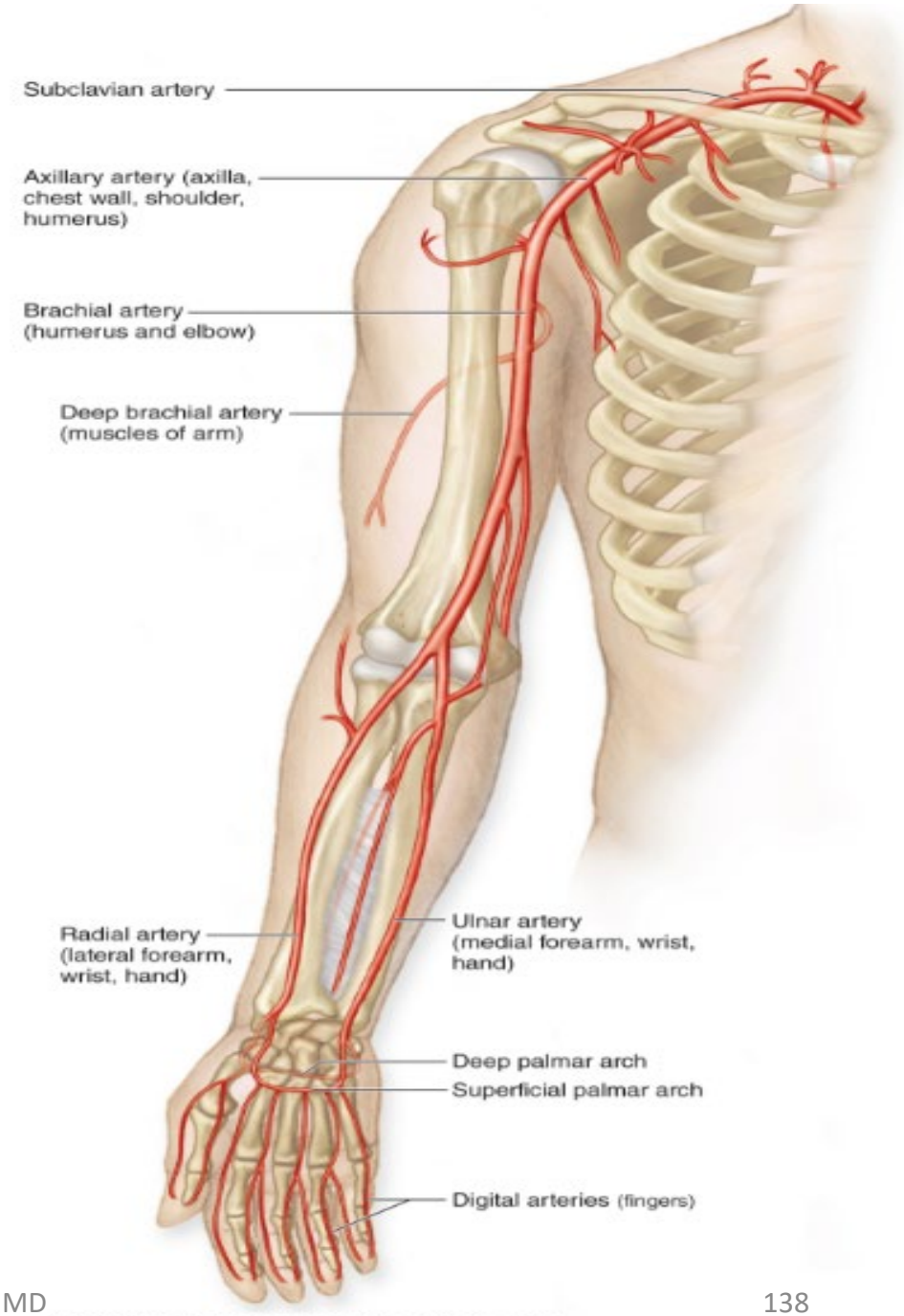
Axillary Artery

Brachial Artery

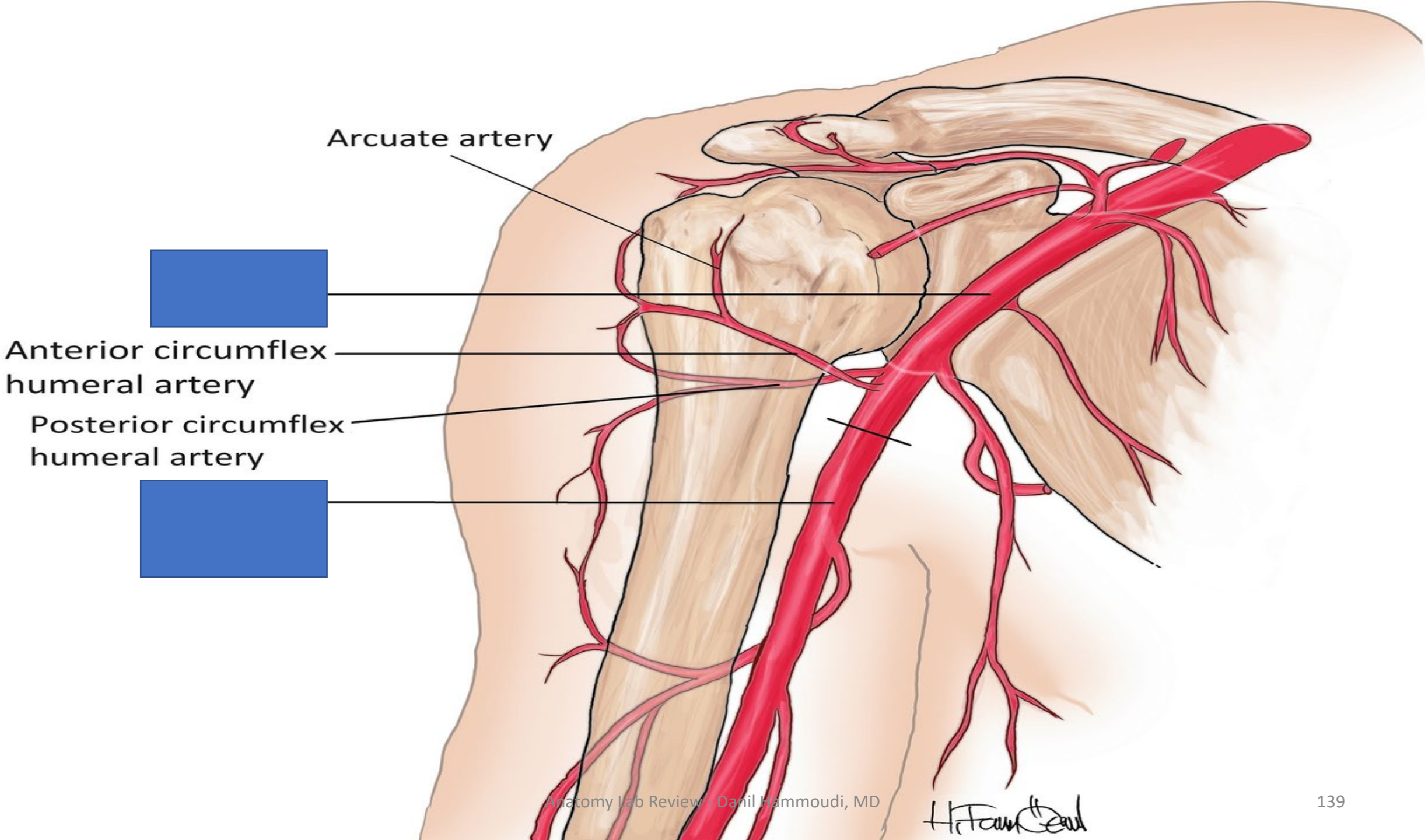
Radial Artery

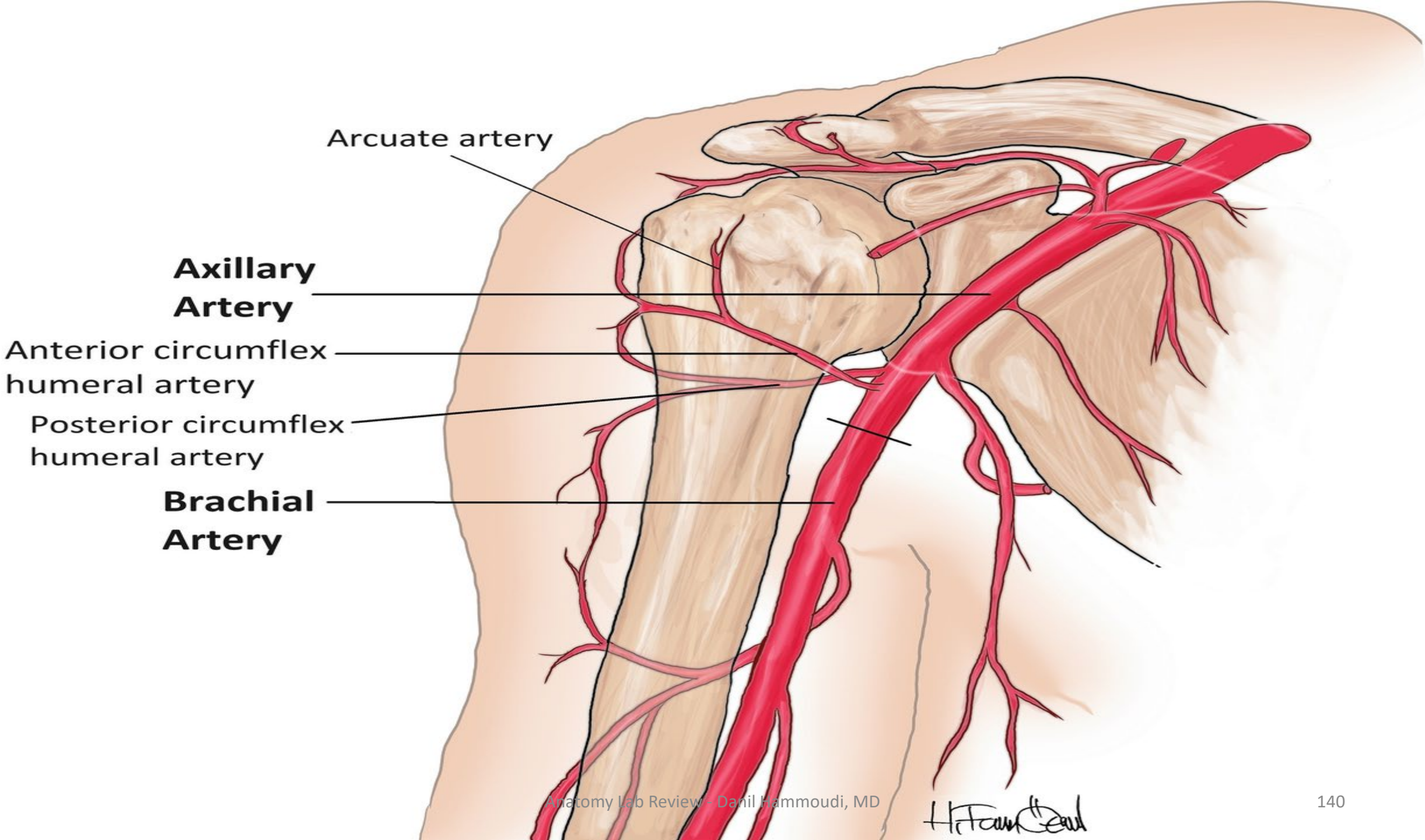
Ulnar Artery

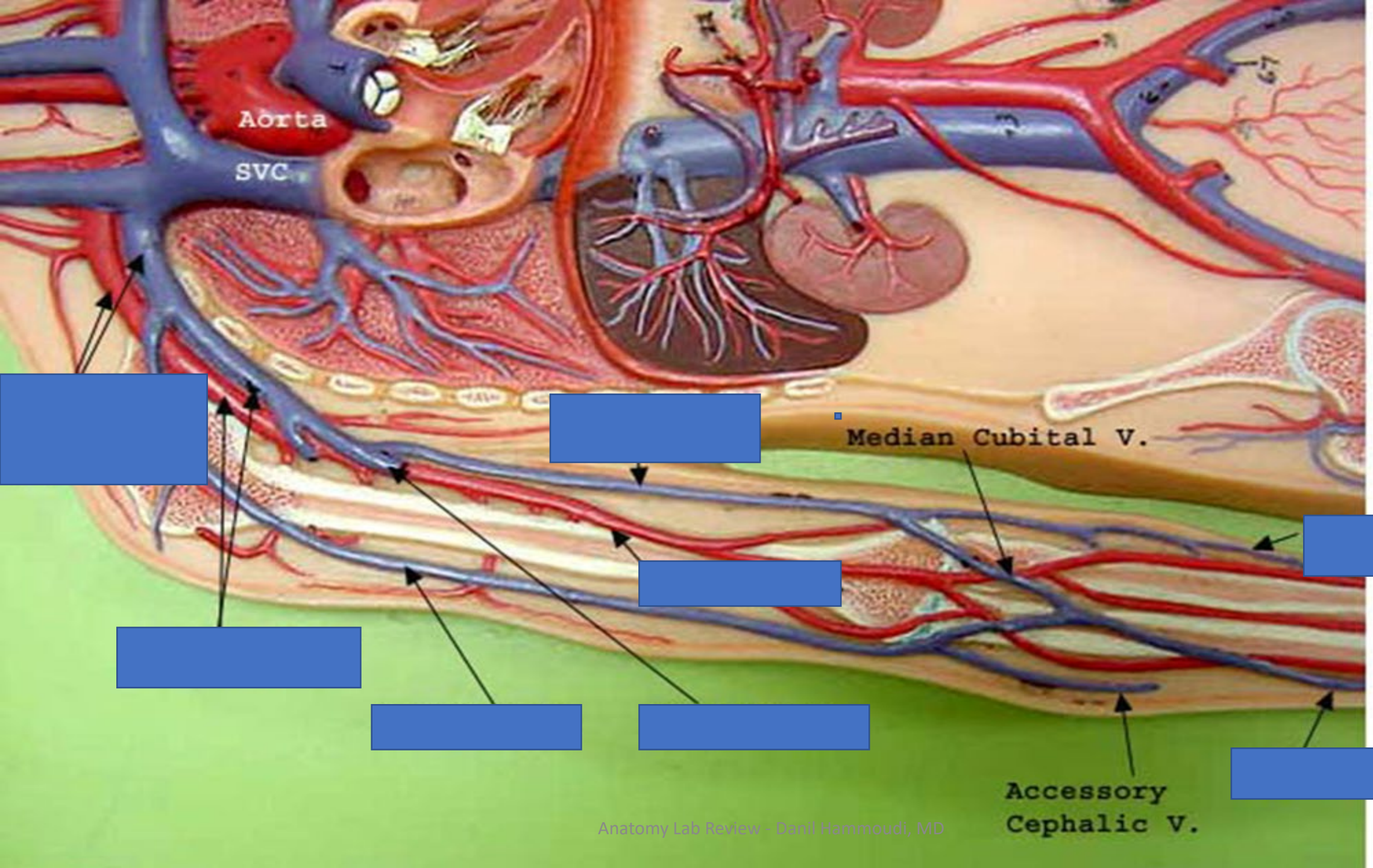


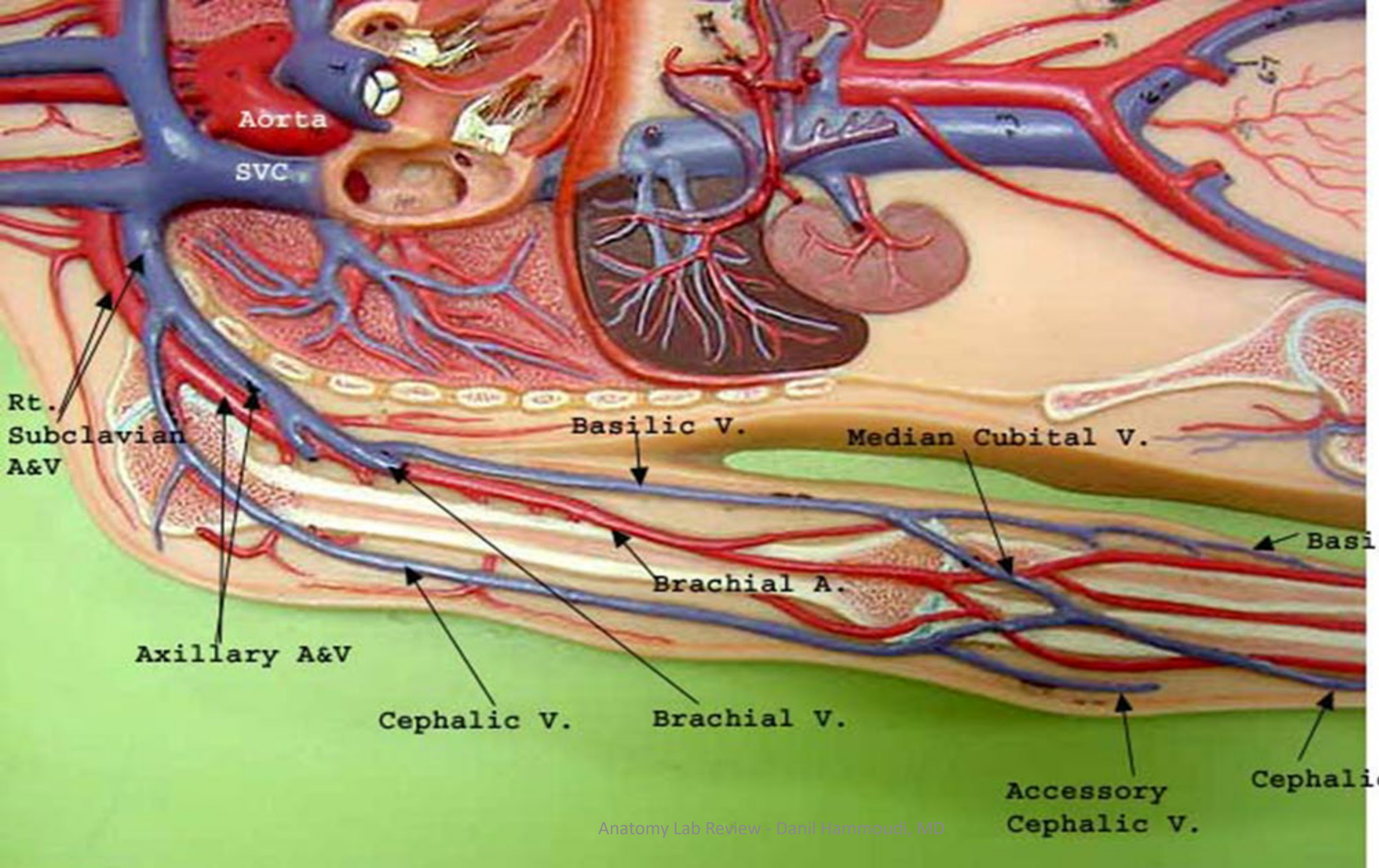


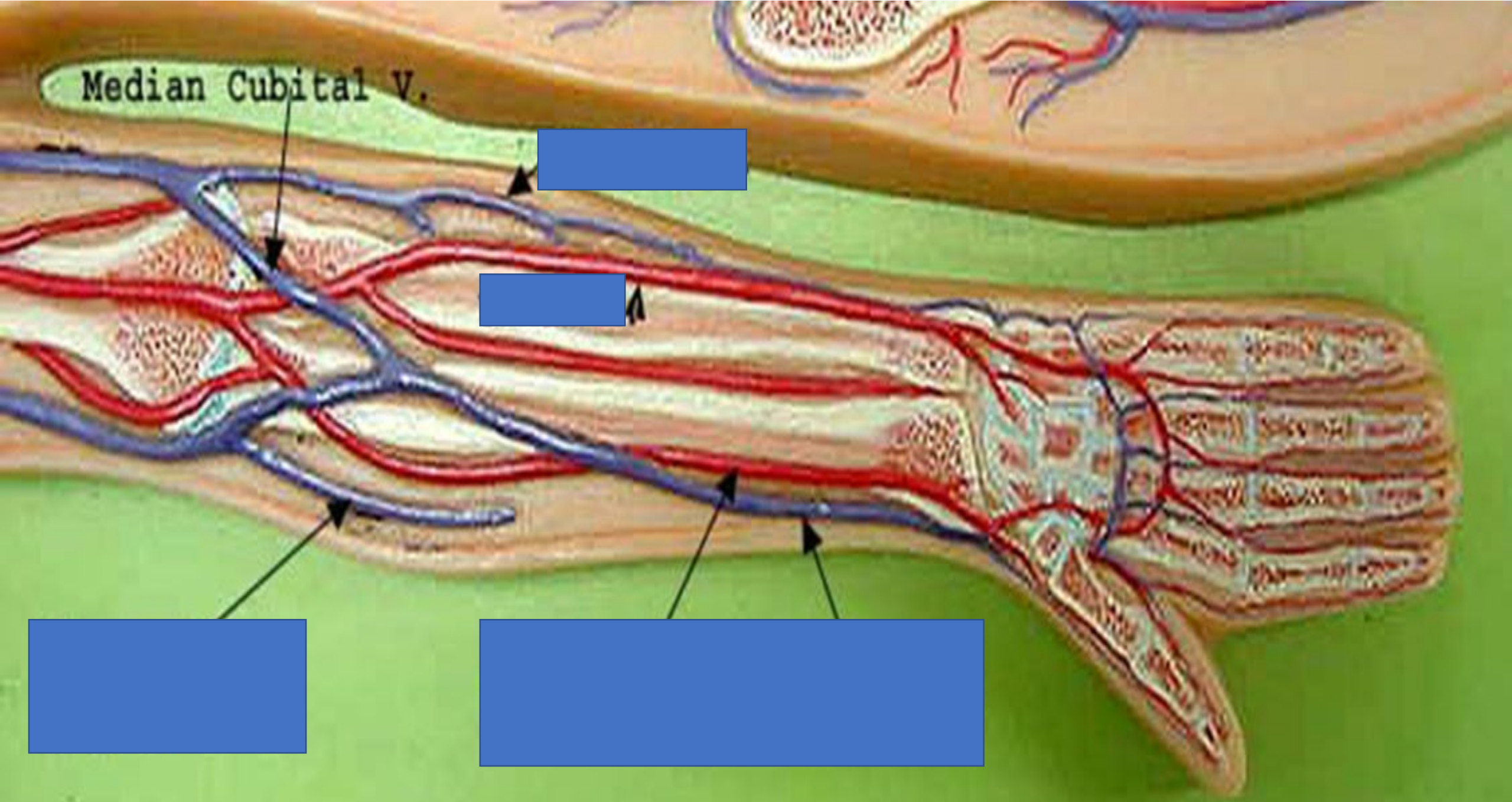
(a) Arteries of right upper limb, anterior view

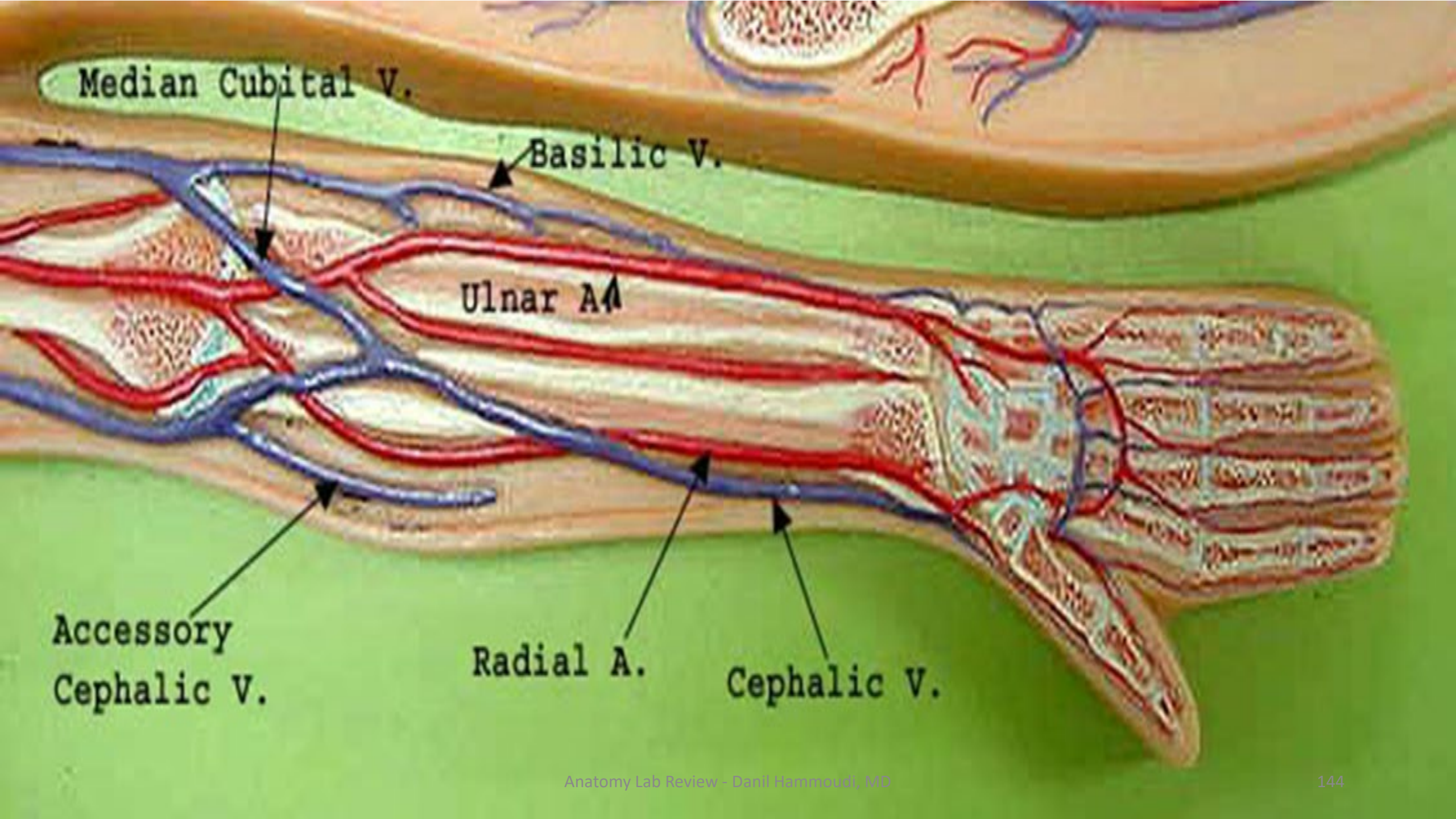

Arcuate artery
Anterior circumflex humeral artery
Posterior circumflex humeral artery

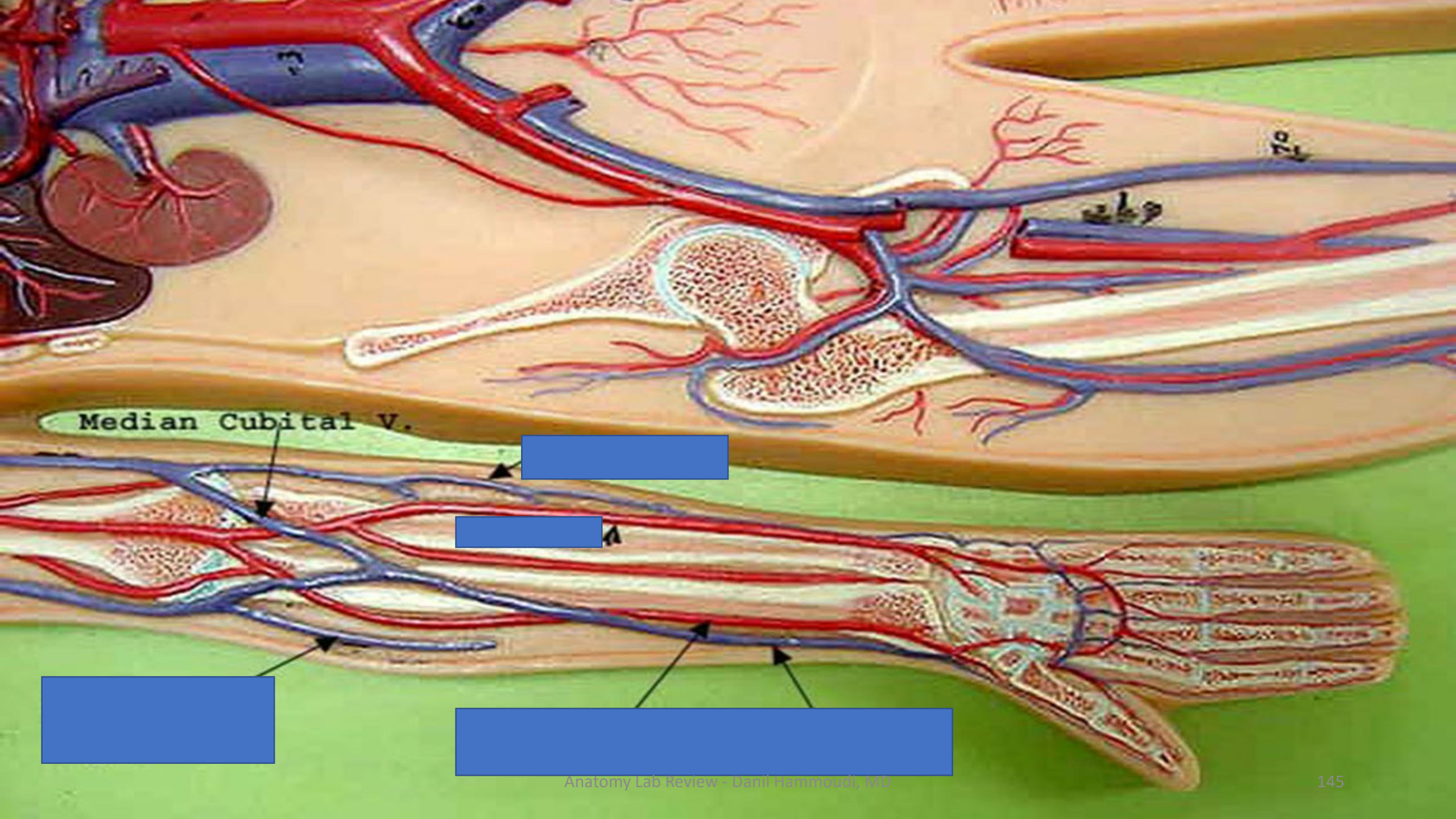

Arcuate artery
Axillary Artery
Anterior circumflex humeral artery
Posterior circumflex humeral artery
Brachial Artery

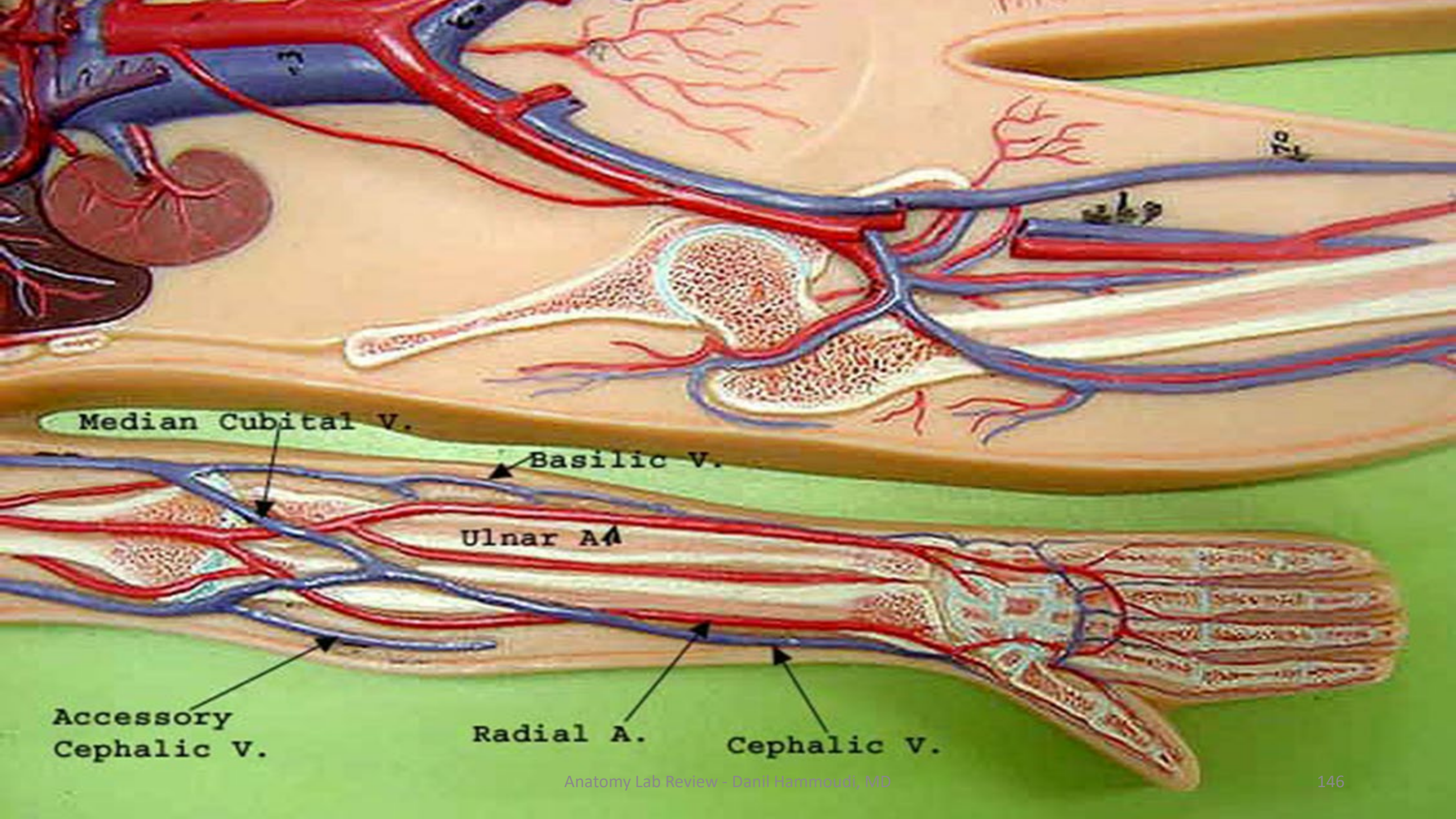

Aorta
SVC
Median Cubital V.
Accessory
Cephalic V.

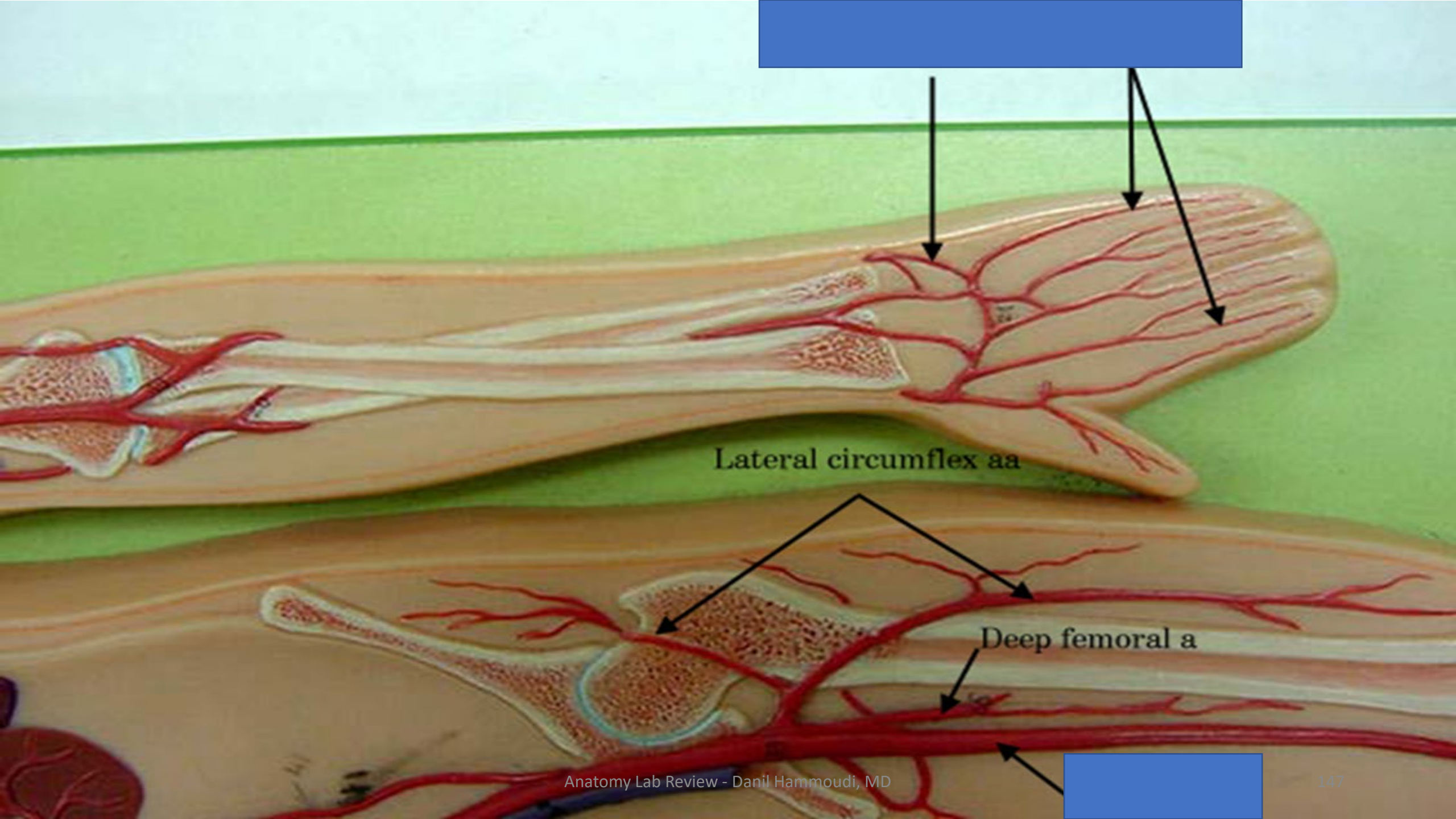

Aorta
SVC
Rt. Subclavian A&V
Basilic V.
Median Cubital V.
Basilic V.
Brachial A.
Axillary A&V
Cephalic V.
Brachial V.
Accessory Cephalic V.
Cephalic V.

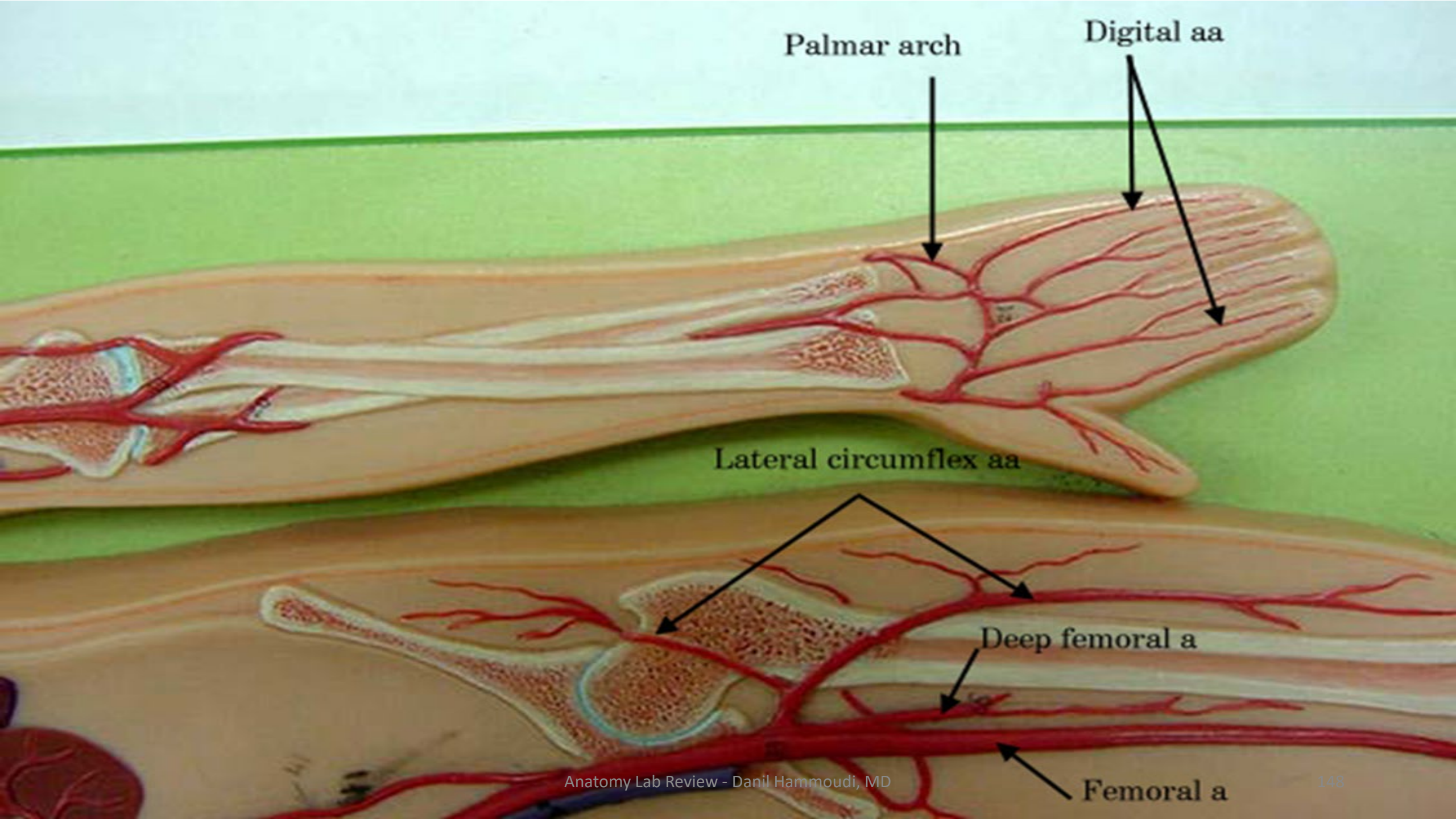

Median Cubital V.

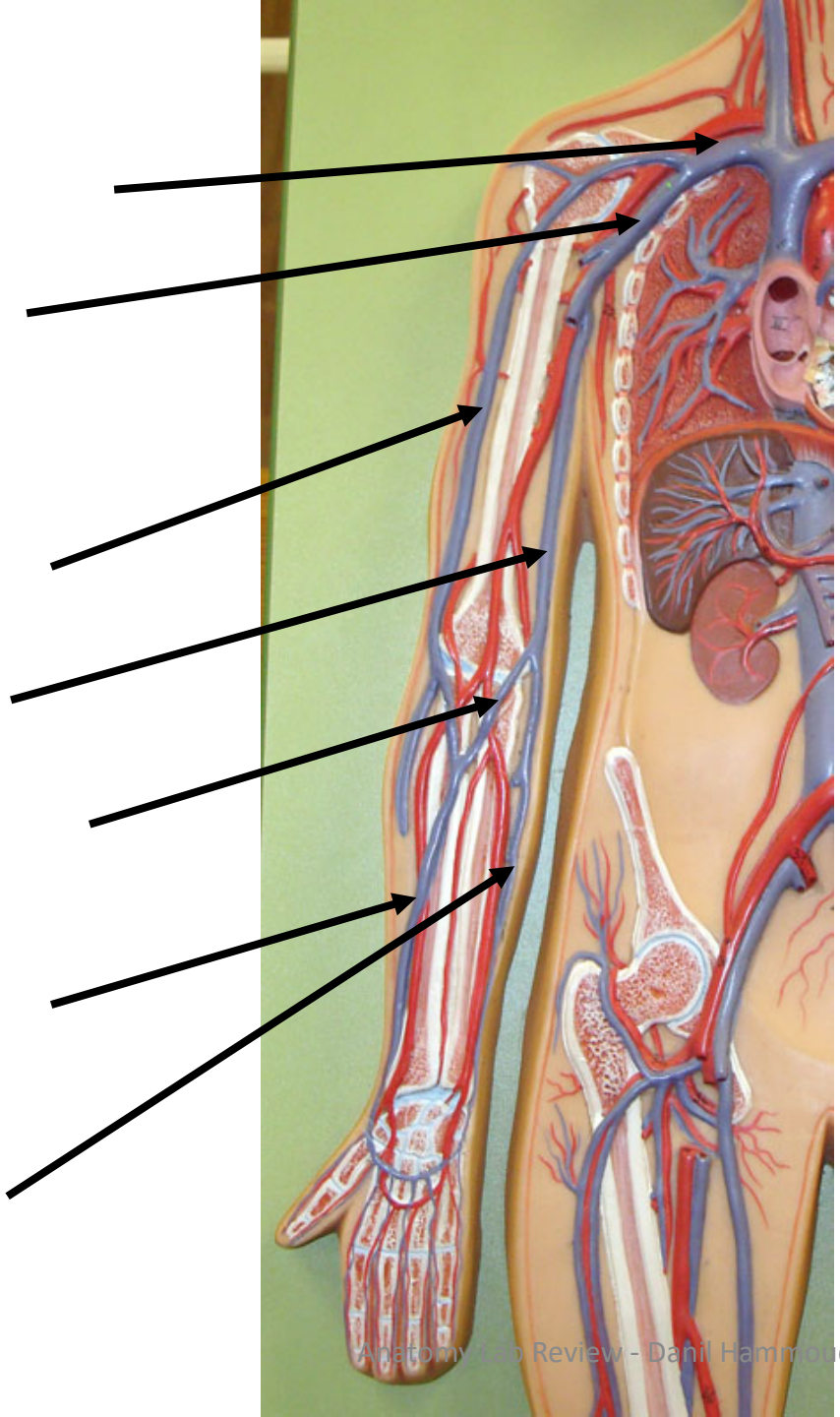

Median Cubital V.
Basilic V.
Ulnar A.
Accessory Cephalic V.
Radial A.
Cephalic V.


Median Cubital V.


Median Cubital V.
Basilic V.
Ulnar A.
Accessory Cephalic V.
Radial A.
Cephalic V.


Lateral circumflex aa
Deep femoral a


Palmar arch
Digital aa
Lateral circumflex aa
Deep femoral a
Femoral a



Right Subclavian Vein

Axillary Vein

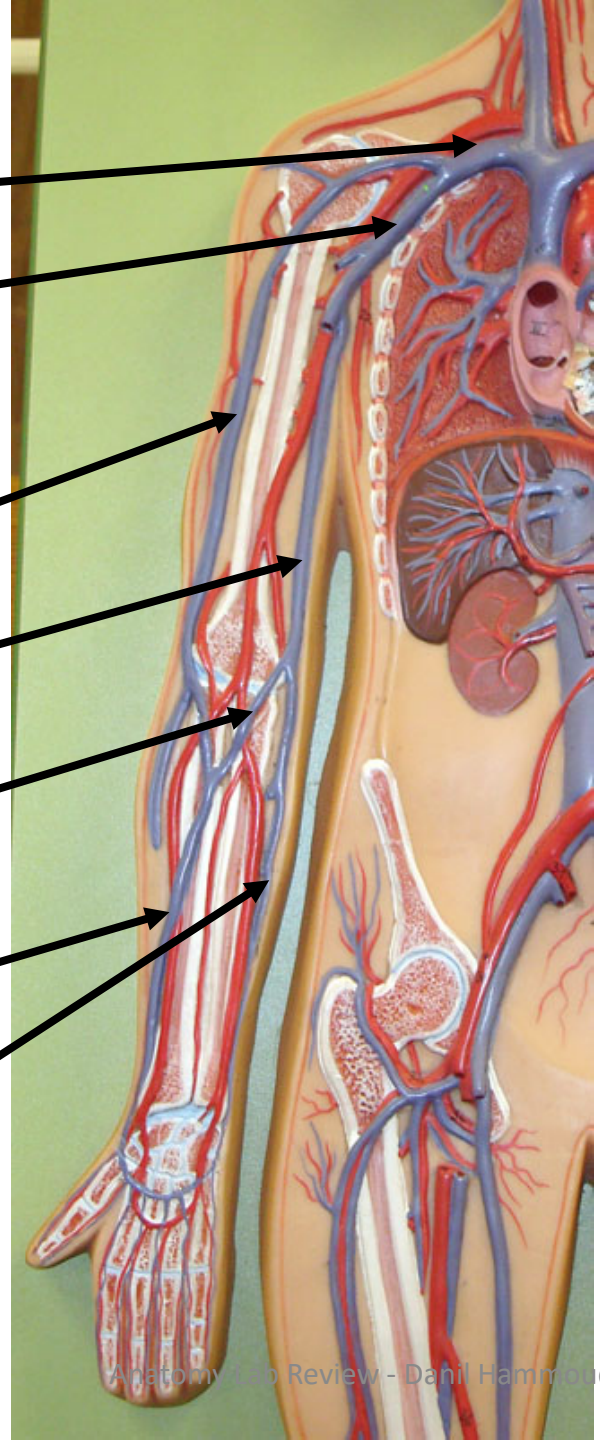
Cephalic Vein

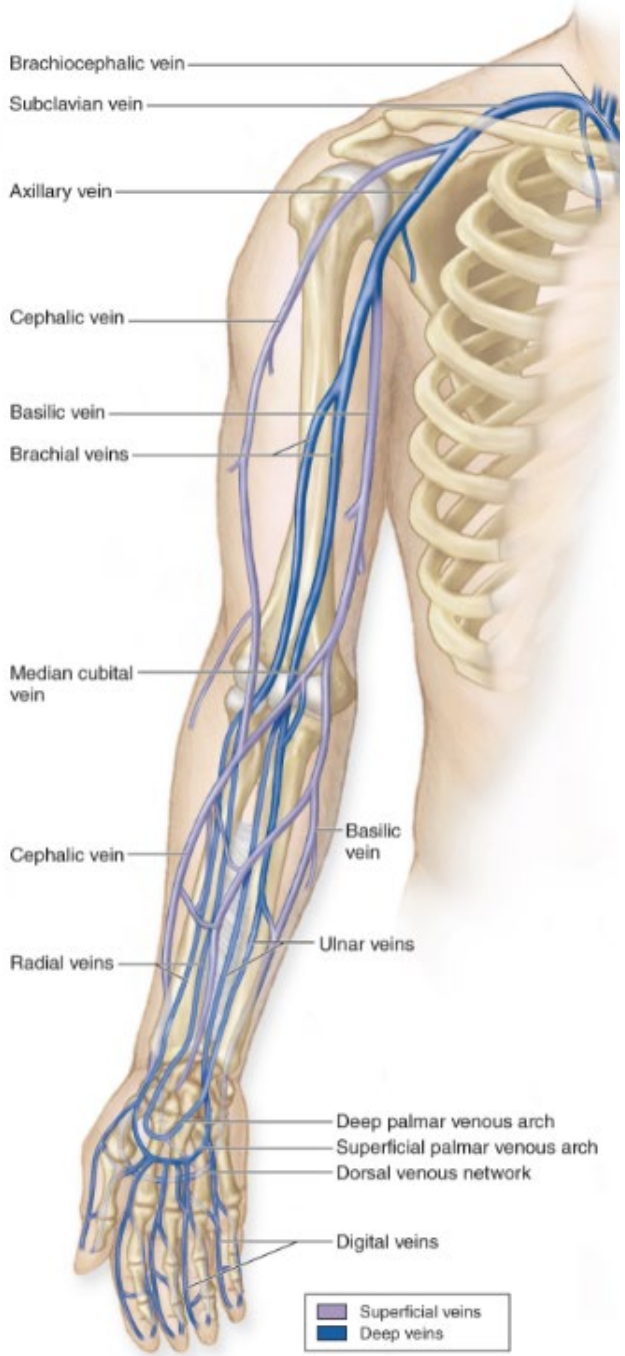
Basilic Vein

Median Cubital Vein

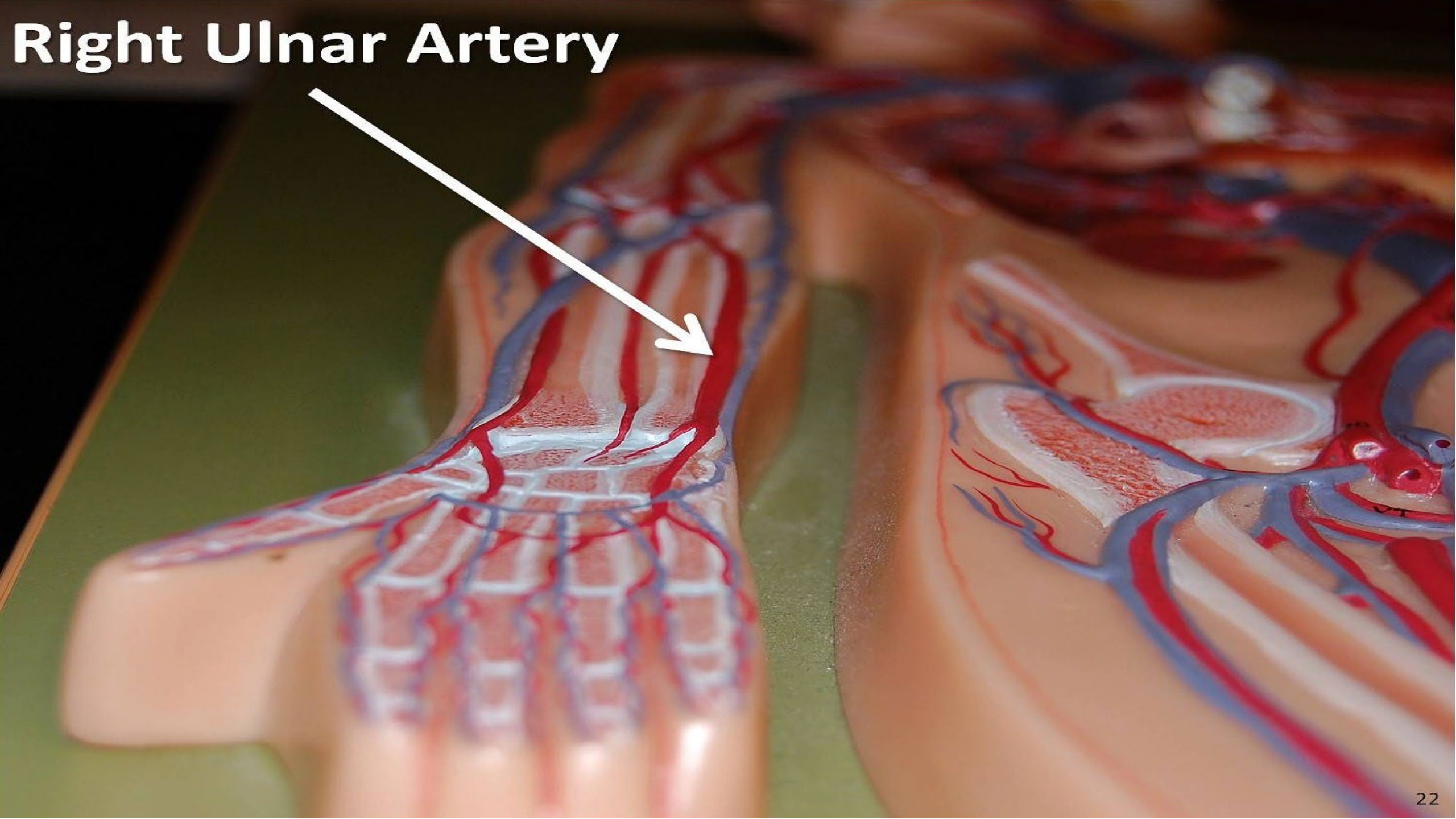
Cephalic vein

Basilic Vein

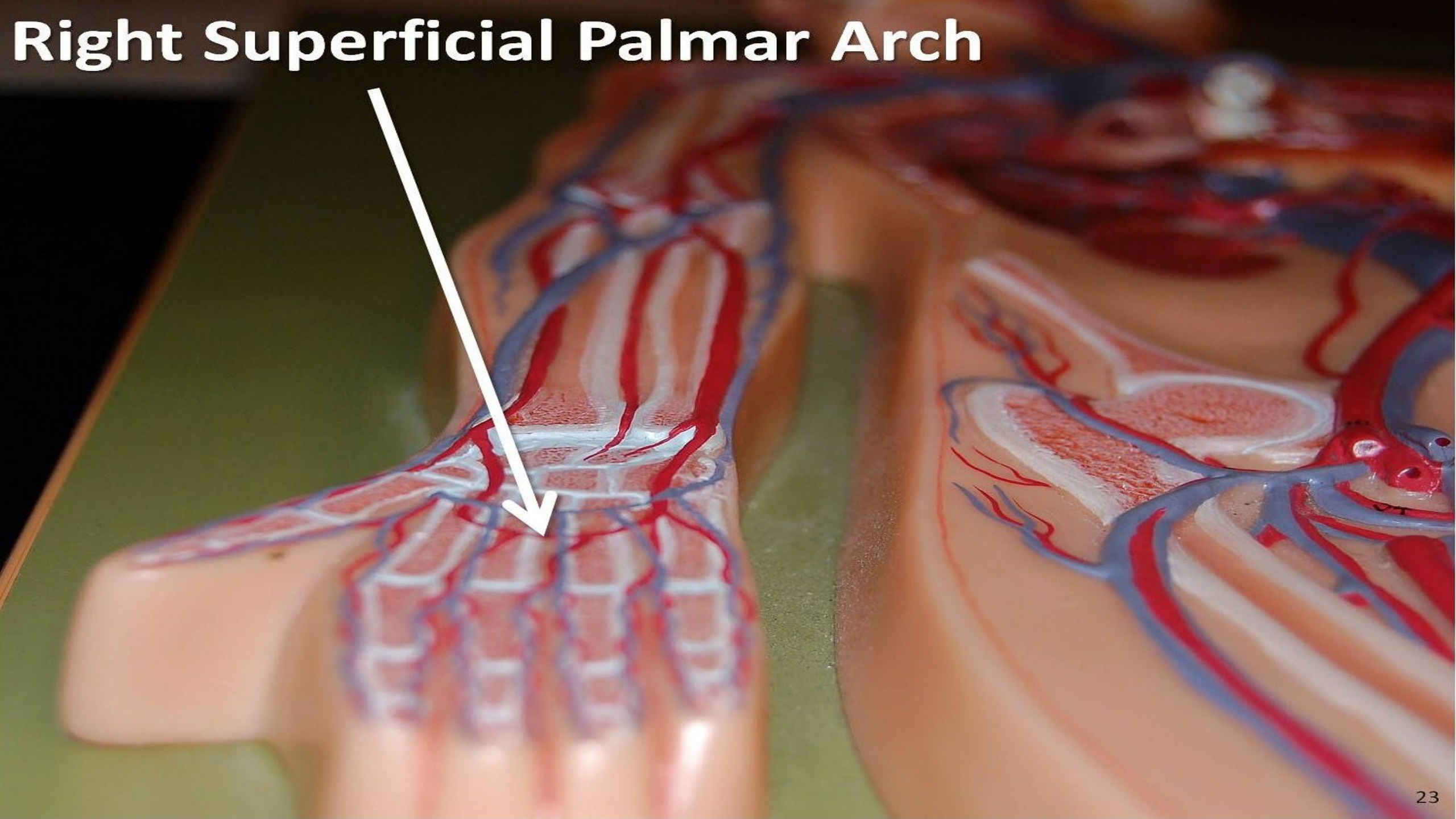


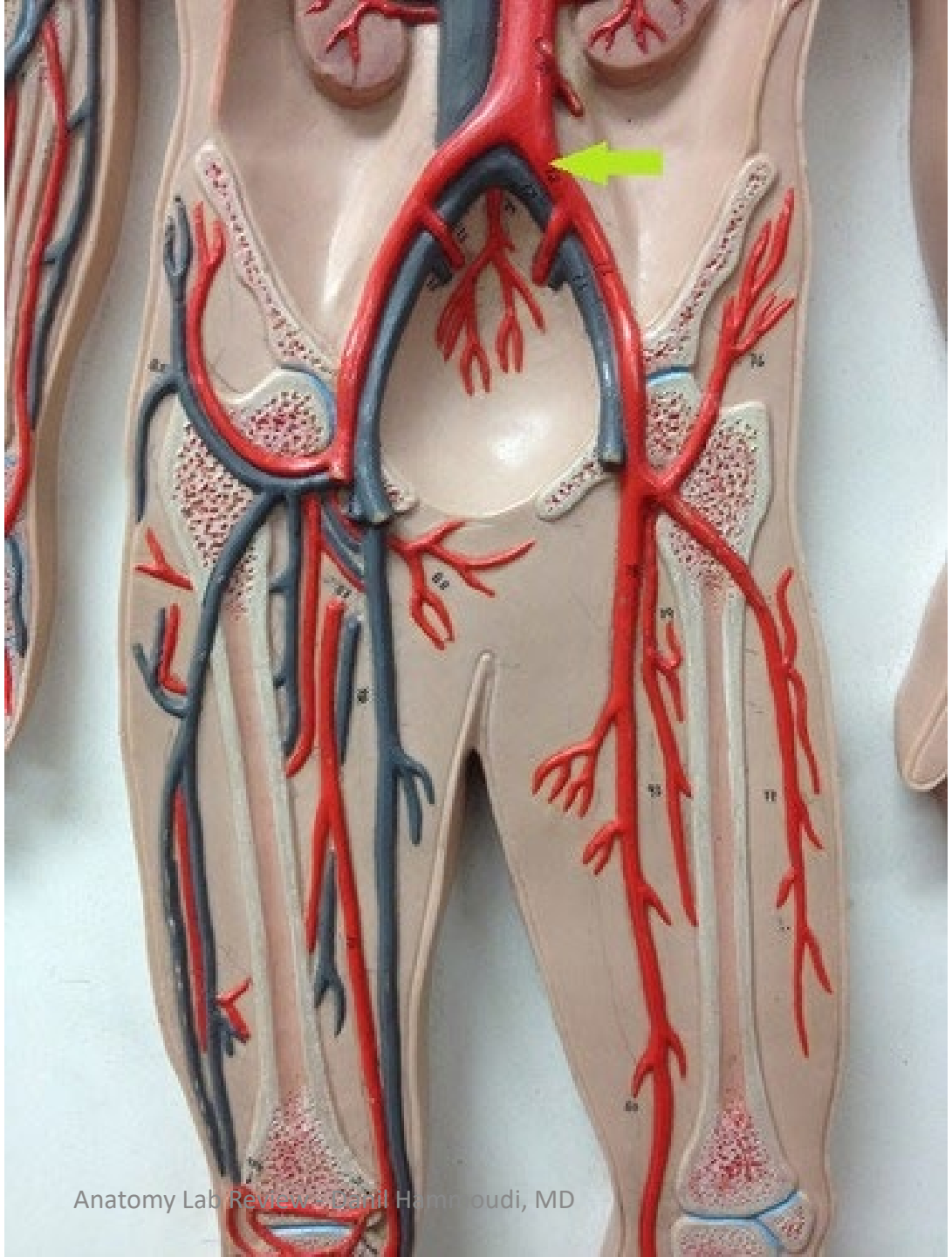


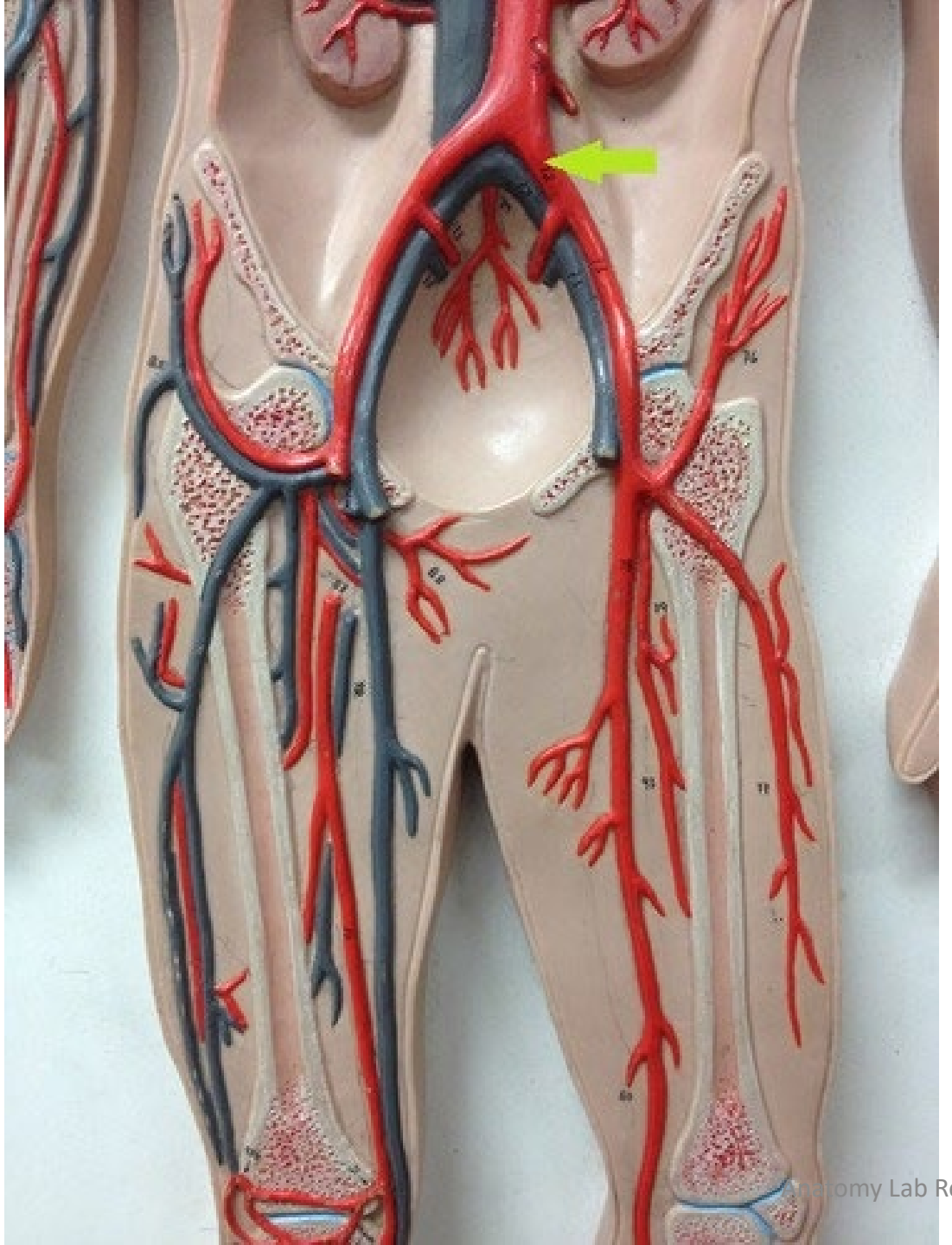
(b) Veins of right upper limb, anterior view


Right Ulnar Artery

Right Superficial Palmar Arch

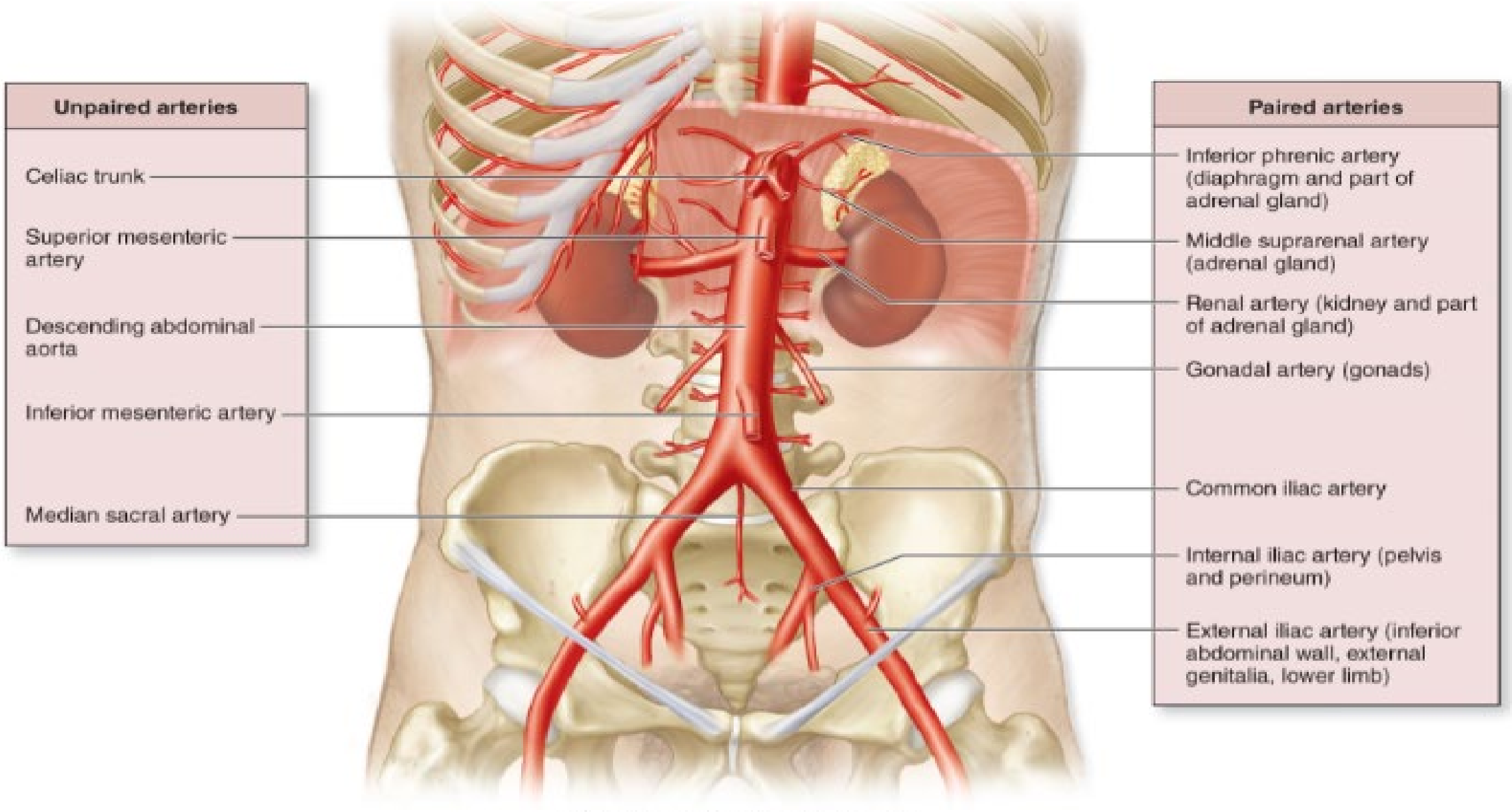


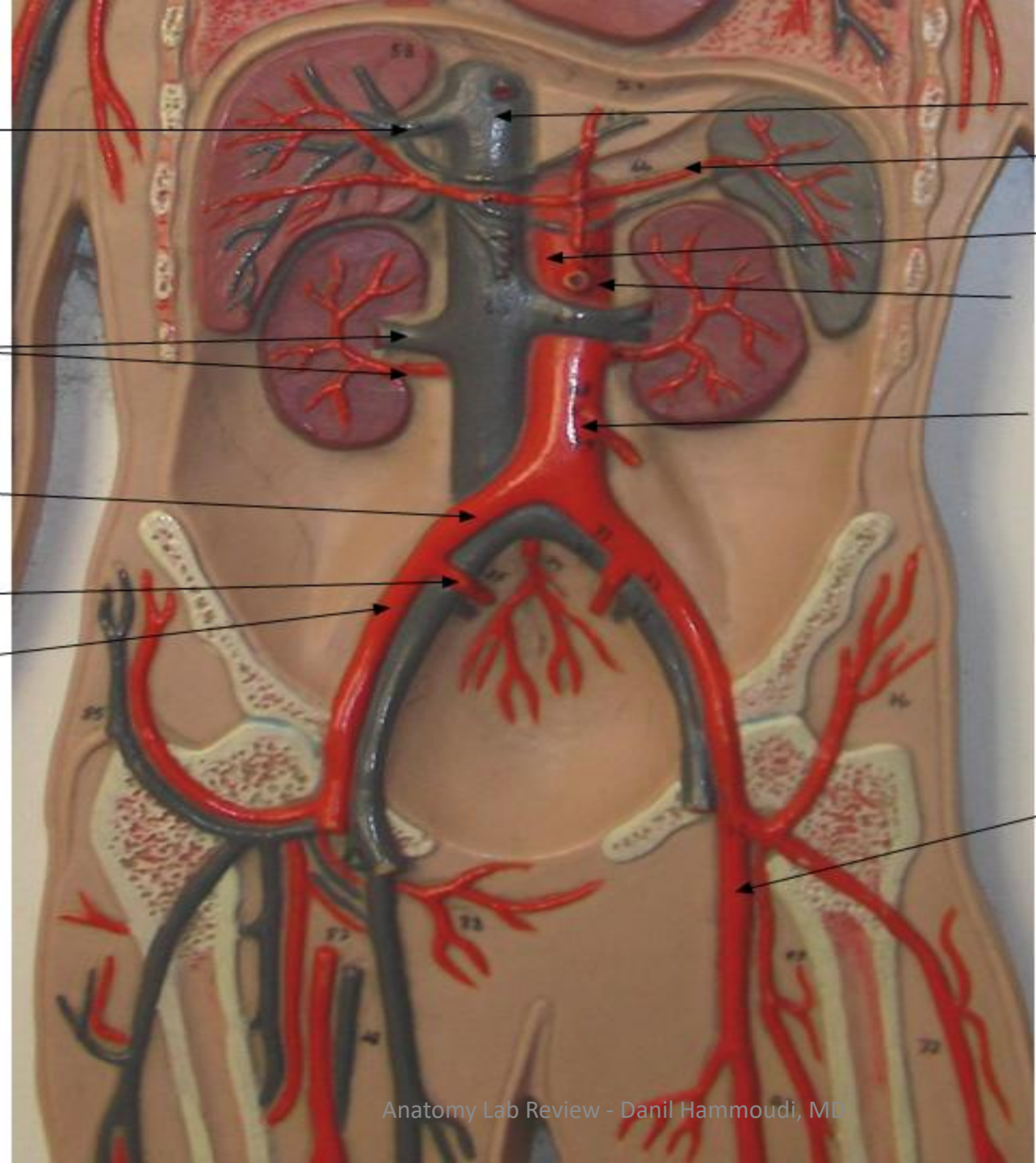




left common iliac artery

Major Arteries of the Abdominal Region




Hepatic artery and vein
Renal artery and vein
Common Iliac
Internal Iliac
External Iliac
Inferior vena cavae
Splenic artery
Abdominal aorta
Superior mesenteric
Inferior mesenteric
Femoral artery

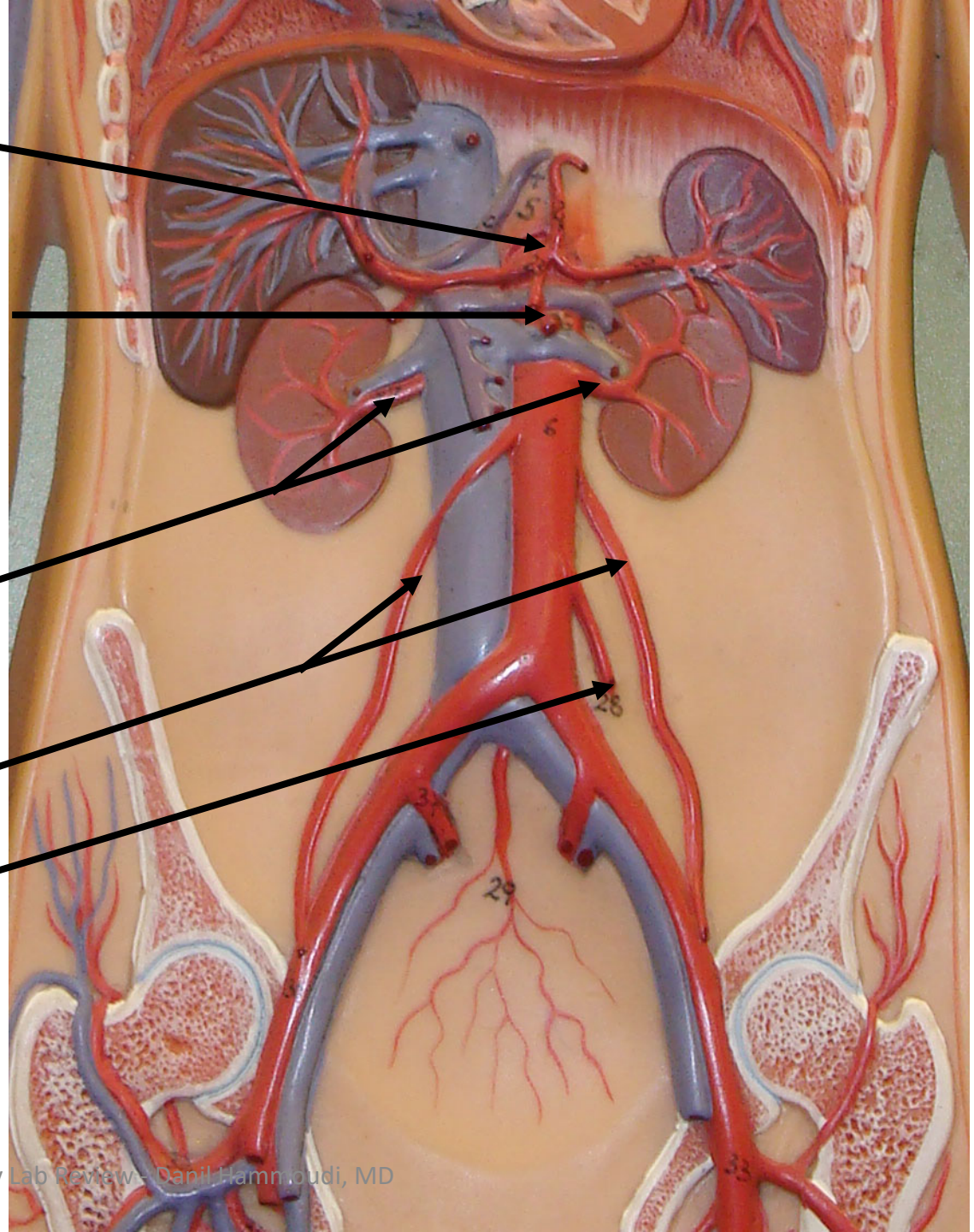
1.

2.

3.

4.

5.



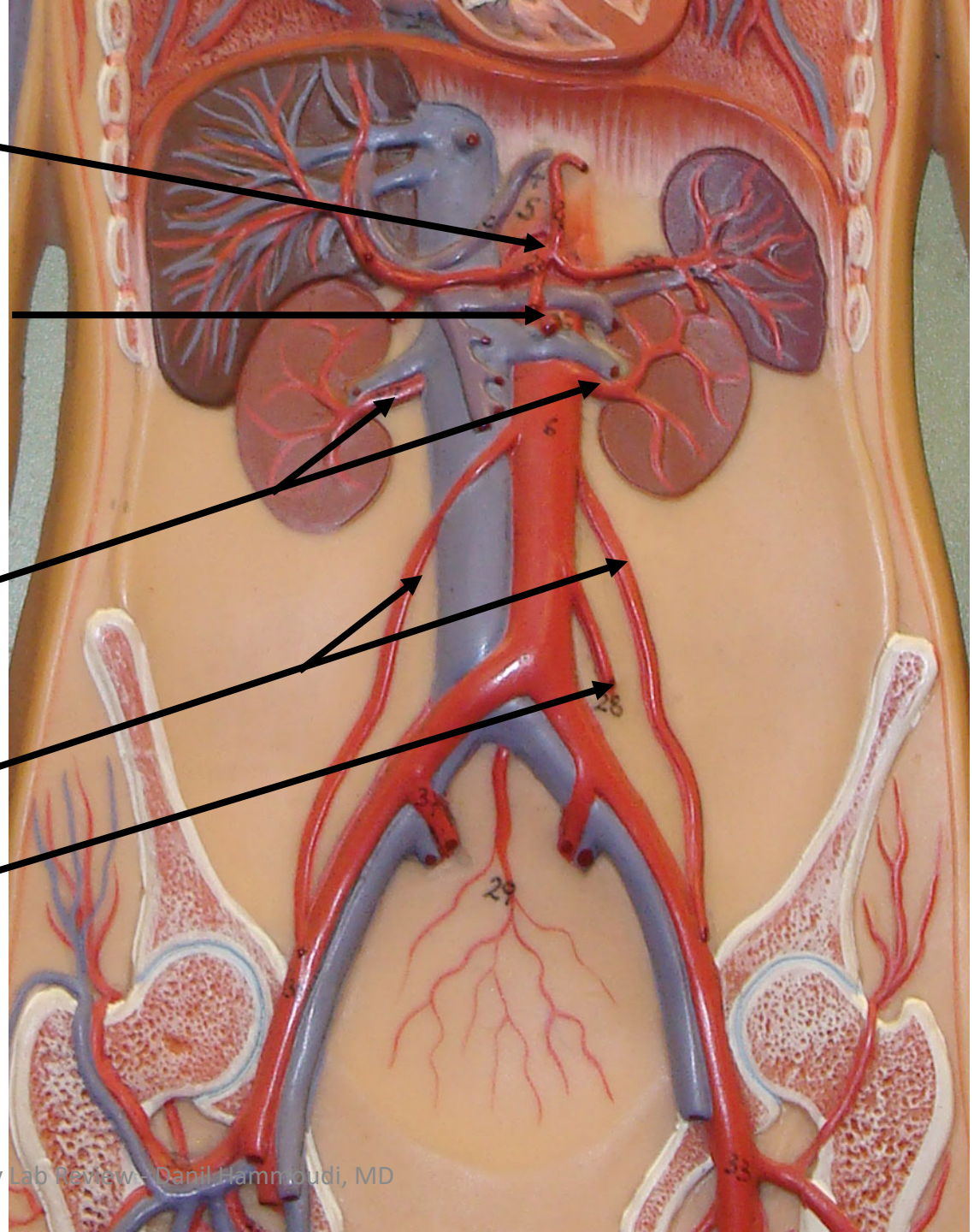
1. Celiac Trunk

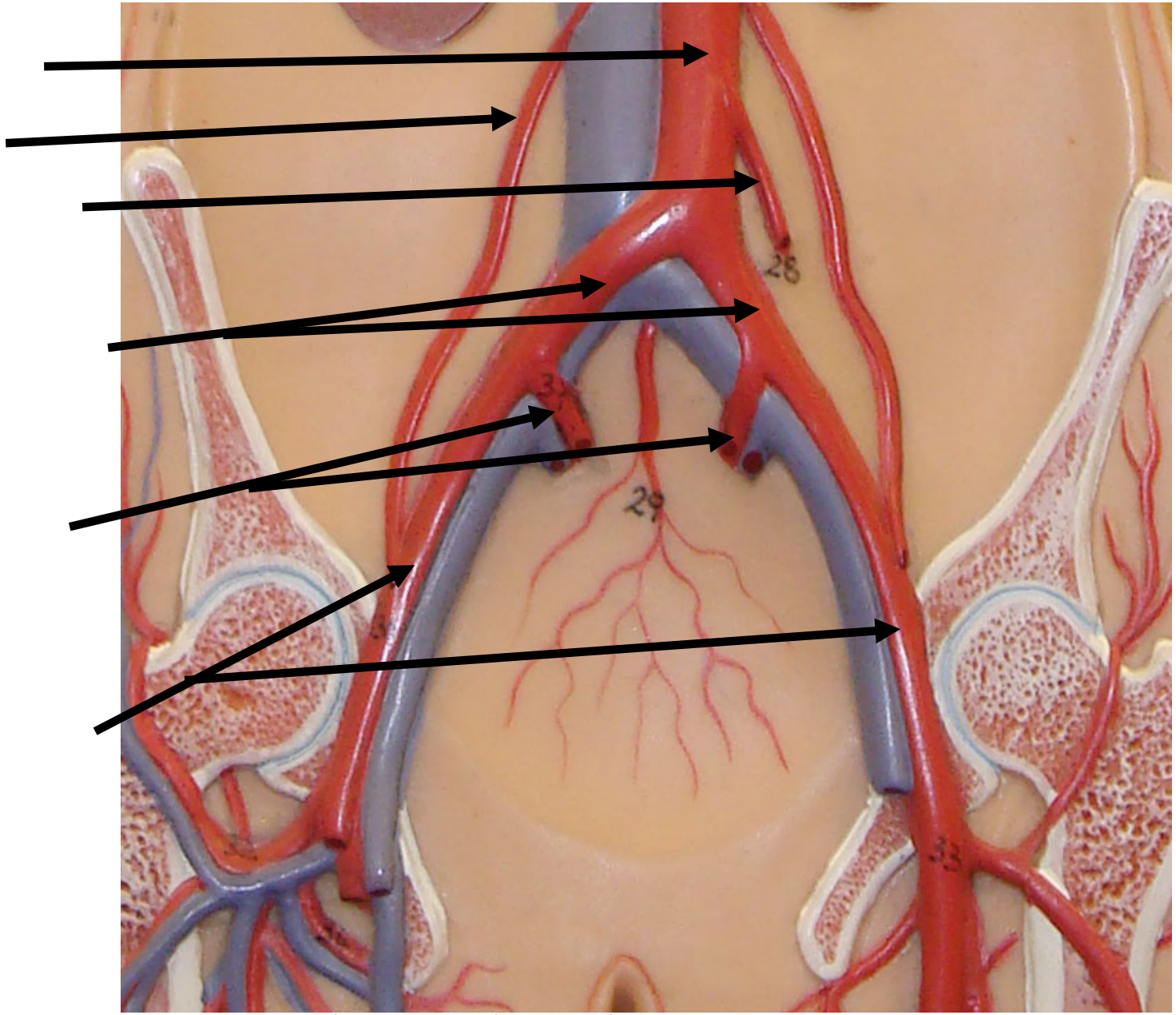
2. Superior Mesenteric Artery

3. R/L Renal Arteries

4. Gonadal Arteries

5. Inferior Mesenteric Artery

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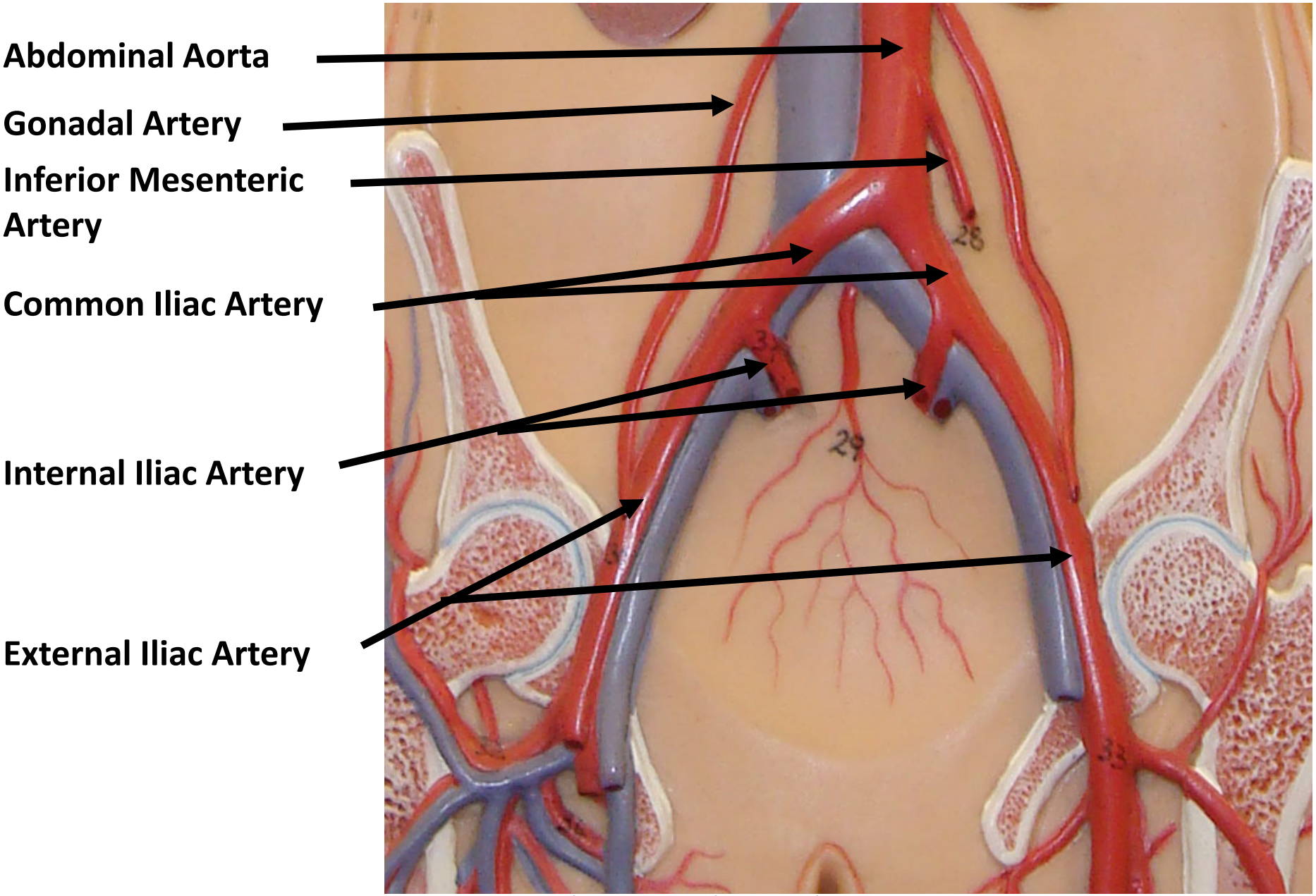
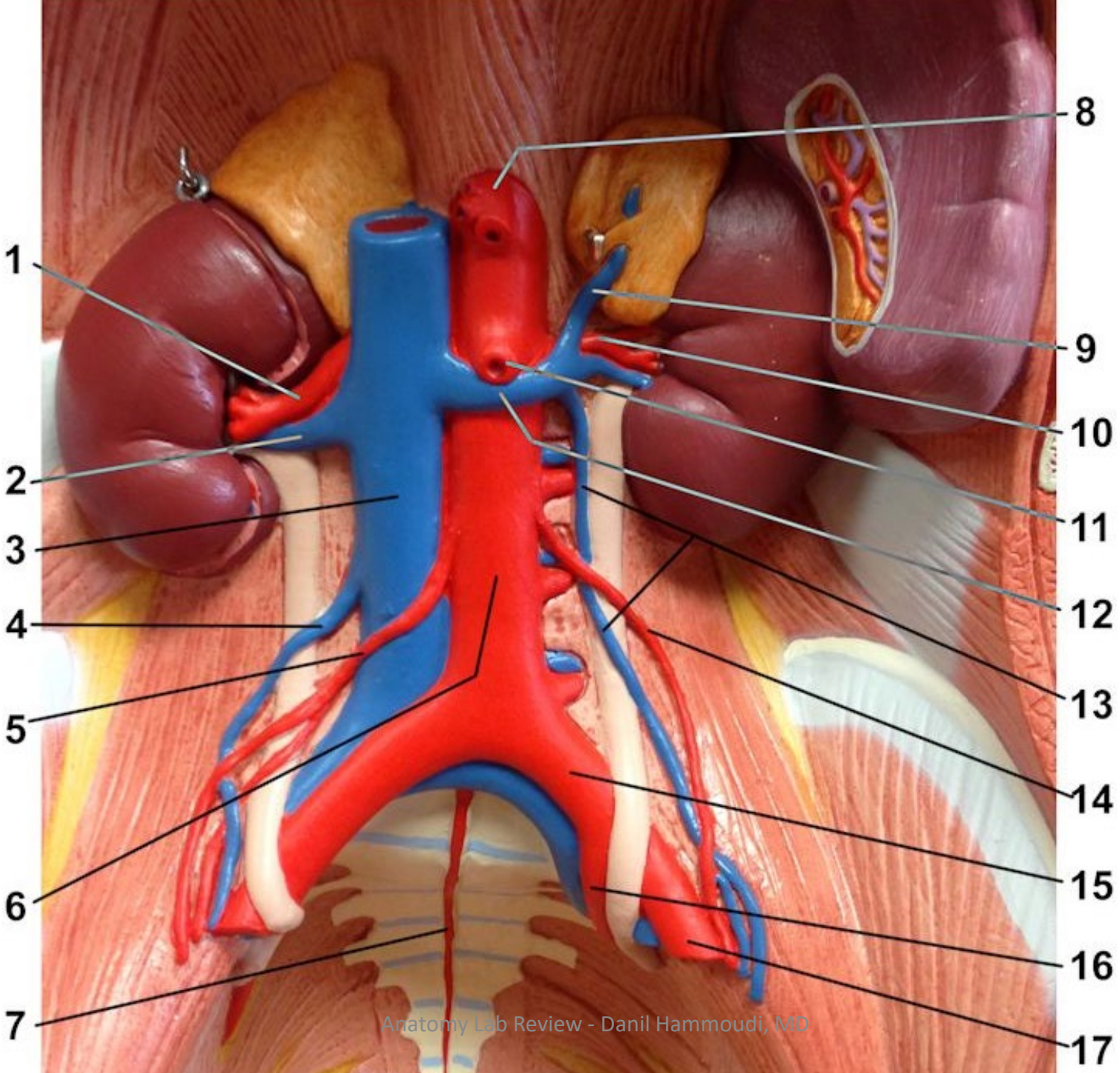

Abdominal Aorta
Gonadal Artery
Inferior Mesenteric Artery
Common Iliac Artery
Internal Iliac Artery
External Iliac Artery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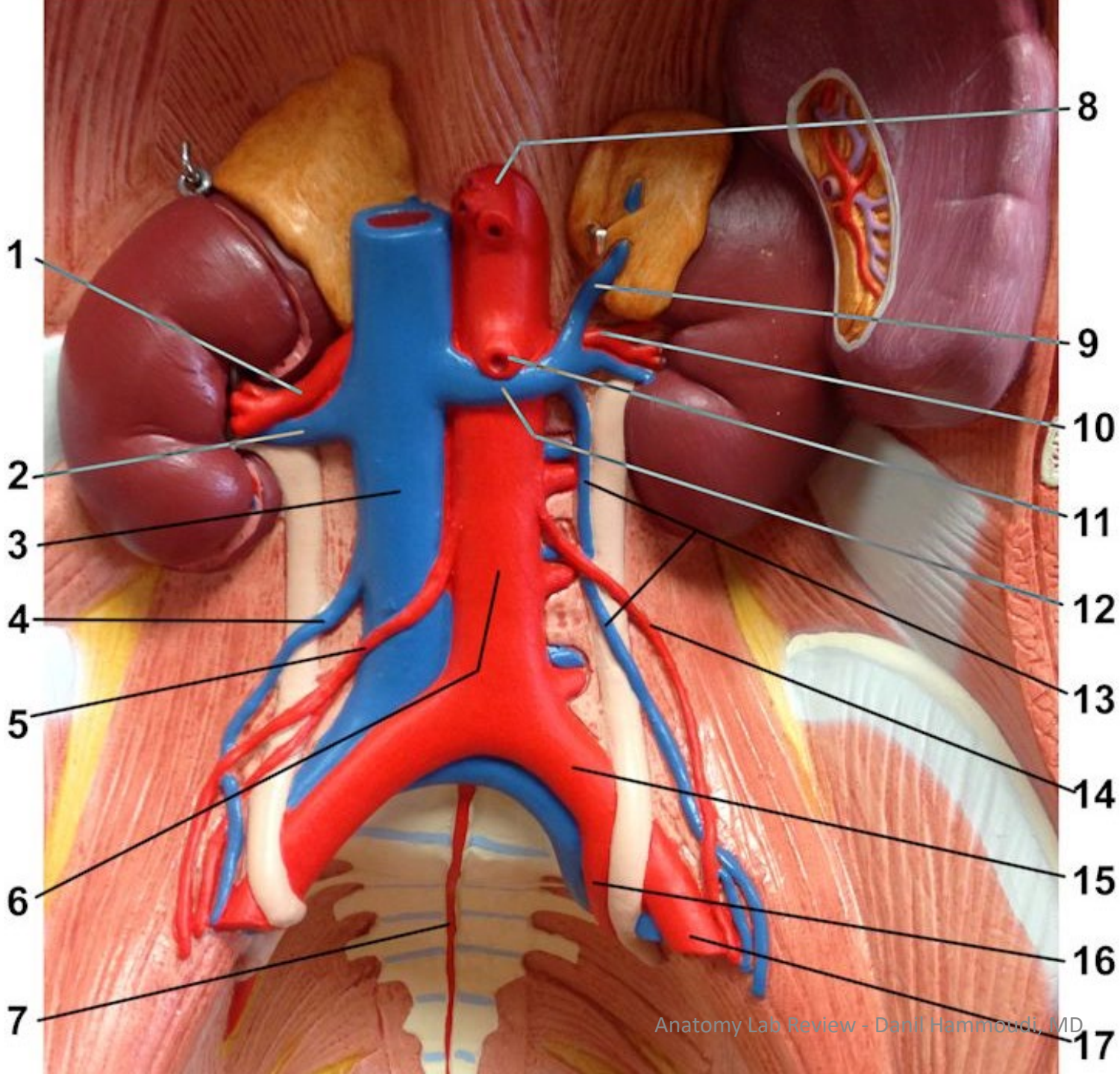
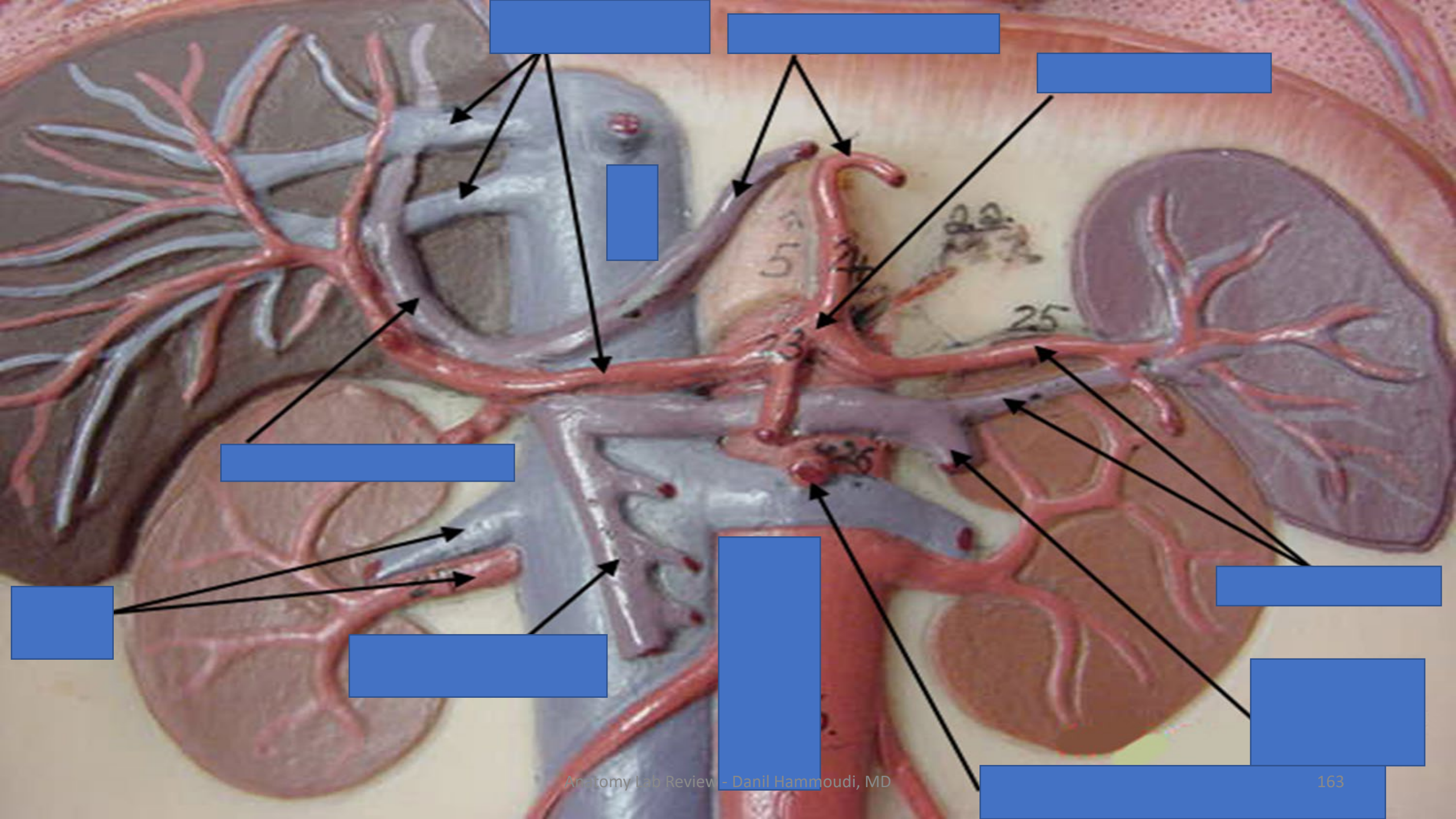
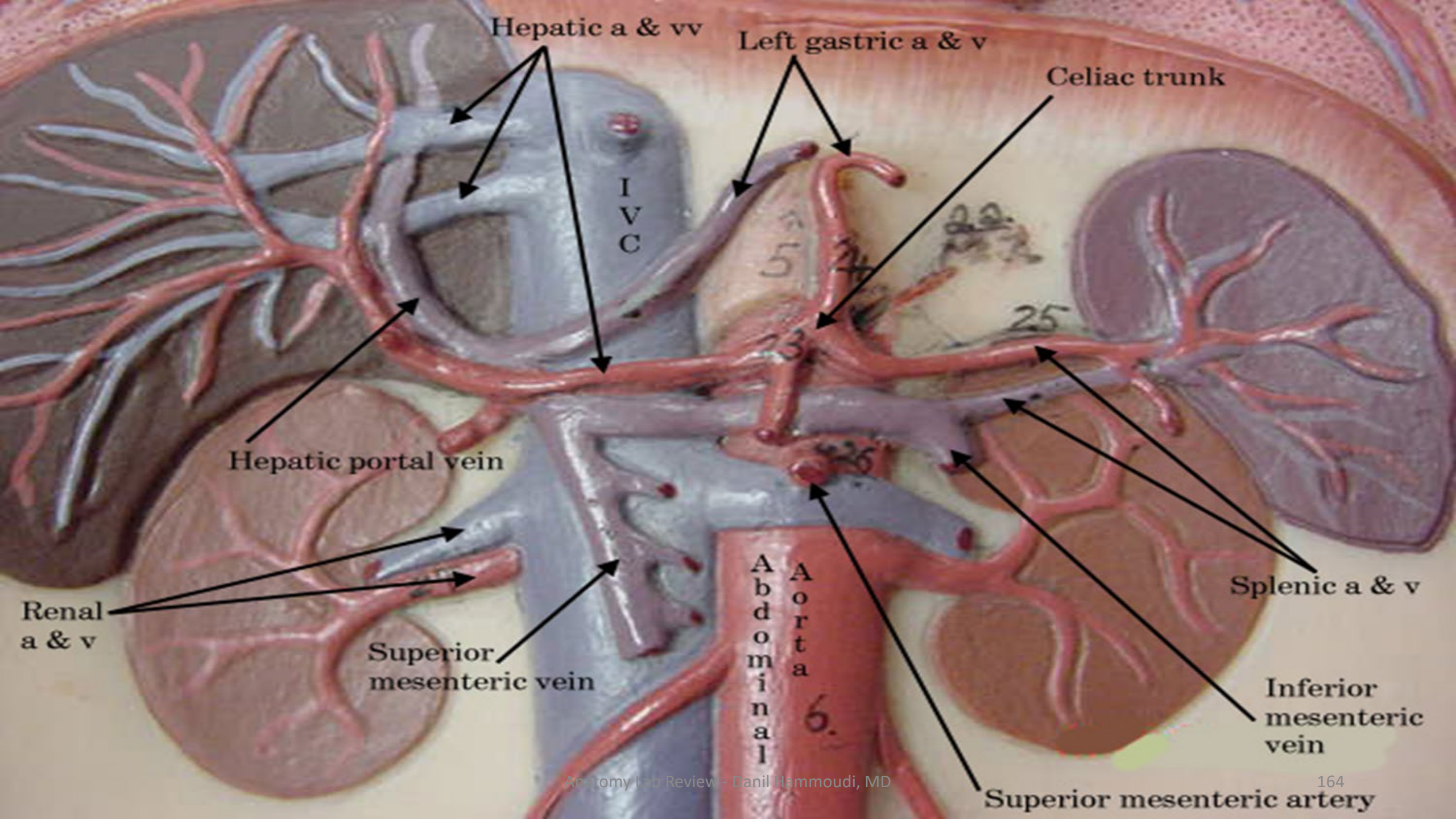
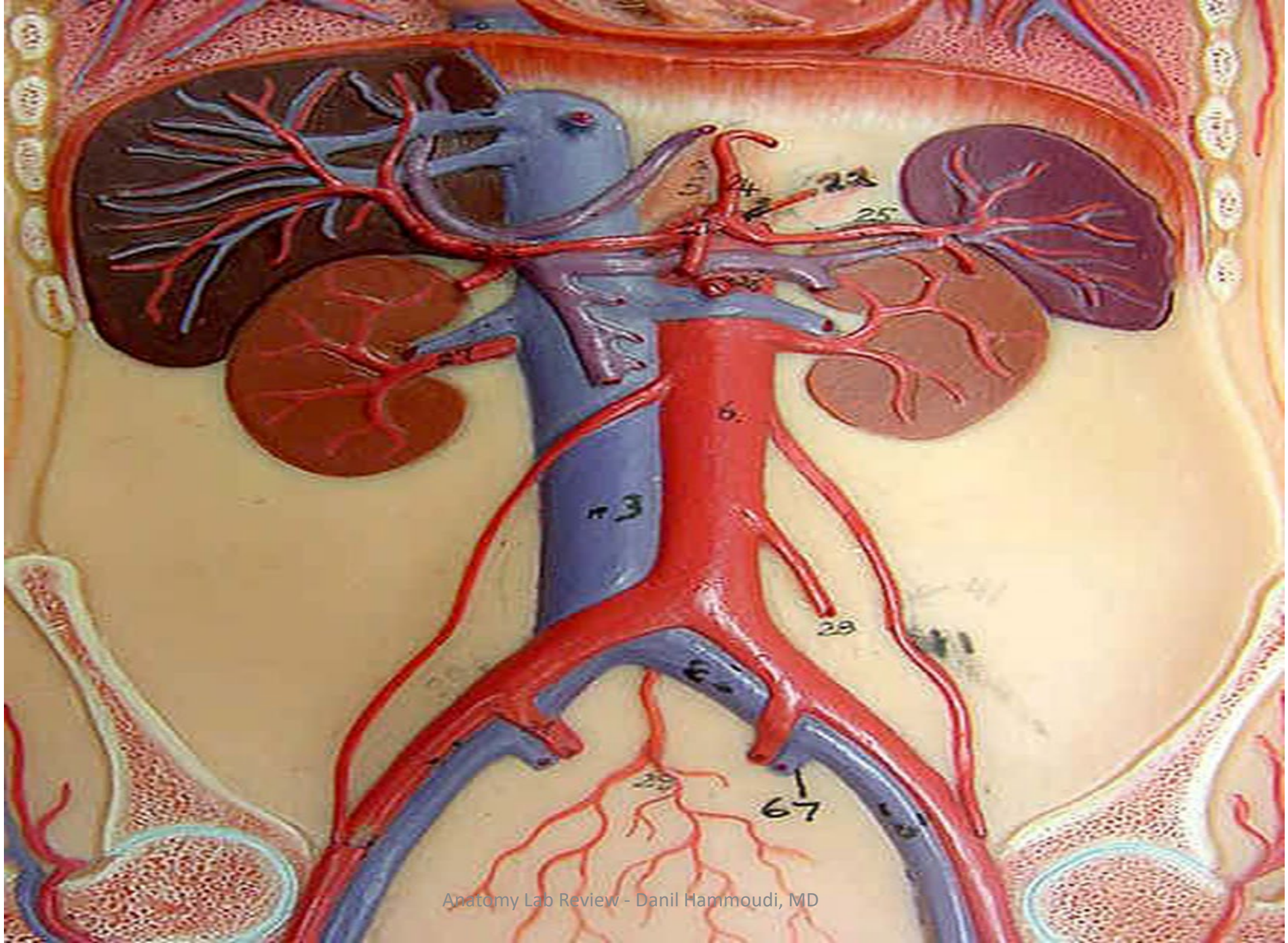


1.Renal a. (right)
2.Renal v. (right)
3.Inferior vena cava
4.Gonadal v. (right)
5.Gonadal a. (right)
6.Abdominal aorta
7.Median sacral a.
8.Celiac trunk (Branches: Splenic, Left gastric, Common hepatic a's)
9.Suprarenal v.
10.Renal a. (left)
11.Superior mesenteric a.
12.Renal v. (left)
13.Gonadal v. (left)
14.Gonadal a. (left)
15.Common iliac a. (left)
16.Internal iliac a. (left)
17.External iliac a. (left)




Hepatic a & vv
Left gastric a & v
Celiac trunk
IVC
Hepatic portal vein
Renal
a & v
Superior
mesenteric vein
Abdominal Aorta
Splenic a & v
Inferior
mesenteric
vein
Superior mesenteric artery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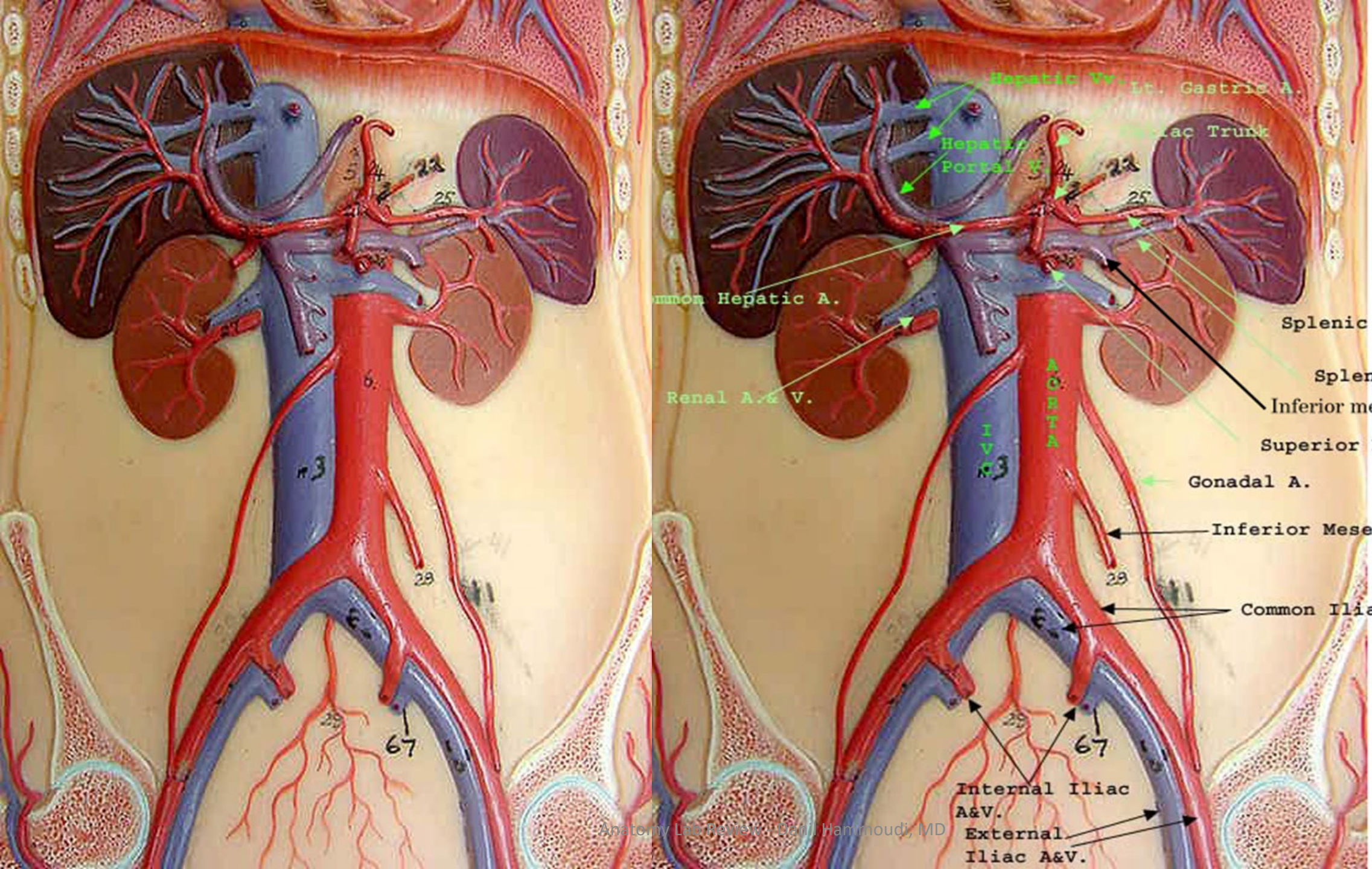
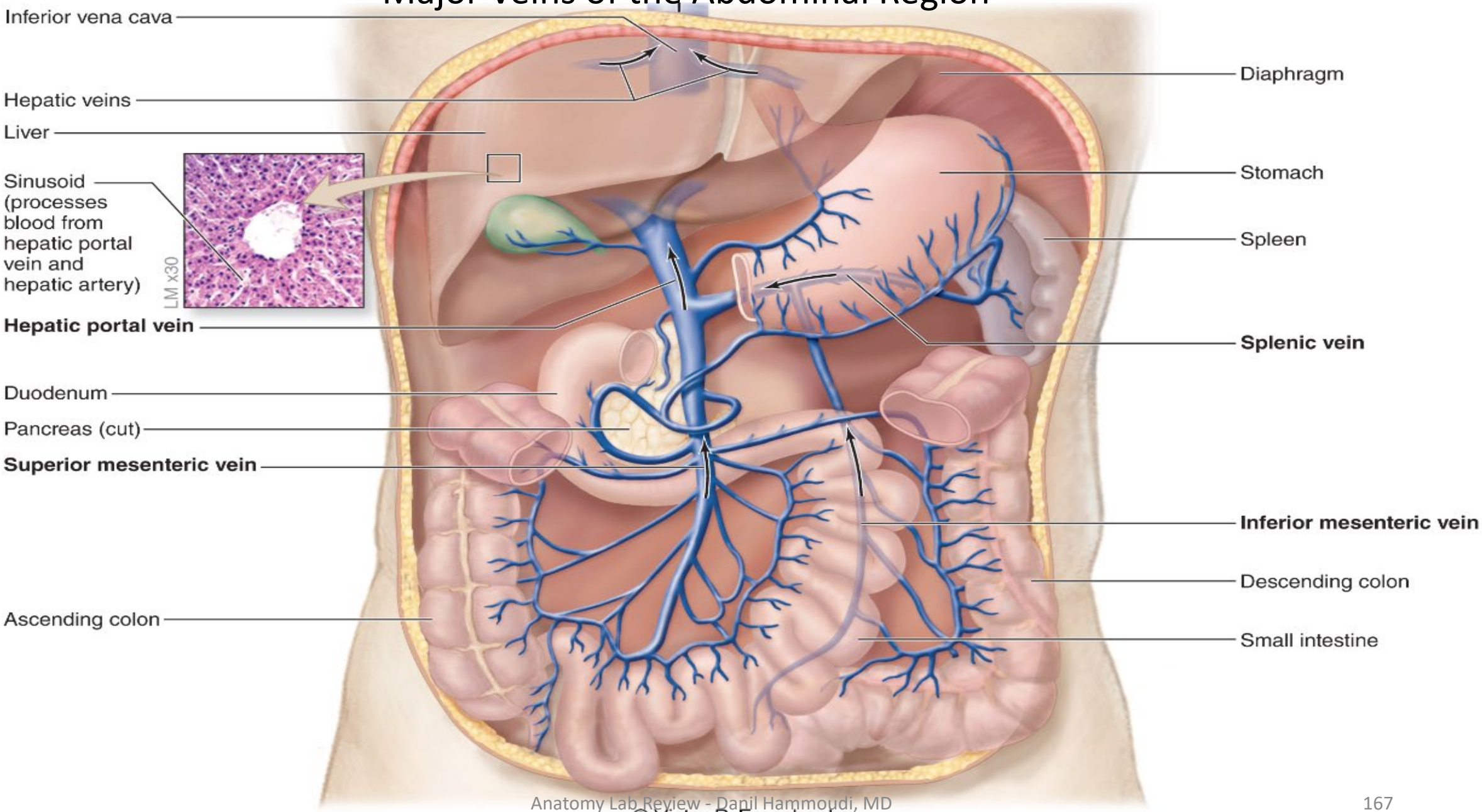
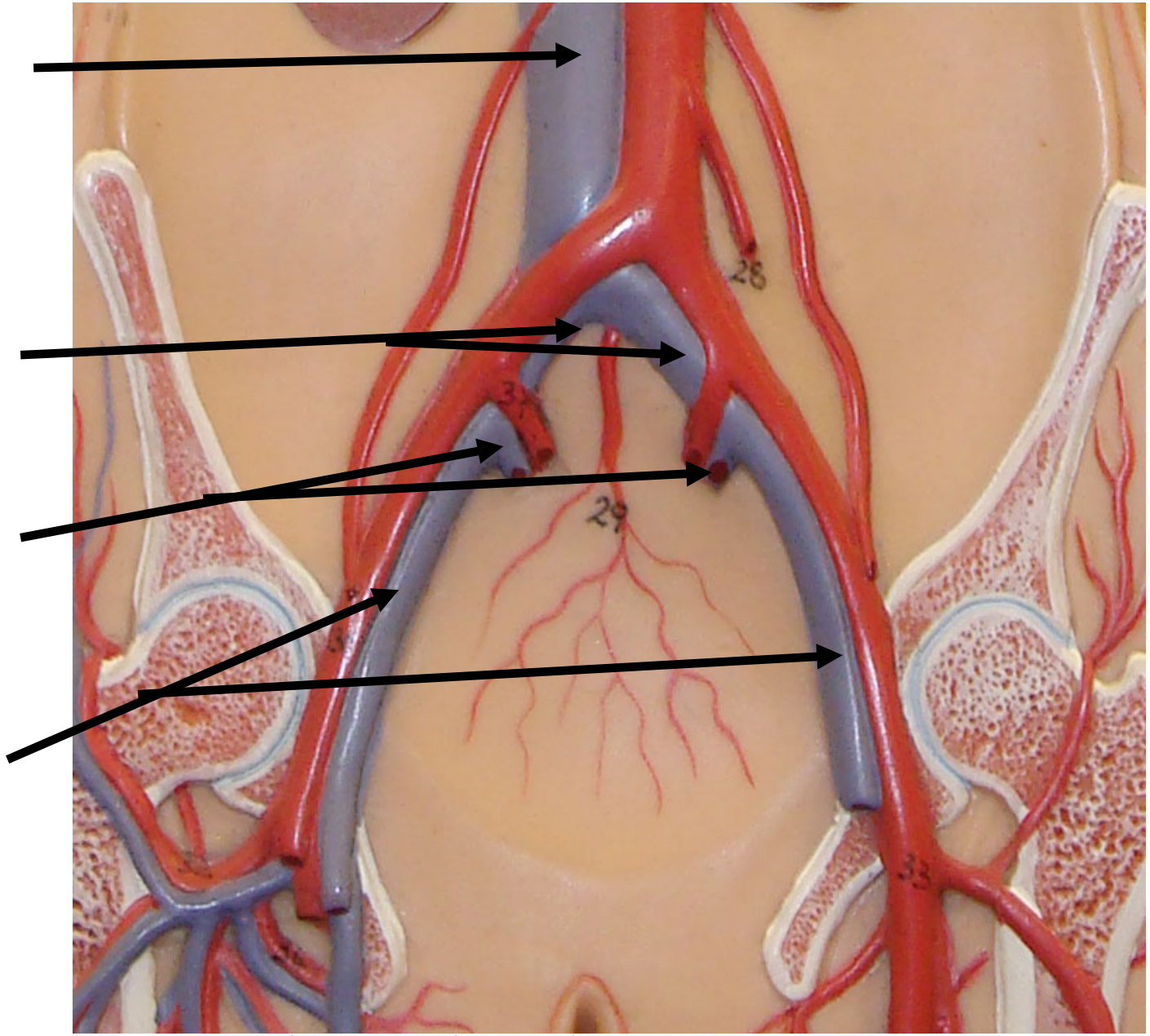

Hepatic Vv.
Lt. Gastric A.
Hepatic
Portal V.
Celiac Trunk
Common Hepatic A.
Renal A. & V.
Splenic A.
Splenic V.
Inferior mesenteric v.
Superior Mesenteric A.
Gonadal A.
Inferior Mesenteric A.
Common Iliac A&V.
Internal Iliac A&V.
External Iliac A&V.
AORTA
IVC

Major Veins of the Abdominal Region

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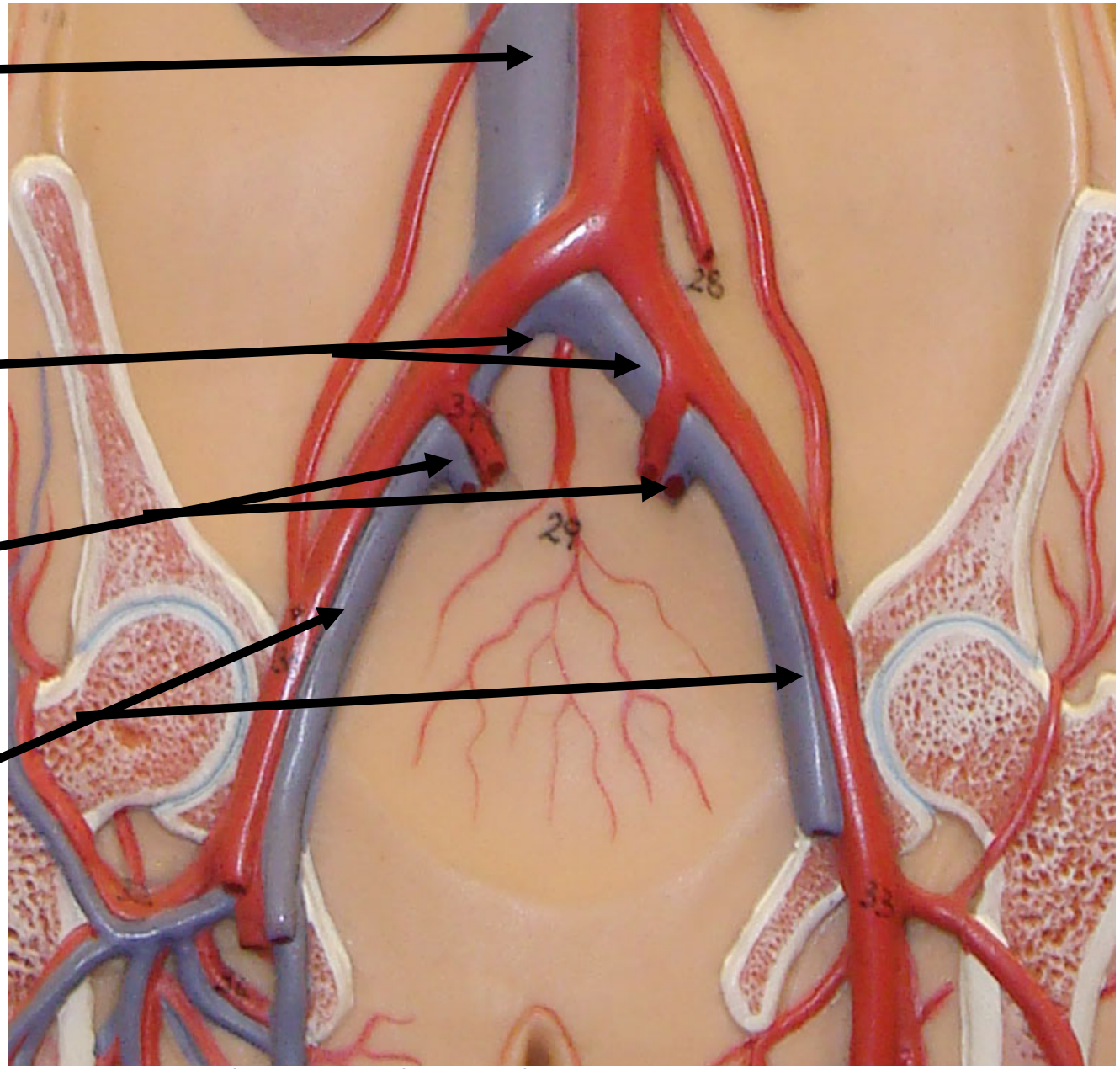
Inferior Vena Cava

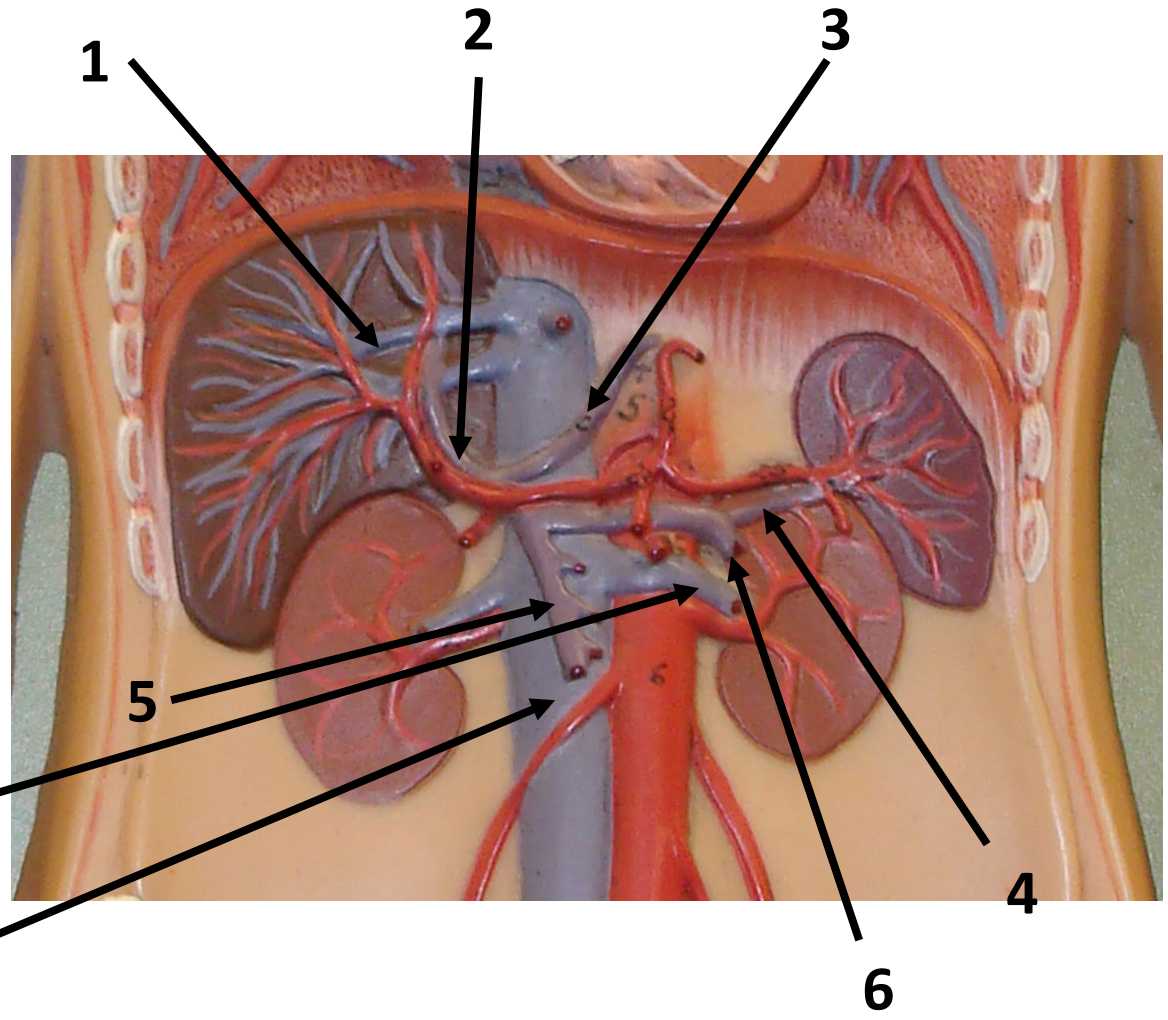
Common Iliac Vein

Internal Iliac Vein

External Iliac Vein



Hepatic Portal Vein: drains the blood of the digestive viscera, spleen and pancreas and delivers it to the liver. The hepatic portal vein receives blood from the Splenic Vein, Superior Mesenteric Vein, Gastric Vein and Inferior Mesenteric Vein.



Hepatic Vein (1)

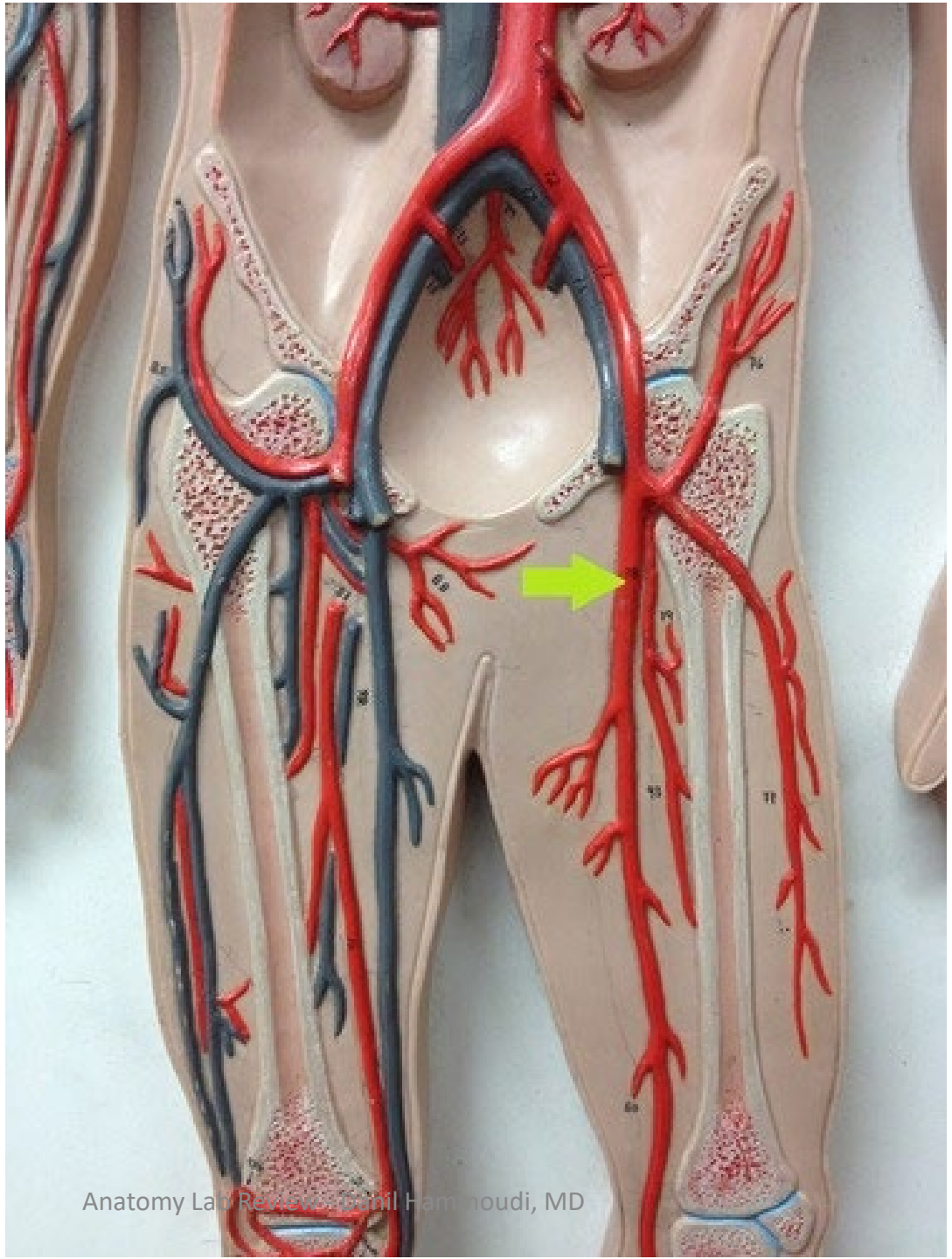
Hepatic Portal Vein (2)

Receives blood from the:

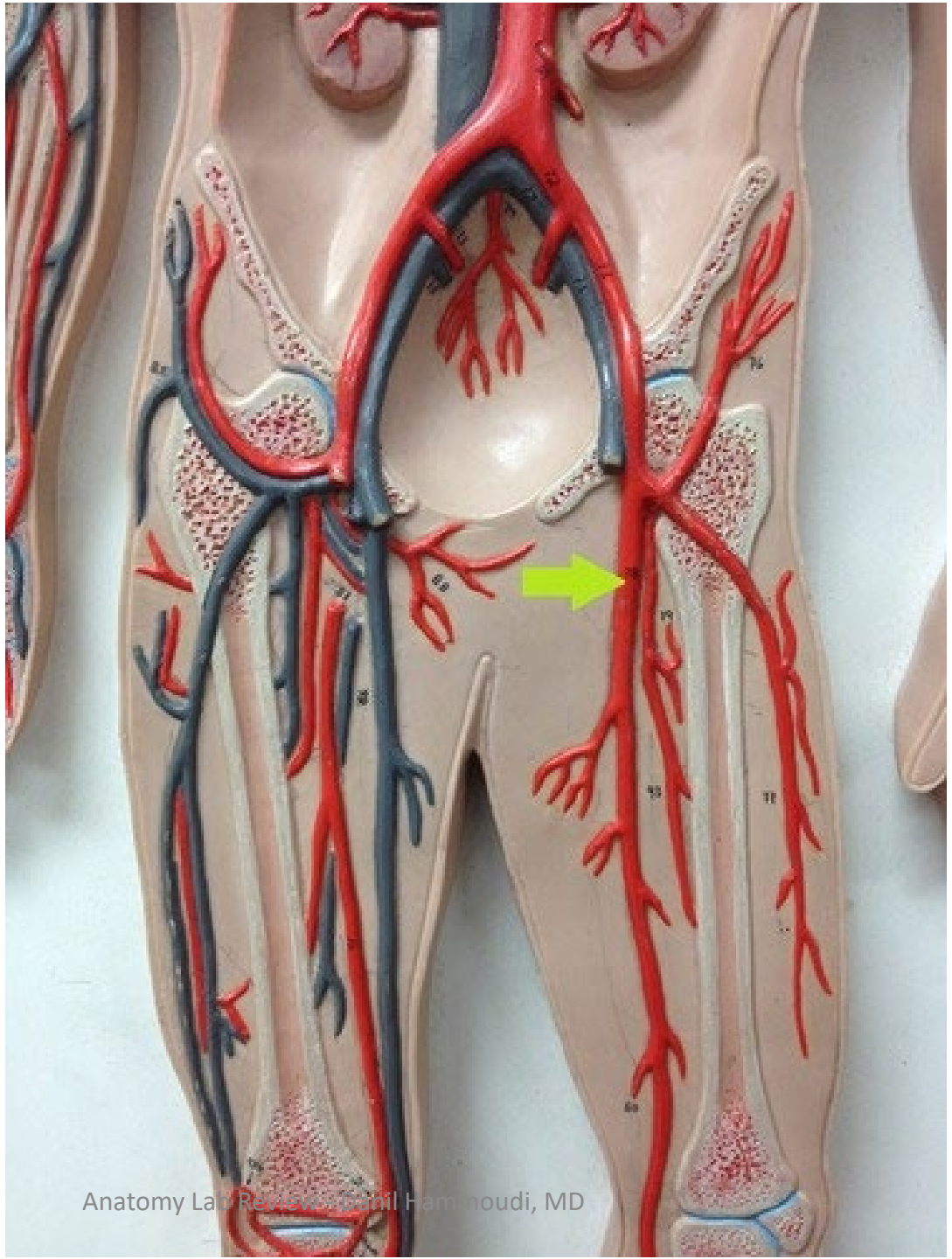
- **Gastric Vein (3)**
- **Splenic Vein (4)**
- **Superior Mesenteric Vein (5)**
- **Inferor Mesenteric Vein (6)**

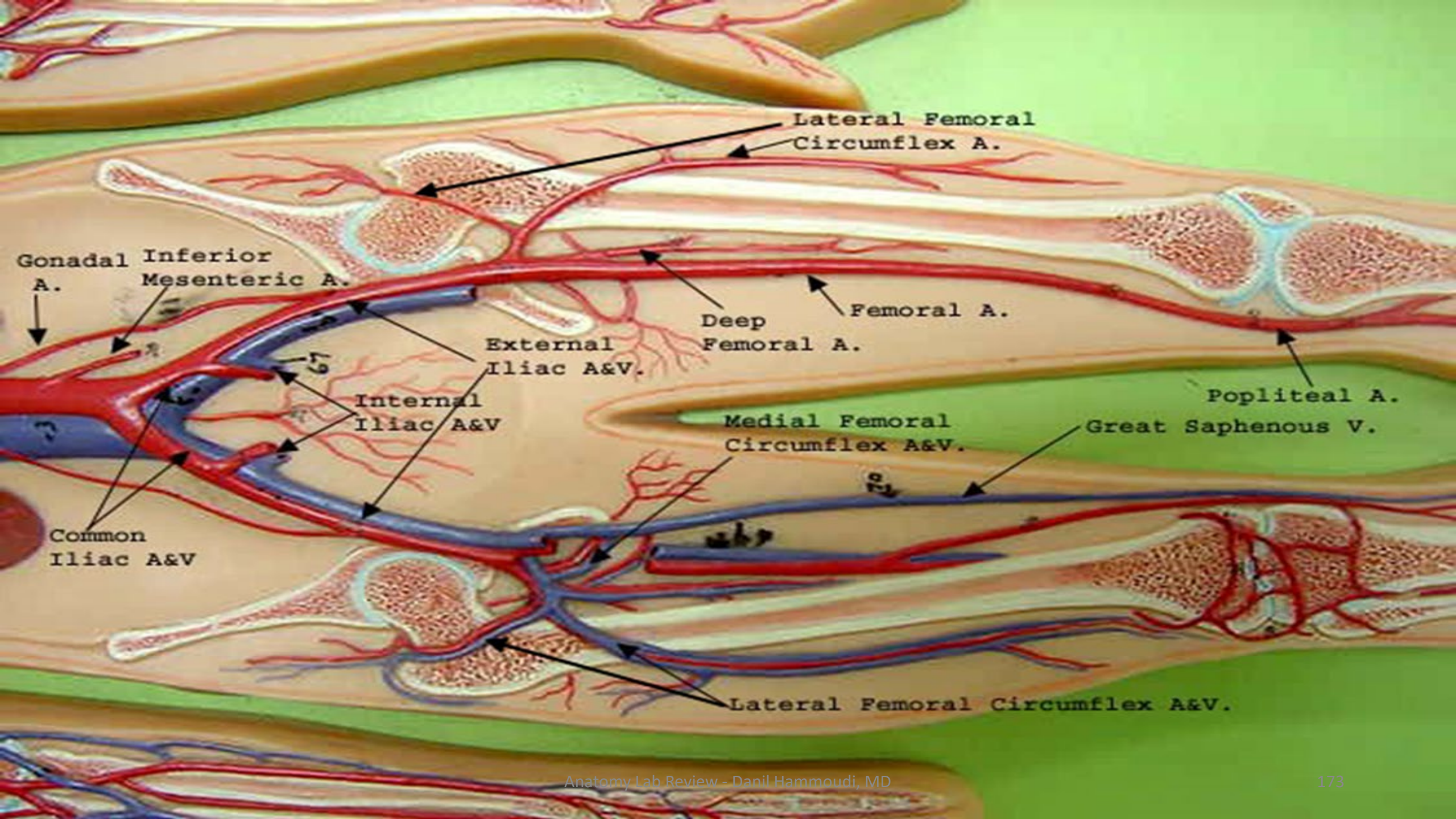
Renal Vein

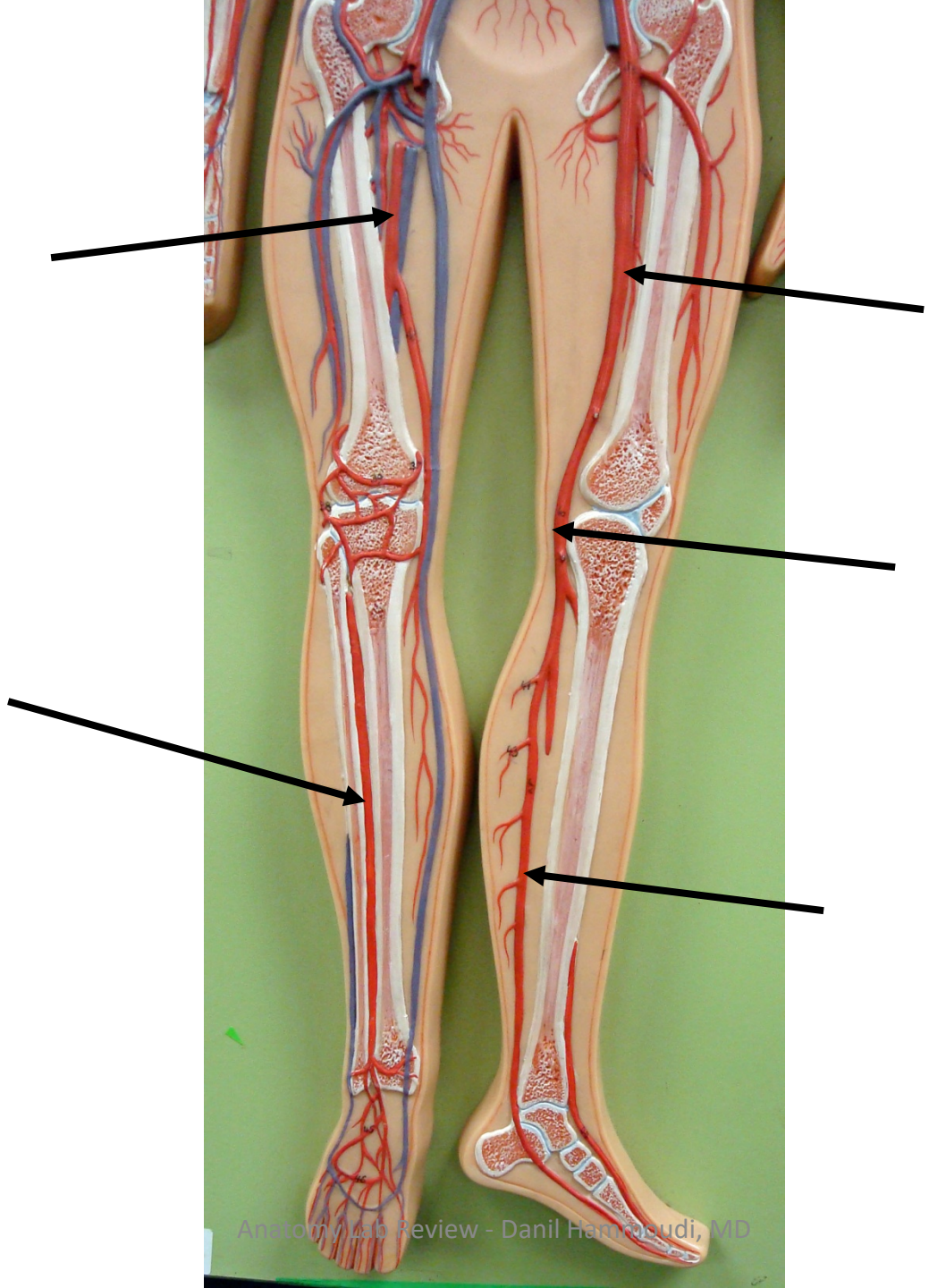
Inferior Vena Cava

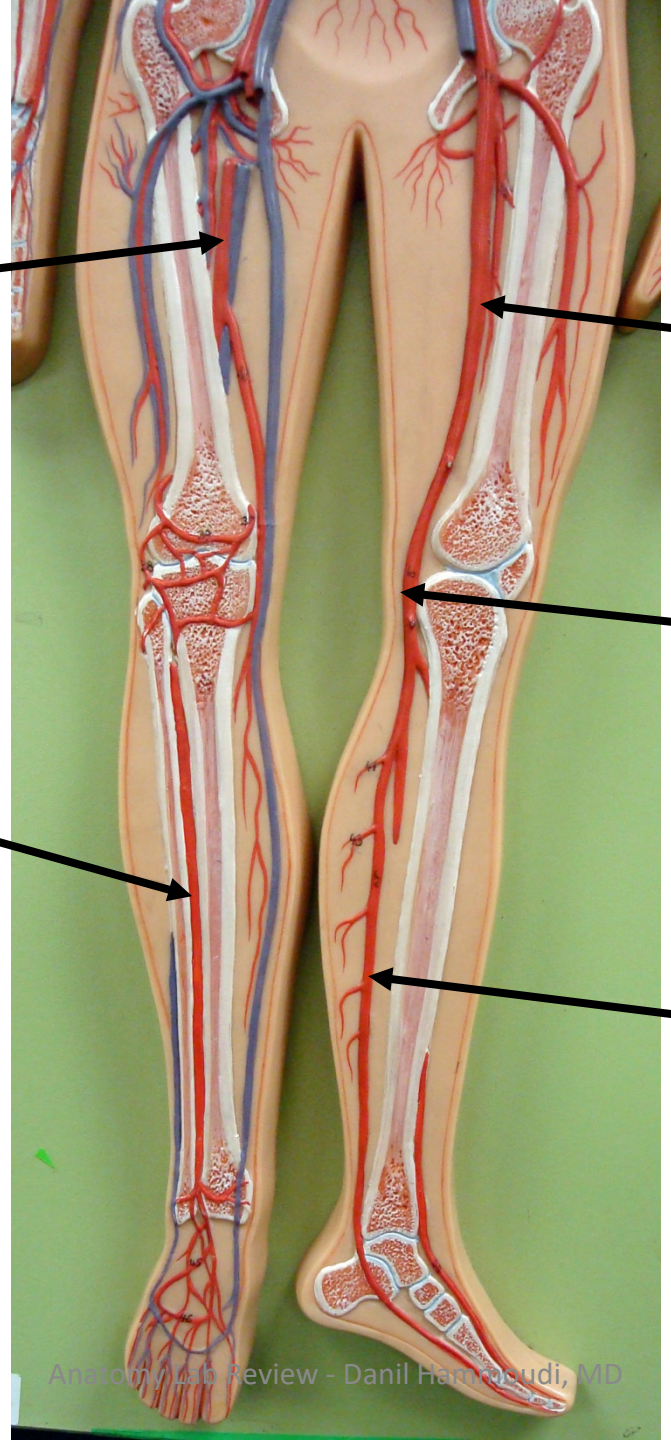


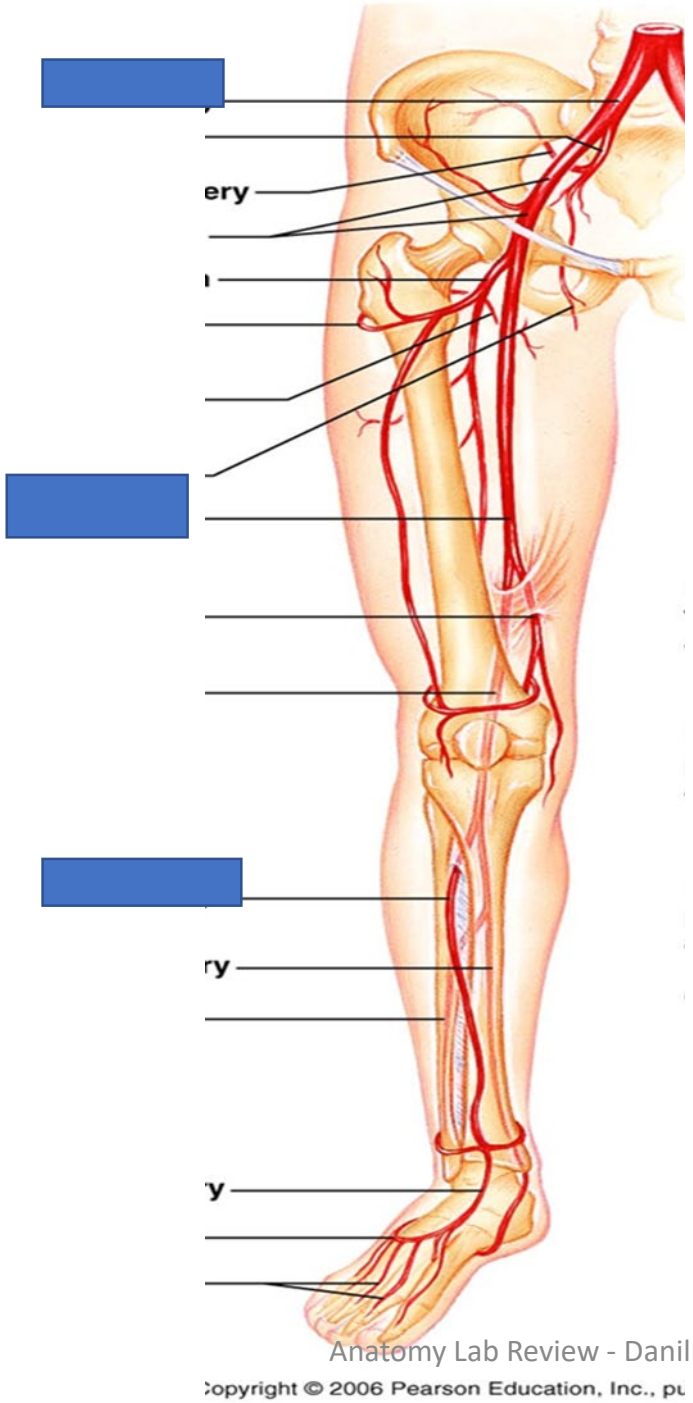
Left femoral atery




Lateral Femoral Circumflex A.
Gonadal A.
Inferior Mesenteric A.
Deep Femoral A.
Femoral A.
External Iliac A&V.
Popliteal A.
Internal Iliac A&V
Medial Femoral Circumflex A&V.
Great Saphenous V.
Common Iliac A&V
Lateral Femoral Circumflex A&V.




Femoral Artery
Femoral Artery
Popliteal Artery
Anterior Tibial Artery
Posterior Tibial Artery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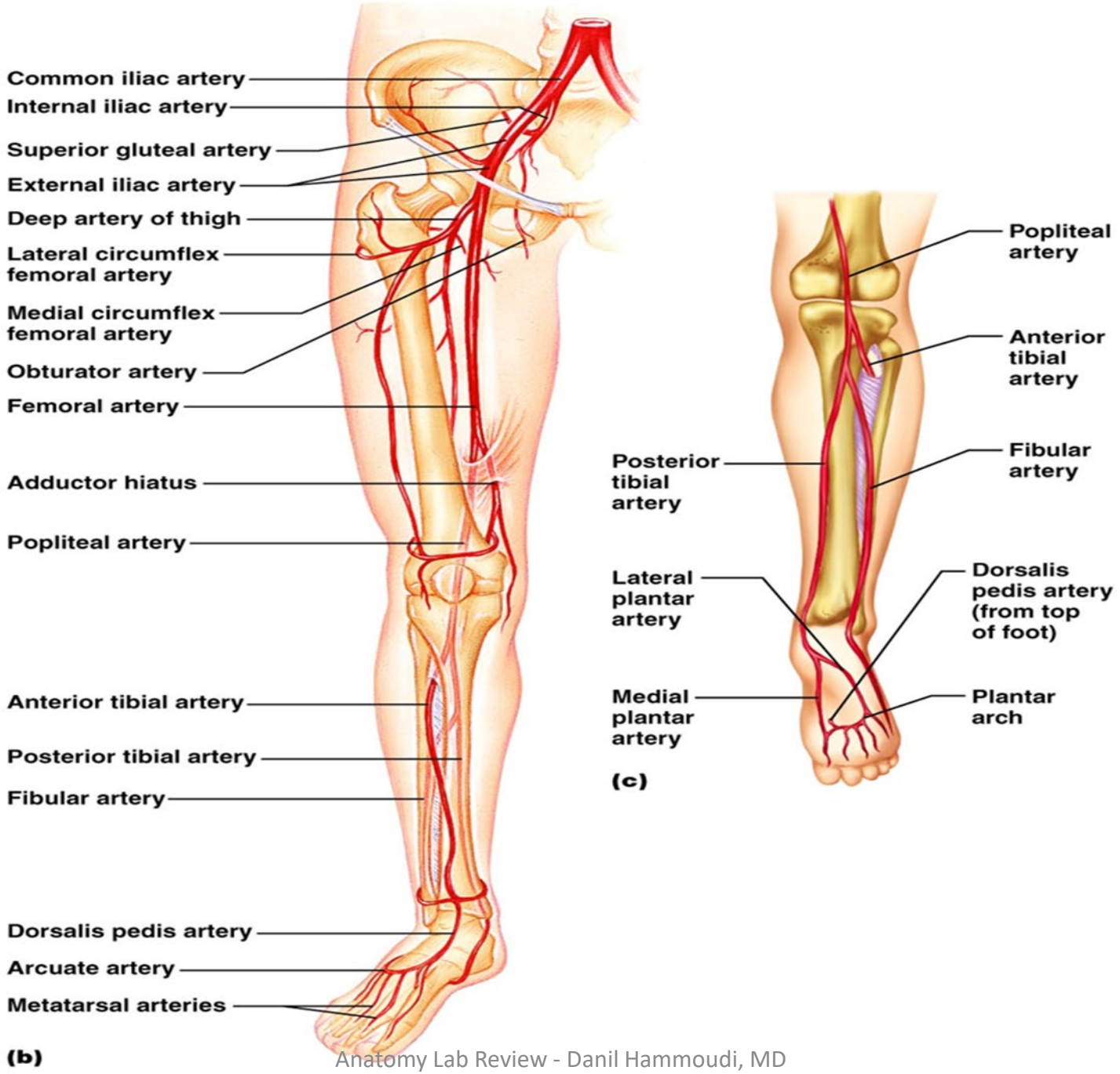
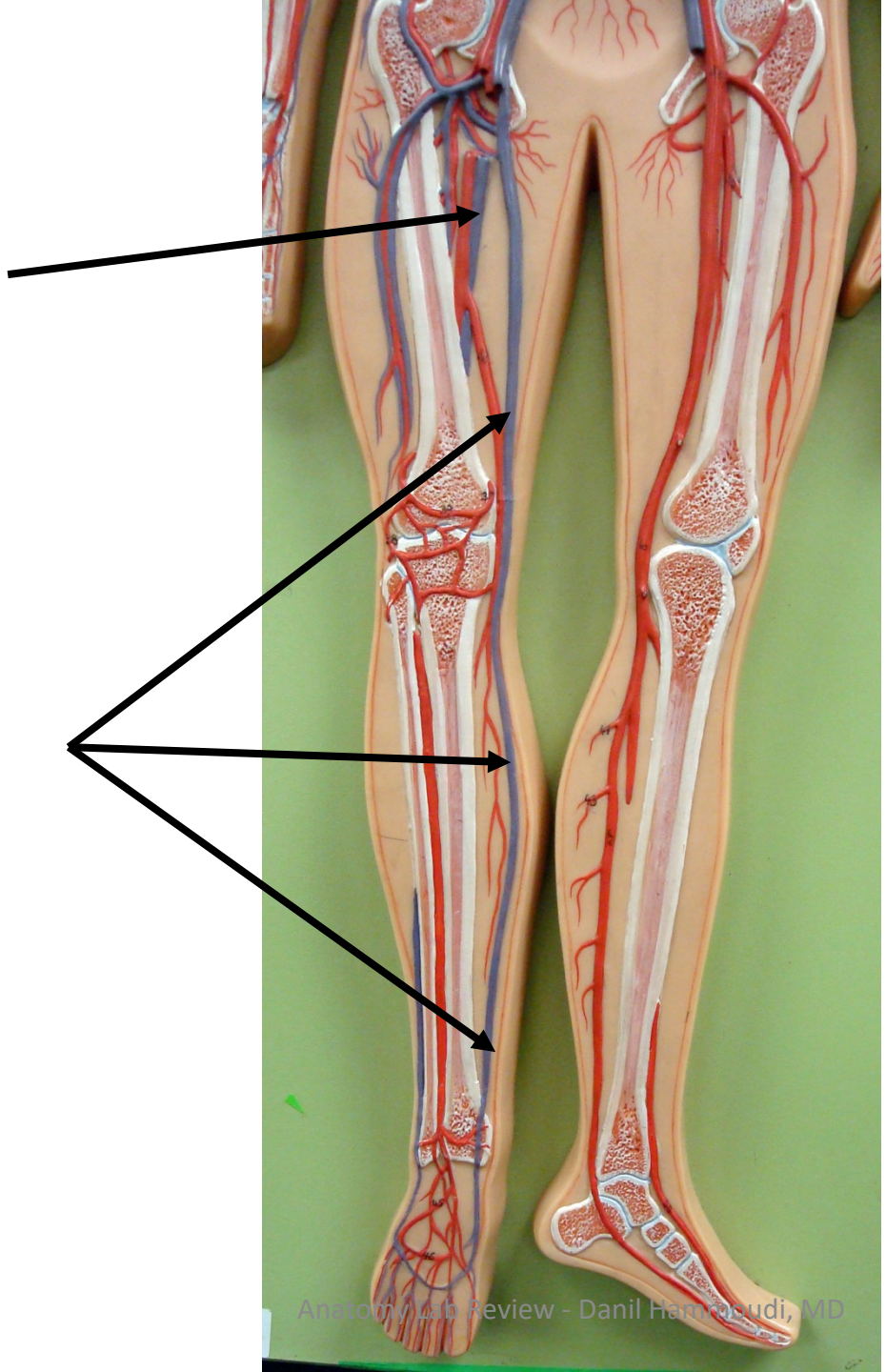
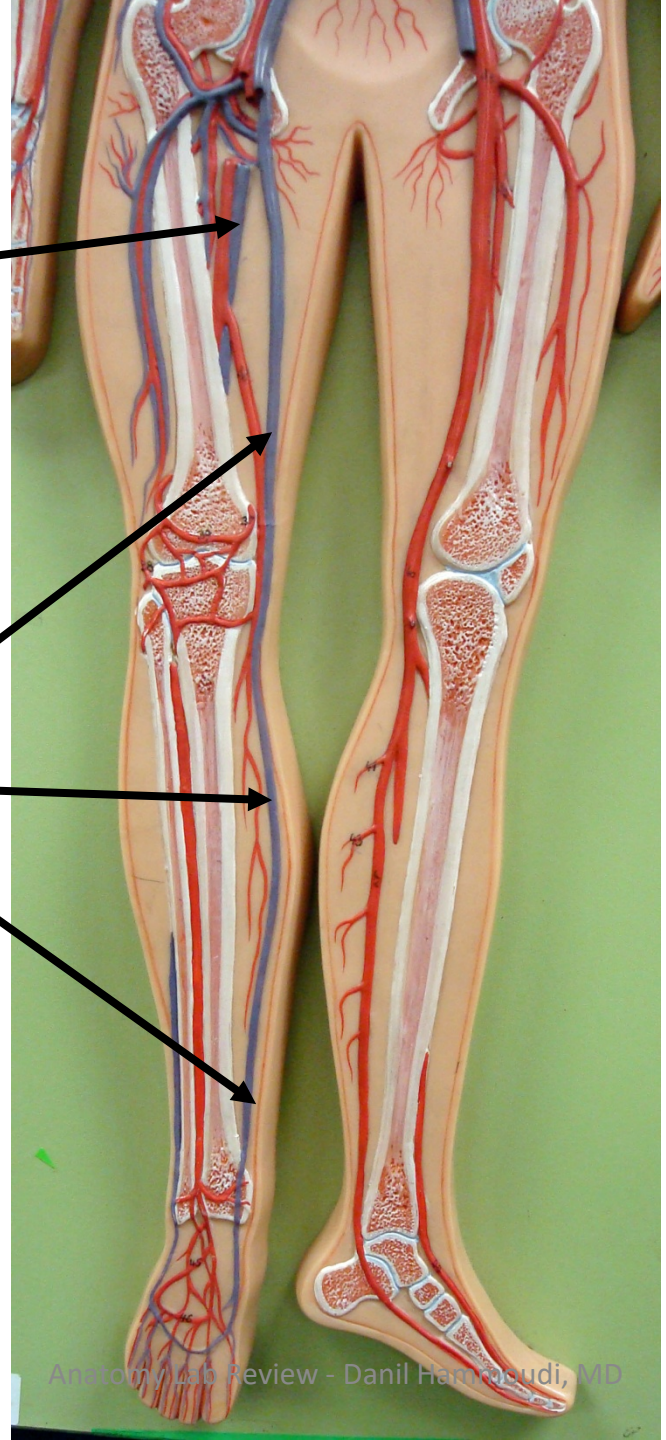
Copyright © 2006 Pearson Education, Inc., pu

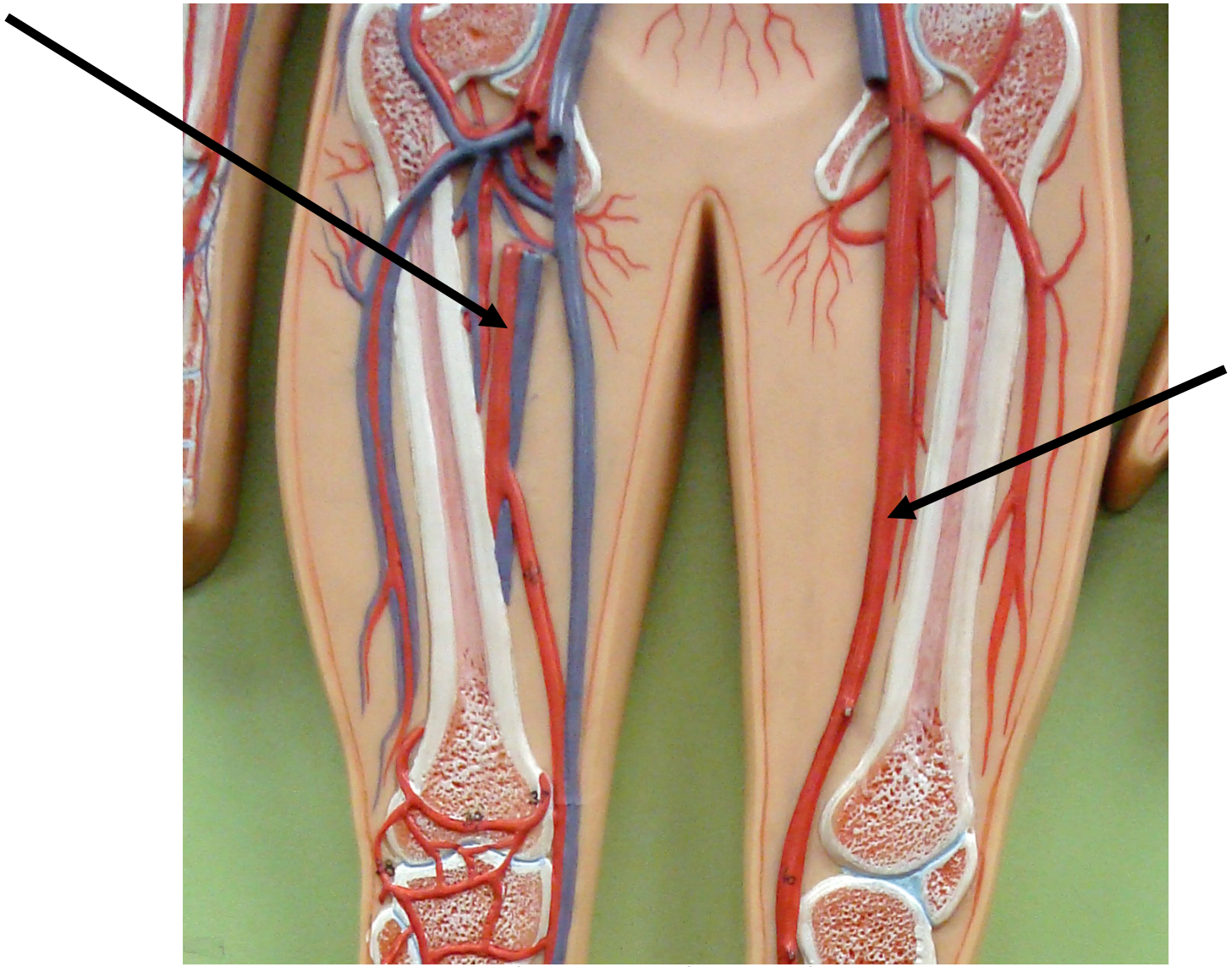




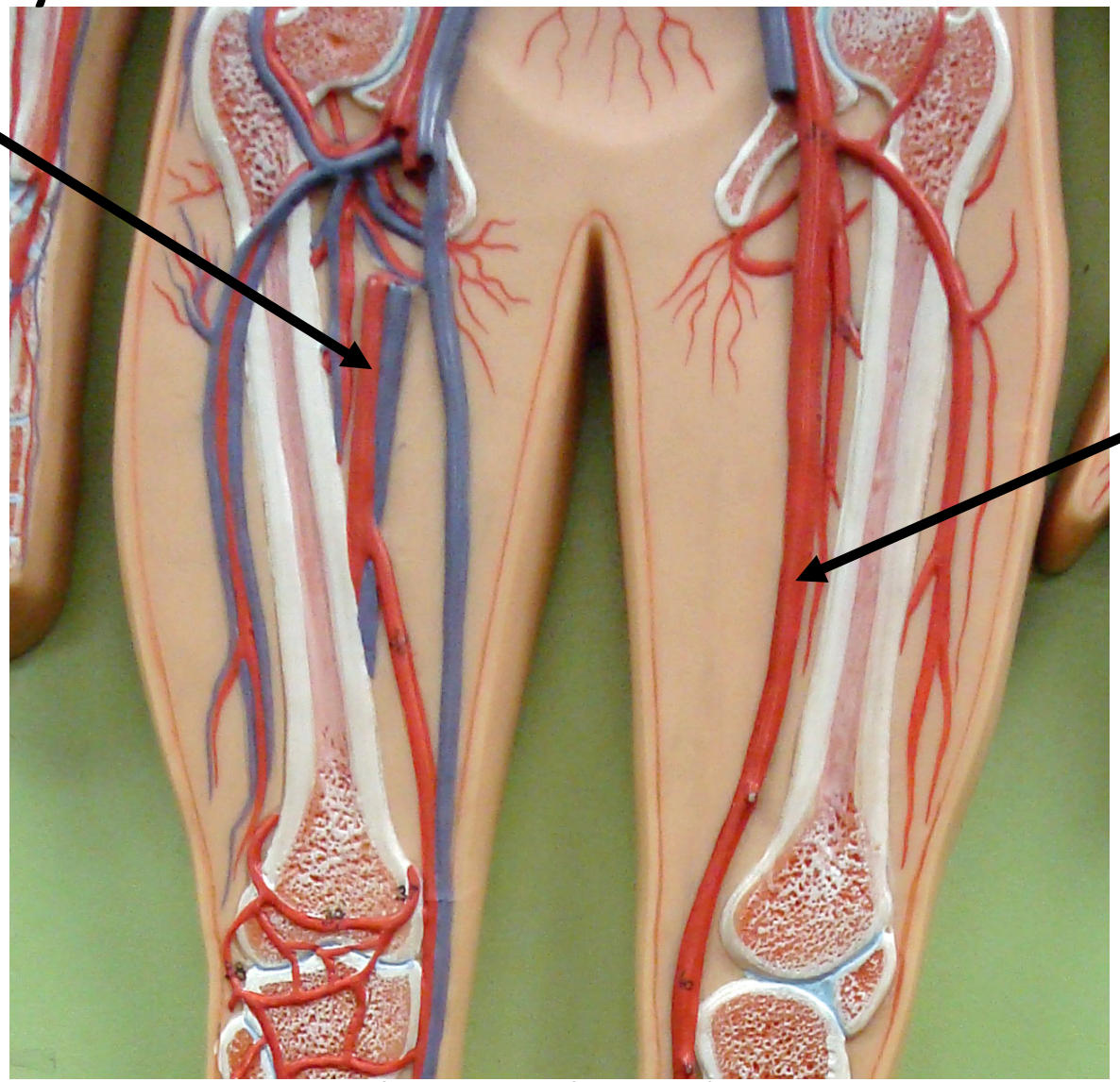
Femoral Vein

Great Saphenous Vein

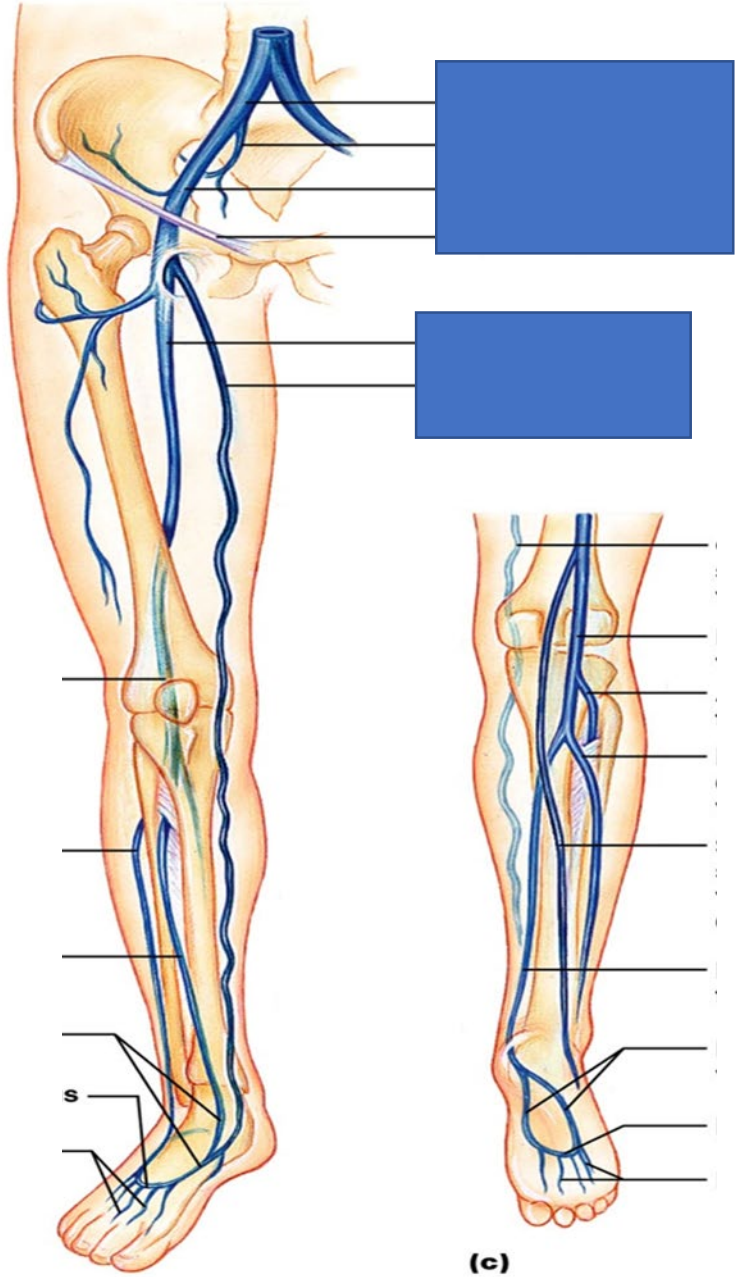


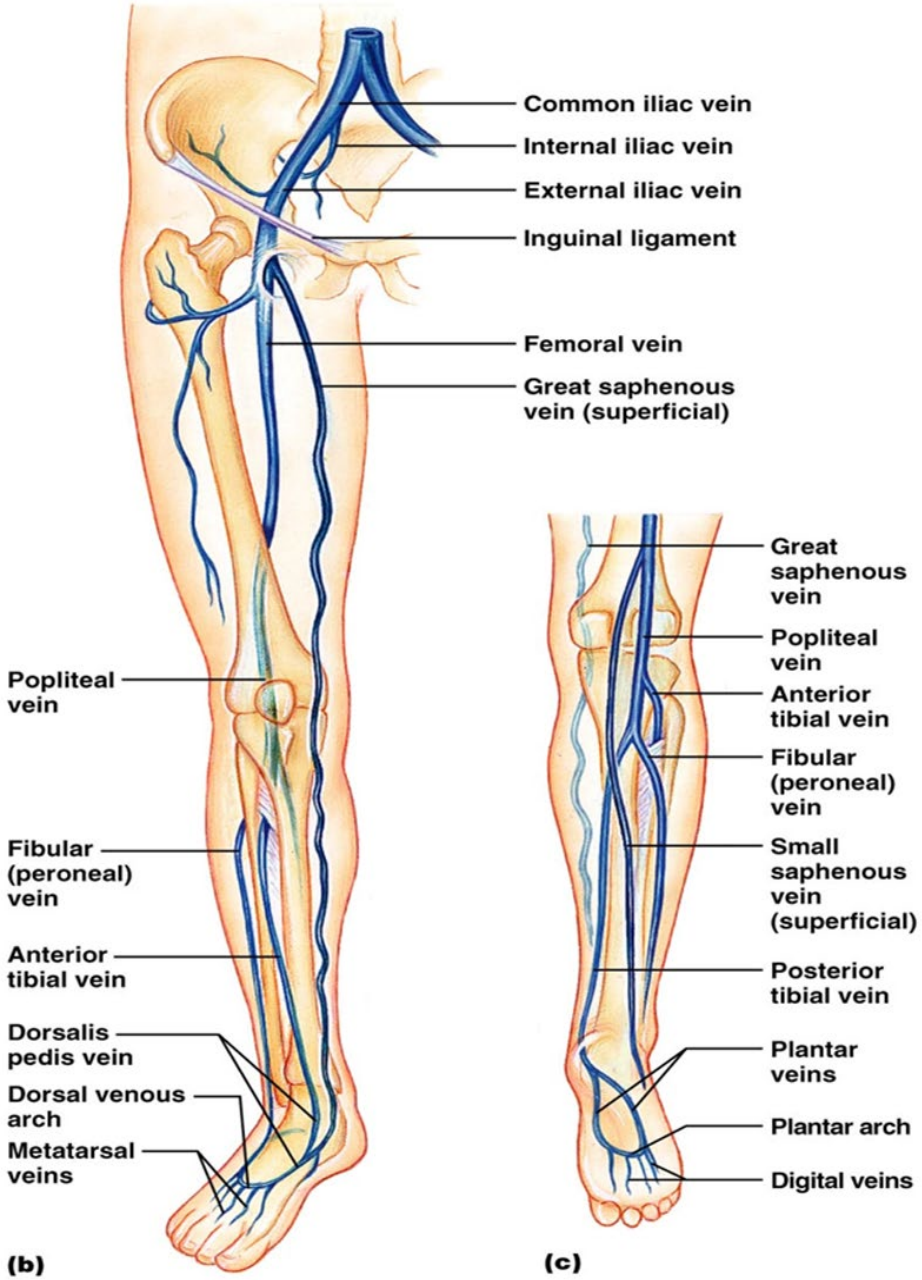


Femoral Artery

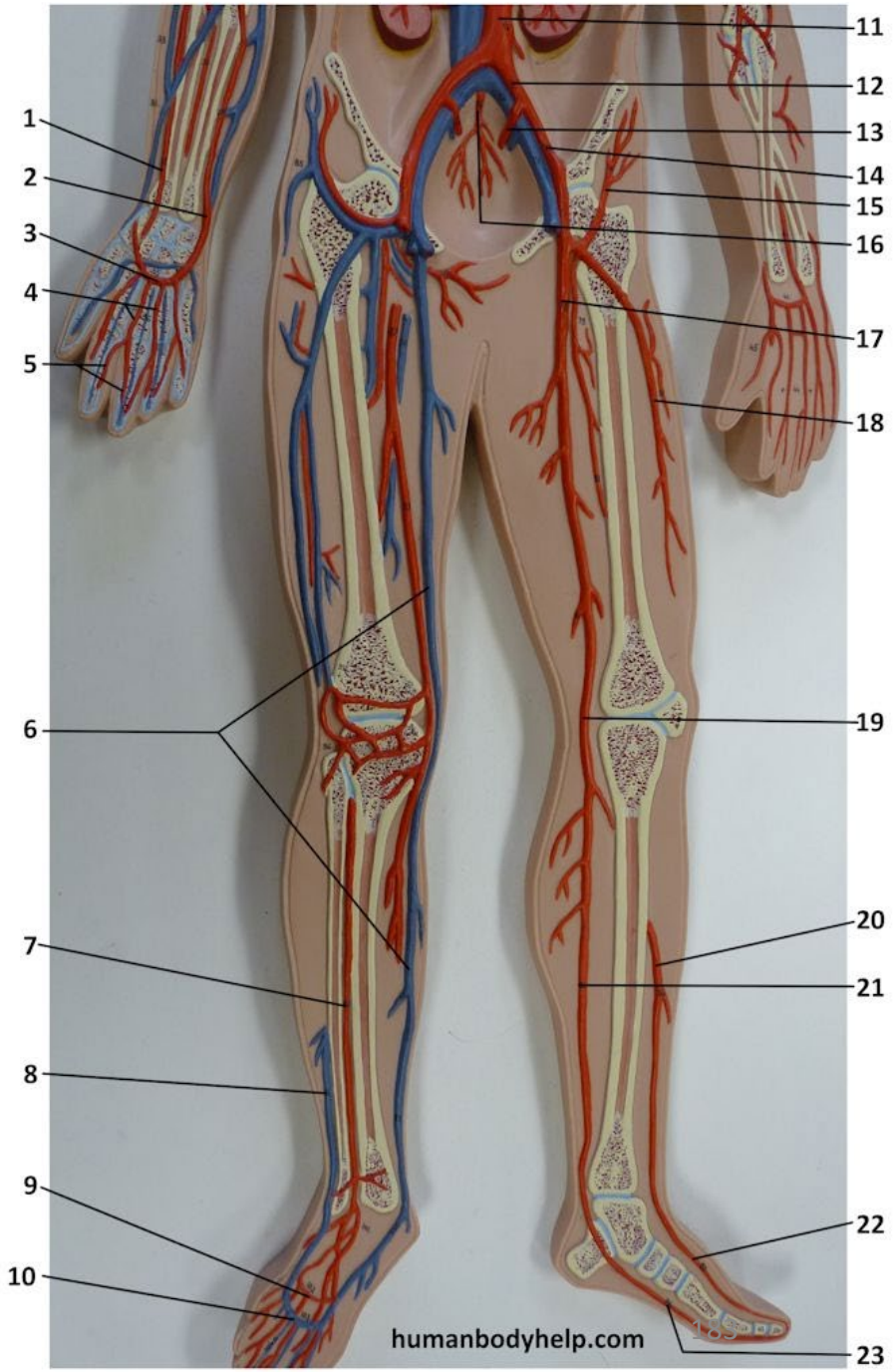


Femoral Artery





1.Radial artery (a.)
2.Ulnar a.
3.Superficial palmar arch
4.Common palmar digitals
5.Proper palmar digitals
6.Great saphenous vein (v.)
7.Anterior tibial a.
8.Small Saphenous v.
9.Arcuate a. (Superficial plantar arch)
10.Dorsal venous arch
11.Abdominal aorta
12.Common iliac a.
13.Internal iliac a.
14.External iliac a.
15.Lateral femoral circumflex a. (ascending branch)
16.Median sacral a.
17.Femoral a.
18.Lateral femoral circumflex a. (descending branch)
19.Popliteal a. (notice: behind the knee)
20.Anterior tibial a.
21.Posterior tibial a.
22.Dorsal pedal a.
23.Medial plantar a.



Deep System

Common Femoral Vein

Deep Femoral Vein

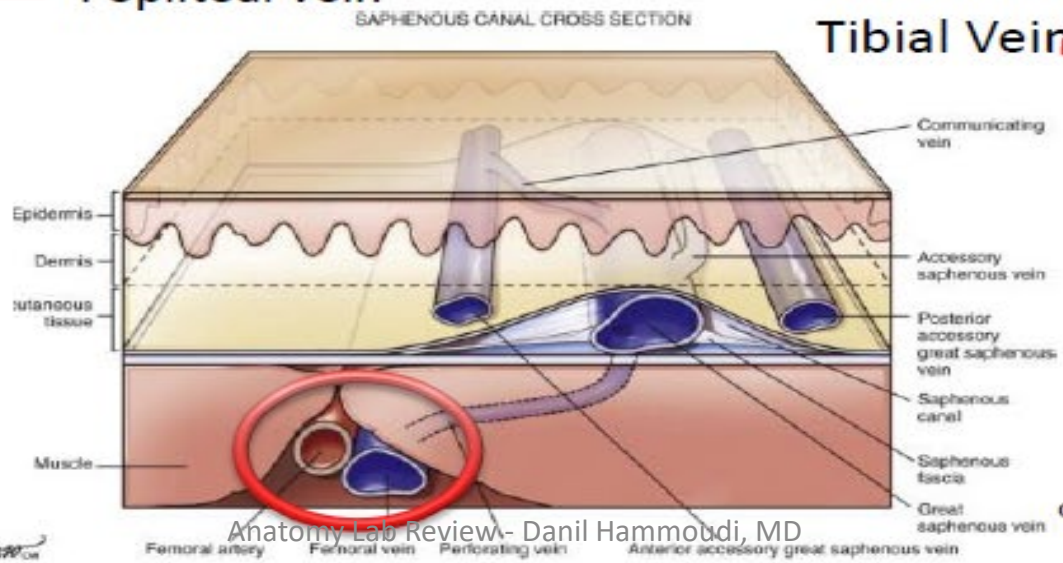
Femoral Vein

Popliteal Vein

Posterior Tibial Vein

Peroneal Vein

Anterior Tibial Vein



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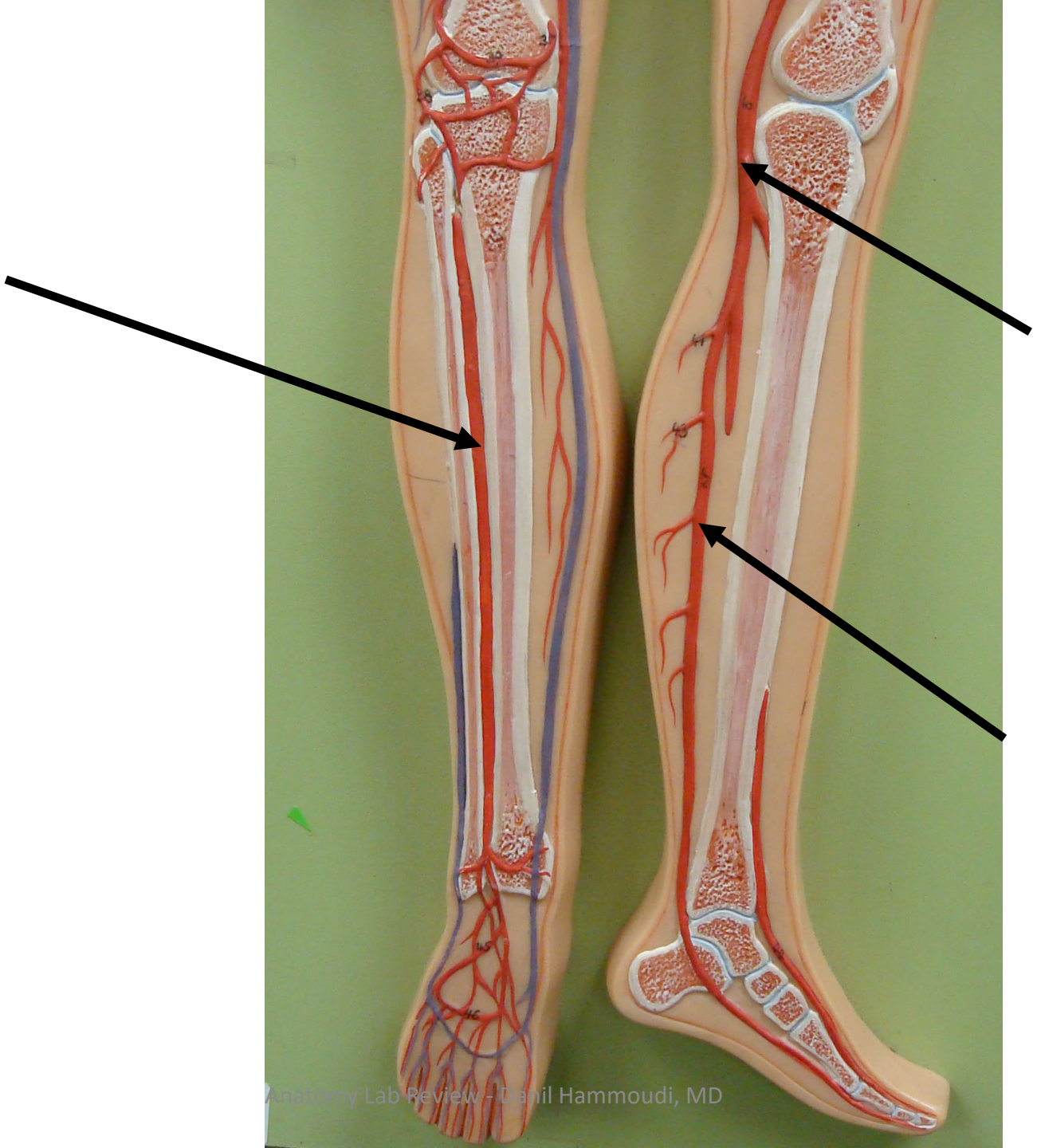
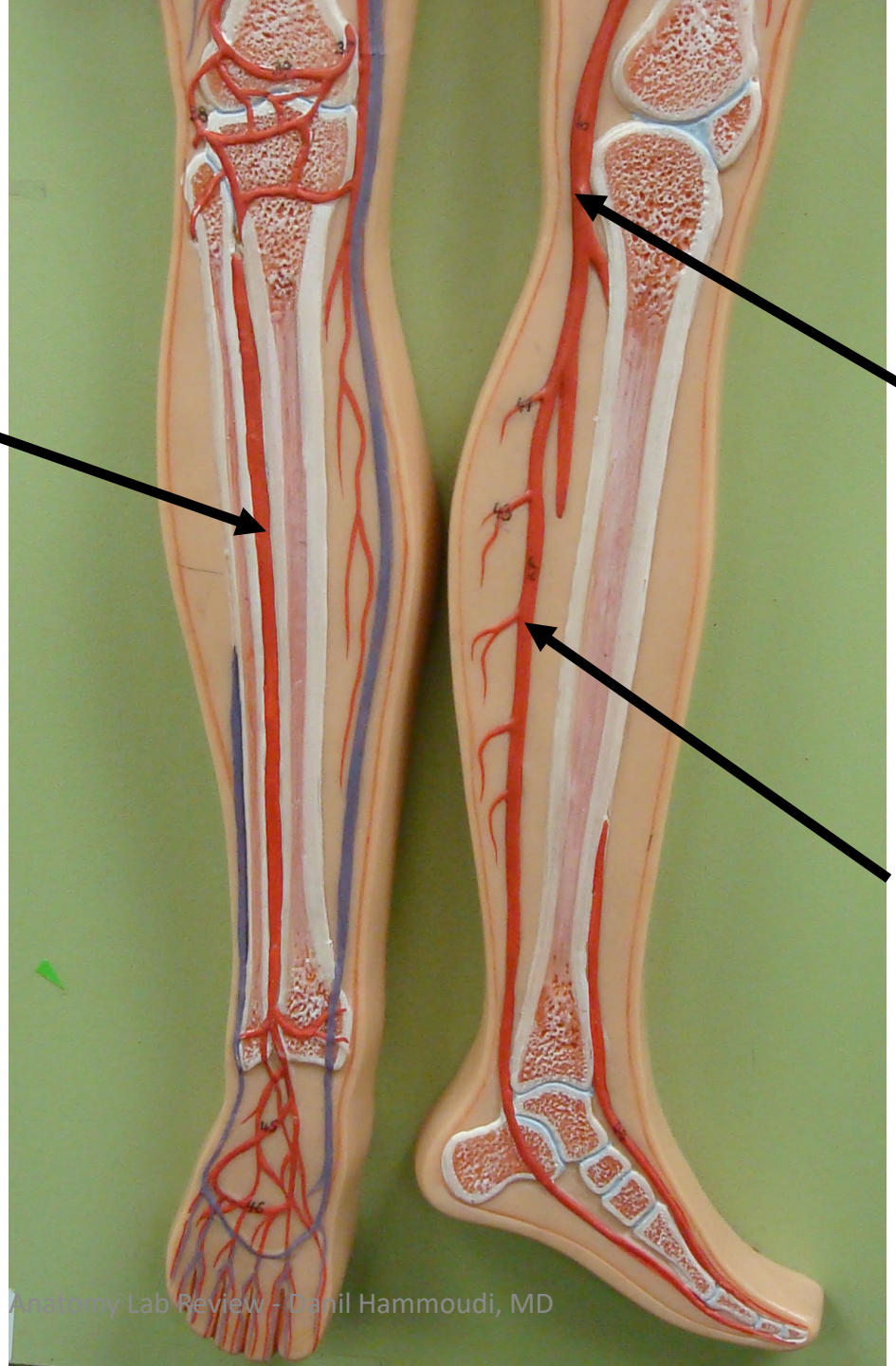


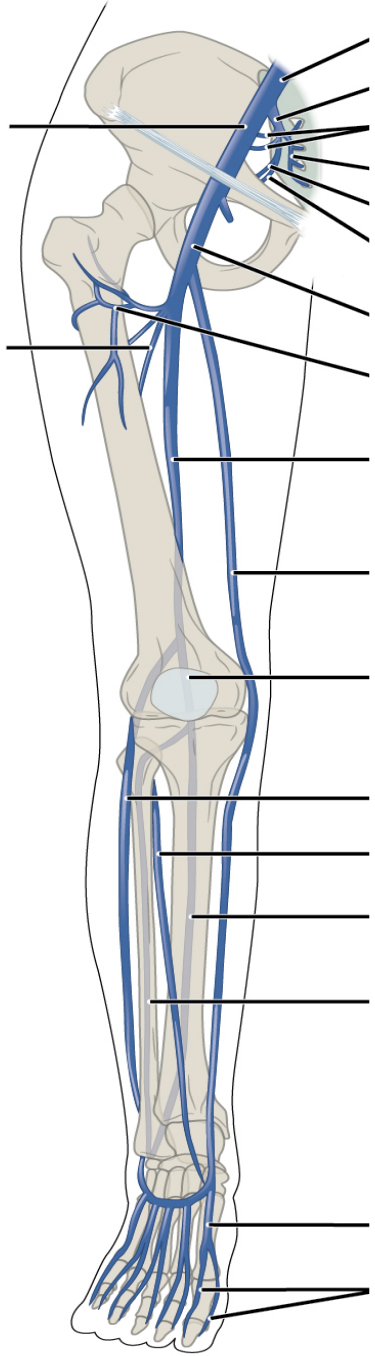
Anterior Tibial Artery



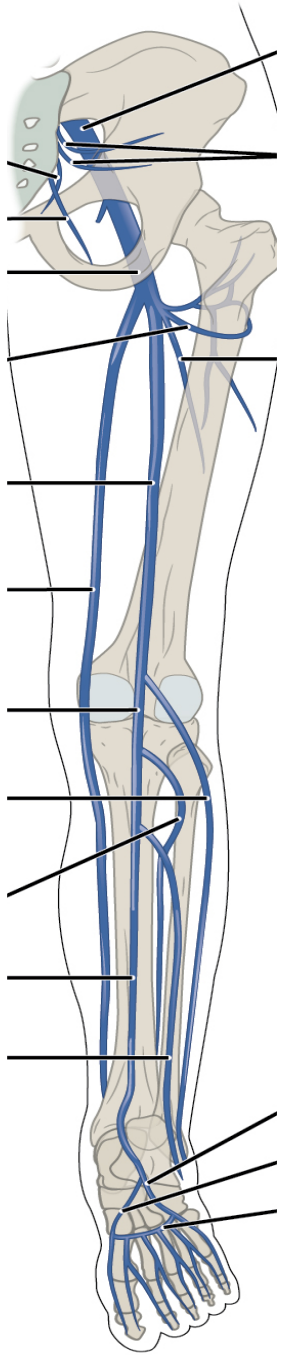
Popliteal Artery

Posterior Tibial Artery

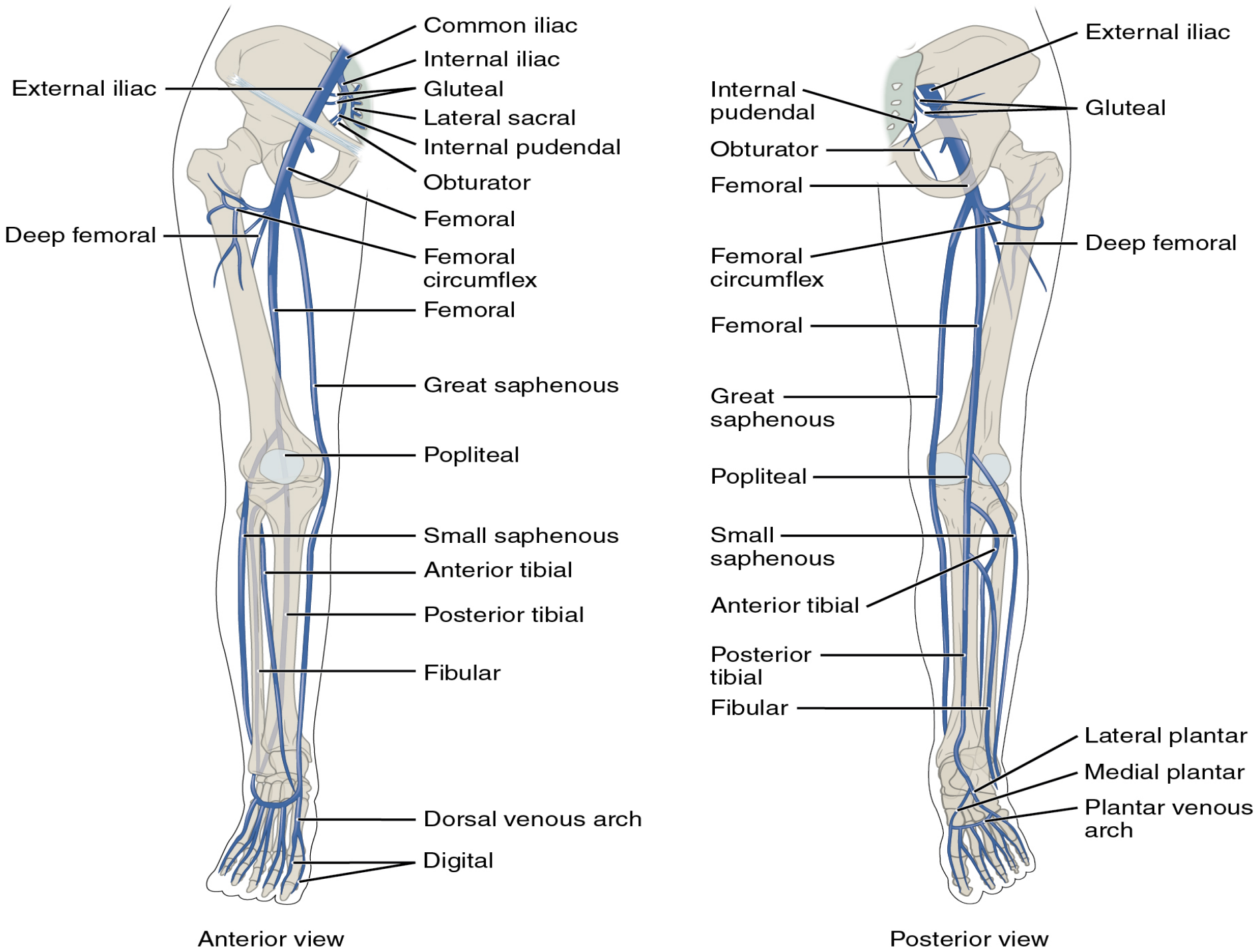
PRACTICE!



Anterior view



Posterior view


Common iliac
Internal iliac
External iliac
Gluteal
Lateral sacral
Internal pudendal
Obturator
Femoral
Deep femoral
Femoral circumflex
Femoral
Great saphenous
Popliteal
Small saphenous
Anterior tibial
Posterior tibial
Fibular
Dorsal venous arch
Digital
Anterior view
External iliac
Internal pudendal
Gluteal
Obturator
Femoral
Deep femoral
Femoral circumflex
Femoral
Great saphenous
Popliteal
Small saphenous
Anterior tibial
Posterior tibial
Fibular
Lateral plantar
Medial plantar
Plantar venous arch
Posterior view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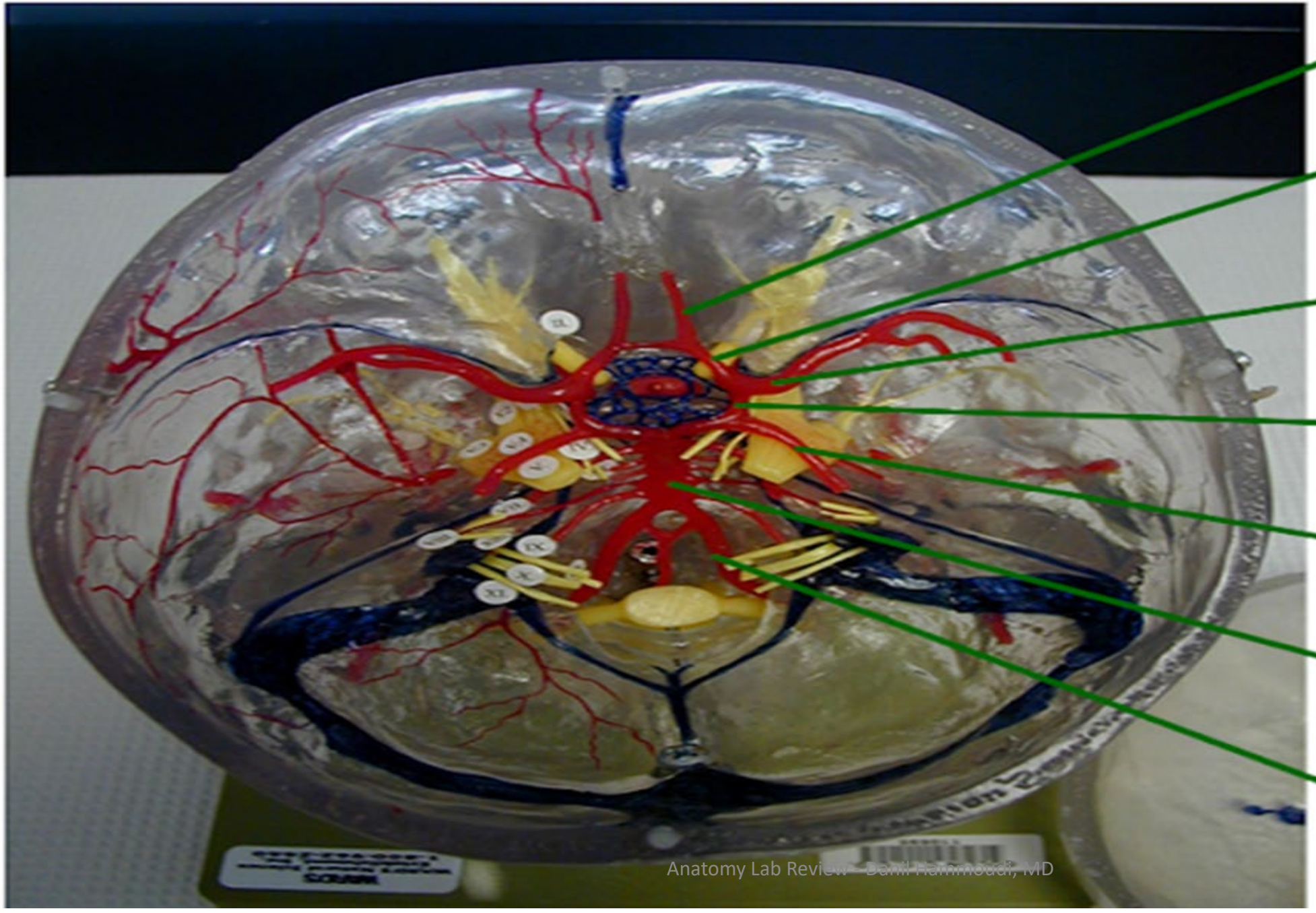
Circle of Willis



Anterior Cerebral artery

Anterior Communicating artery

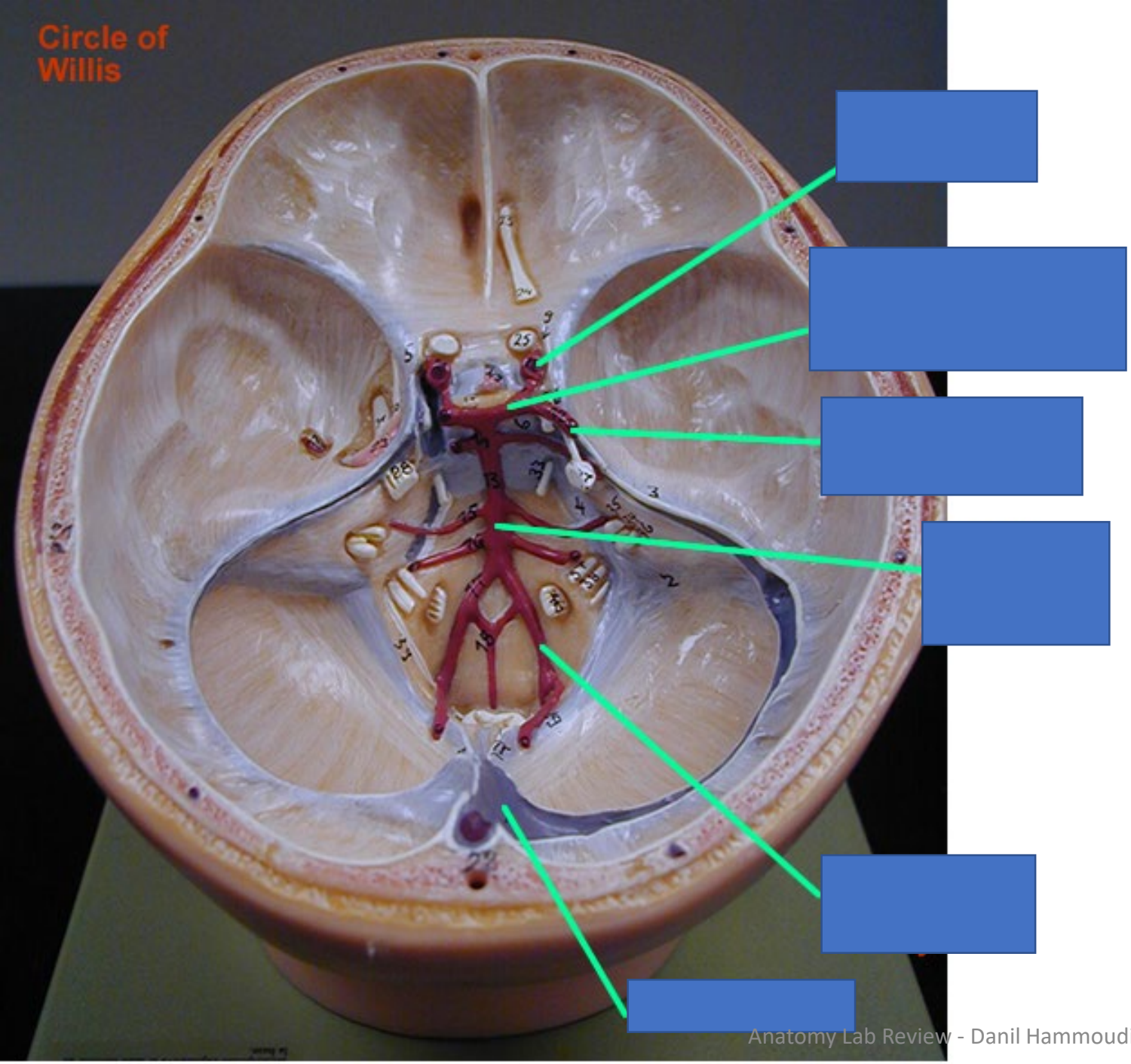
Middle Cerebral artery

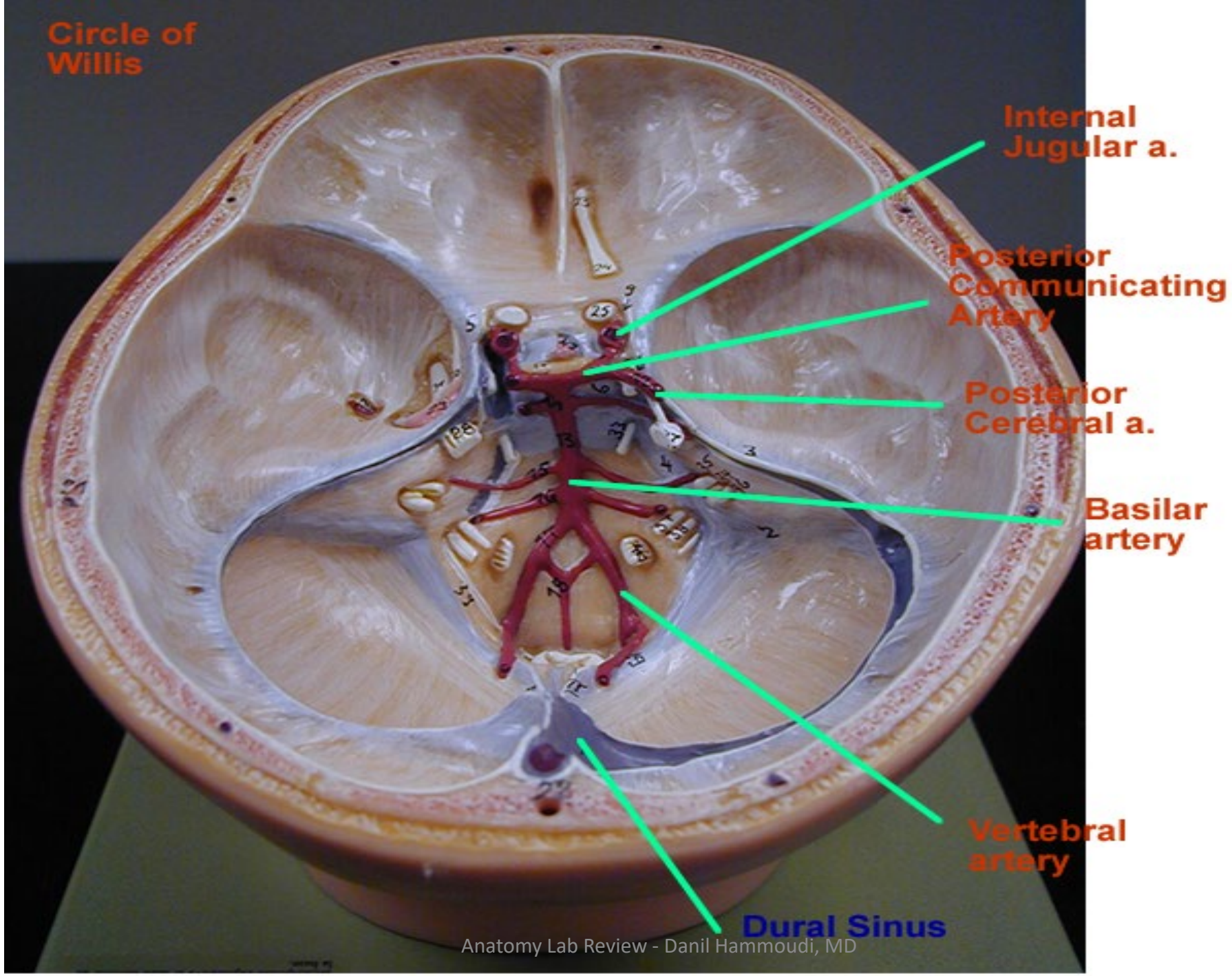
Posterior Communicating artery

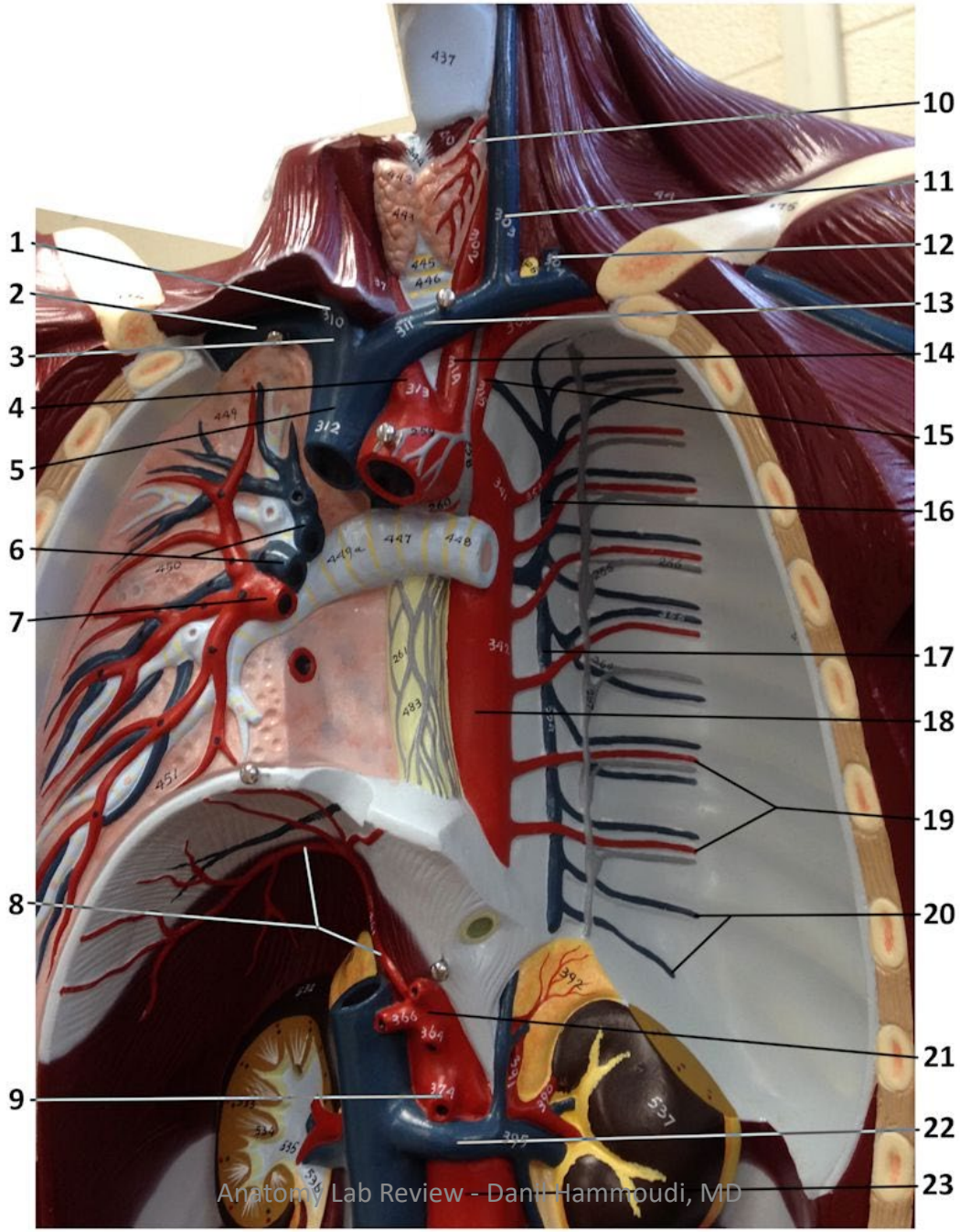
Posterior Cerebral artery

Basilar artery

Vertebral artery


Circle of
Willis


Circle of Willis
Internal Jugular a.
Posterior Communicating Artery
Posterior Cerebral a.
Basilar artery
Vertebral artery
Dural Sinus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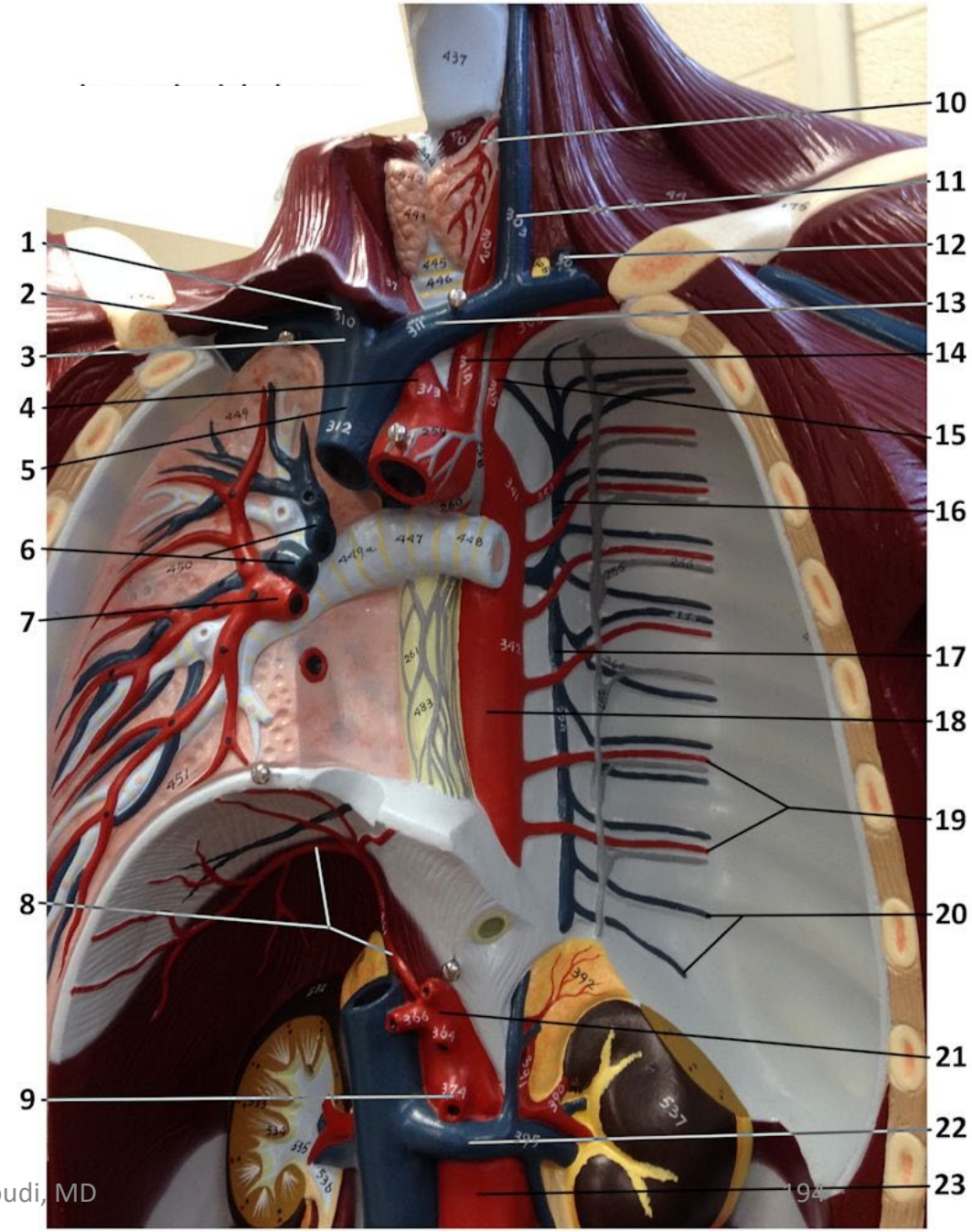
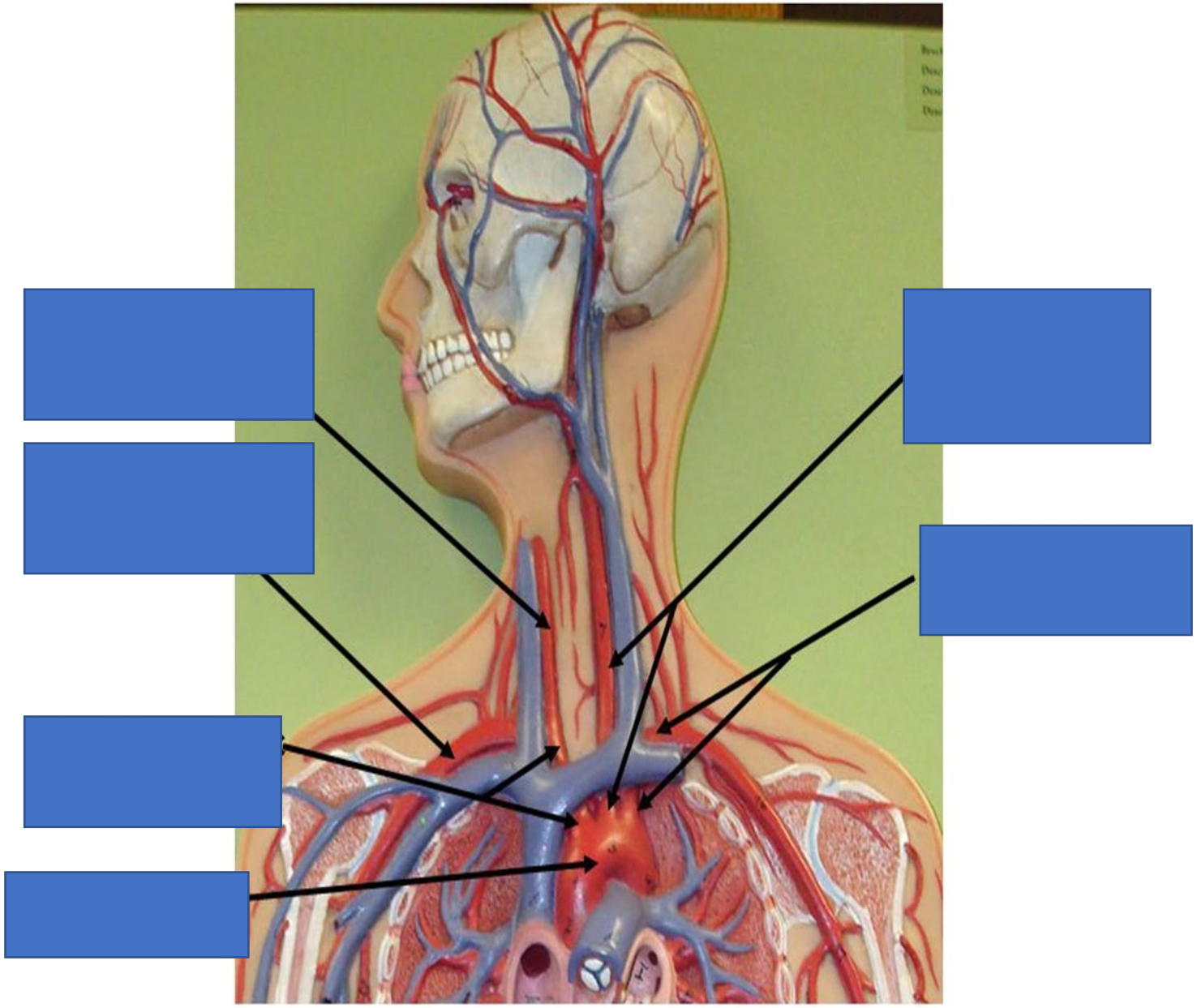
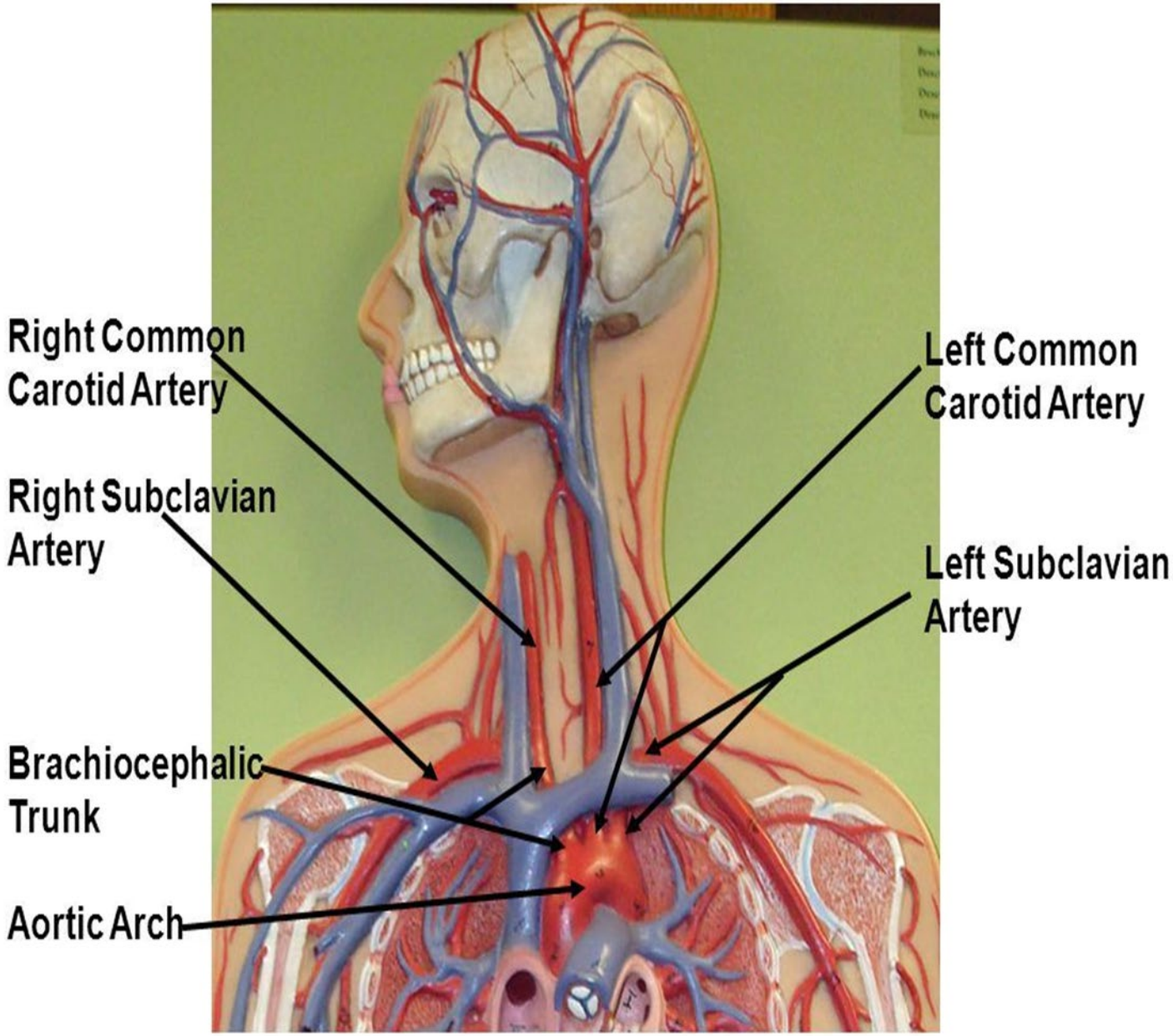
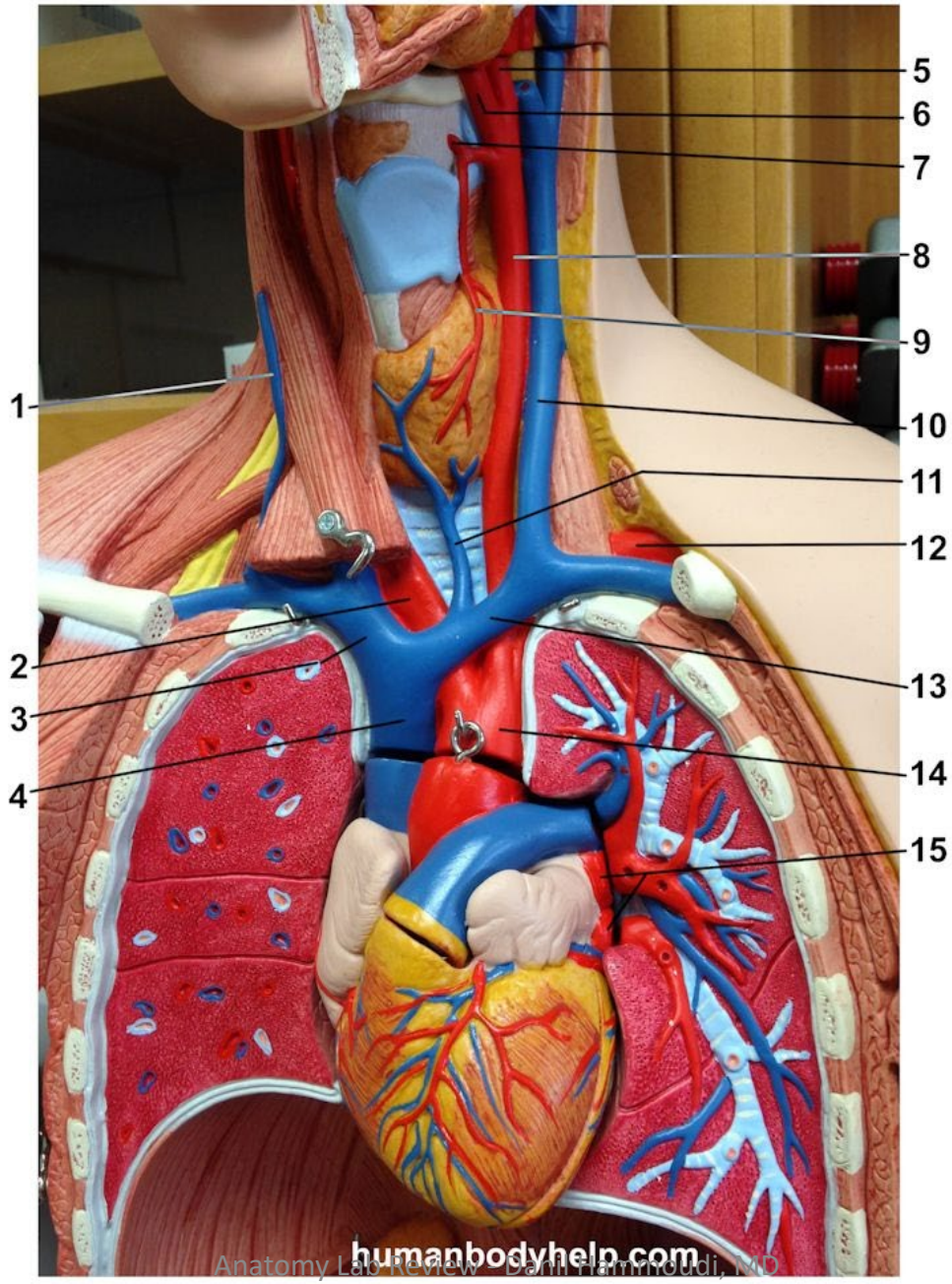
1.Internal jugular v. (right)
2.Subclavian v. (right)
3.Brachiocephalic v. (right)
4.Brachiocephalic trunk
5.Superior vena cava
6.Pulmonary a's
7.Pulmonary v.
8.Inferior phrenic a.
9.Superior mesenteric a.
10.Superior thyroid a.
11.Internal jugular v. (left)
12.External jugular v. (left)
13.Brachiocephalic v. (left)
14.Common carotid a. (left)
15.Subclavian a. (left)
16.Accessory hemiazygous v.
17.Hemiazygous v.
18.Thoracic aorta
19.Intercostal a's
20.Intercostal v's
21.Celiac trunk (Branches: Splenic, Left gastric, Common hepatic a's)
22.Renal v. (left)
23.Abdominla aorta






Right Common Carotid Artery
Left Common Carotid Artery
Right Subclavian Artery
Left Subclavian Artery
Brachiocephalic Trunk
Aortic Arch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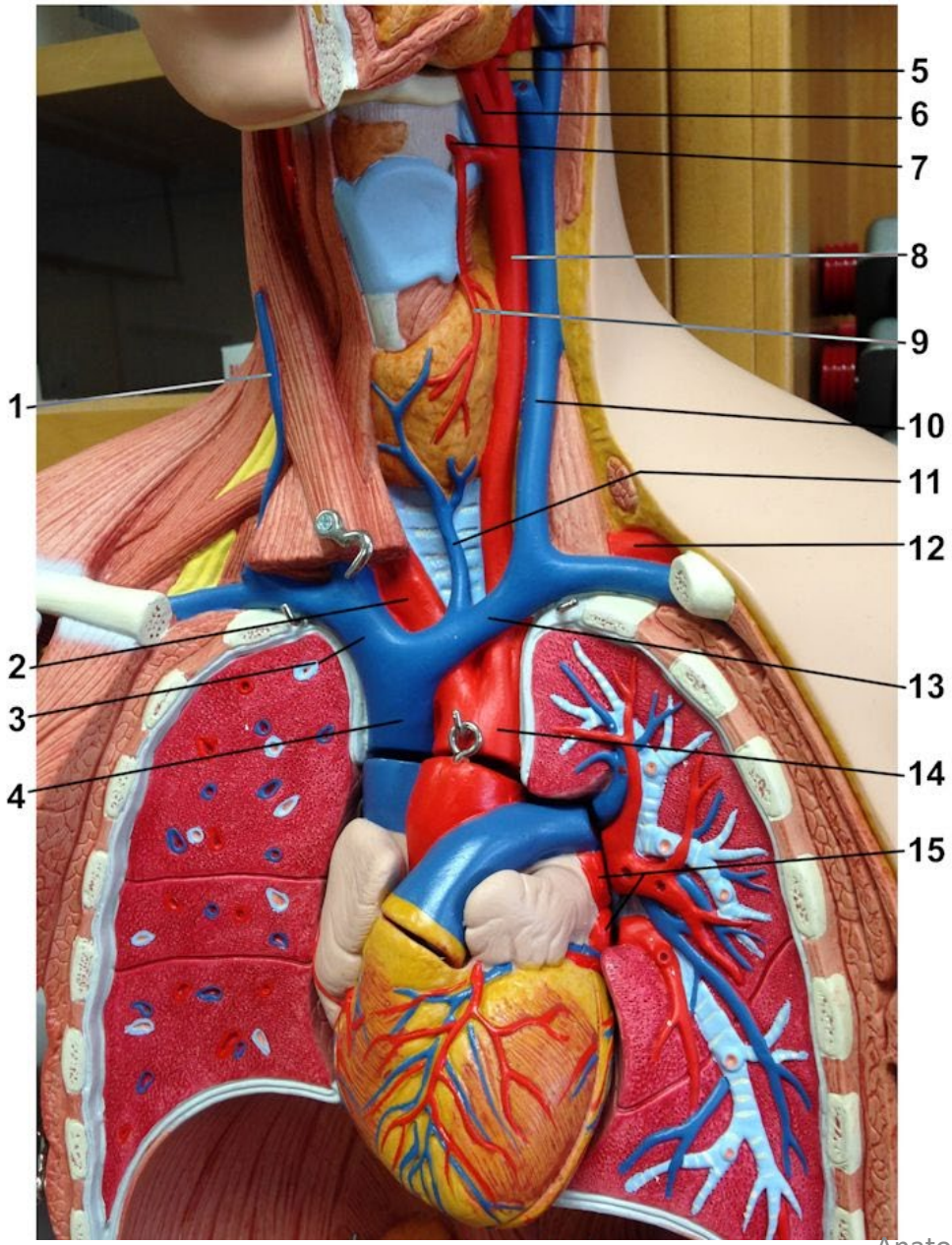
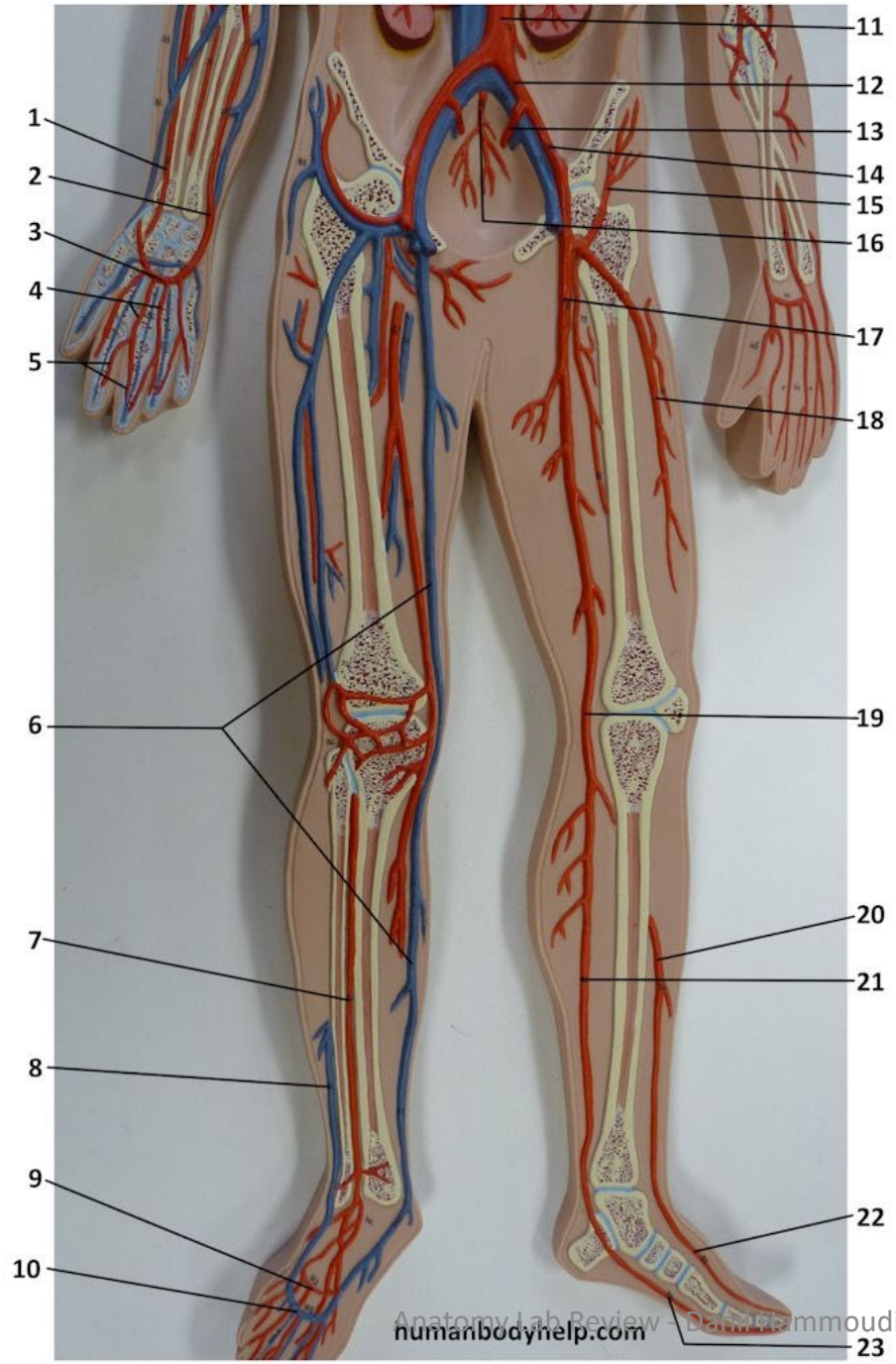


1. External jugular v.
2. Brachiocephalic trunk
3. Right brachiocephalic v.
4. Superior vena cava
5. External carotid a.
6. Internal carotid a.
7. Superior laryngeal a.
8. Left common carotid a.
9. Superior thyroid a.
10. Internal jugular v.
11. Inferior thyroid v.
12. Left subclavian a.
13. Left brachiocephalic v.
14. Aortic arch
15. Left pulmonary veins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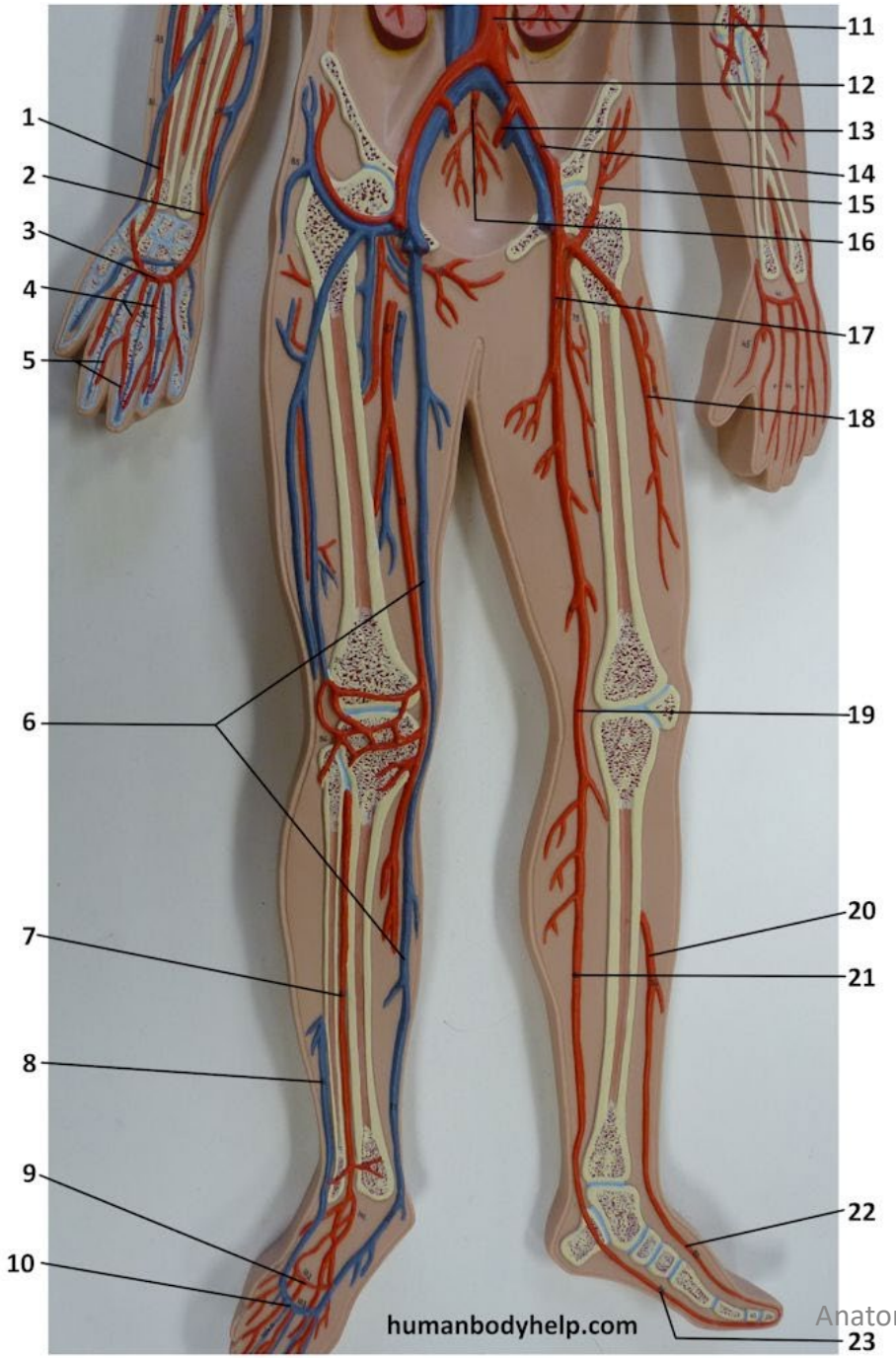
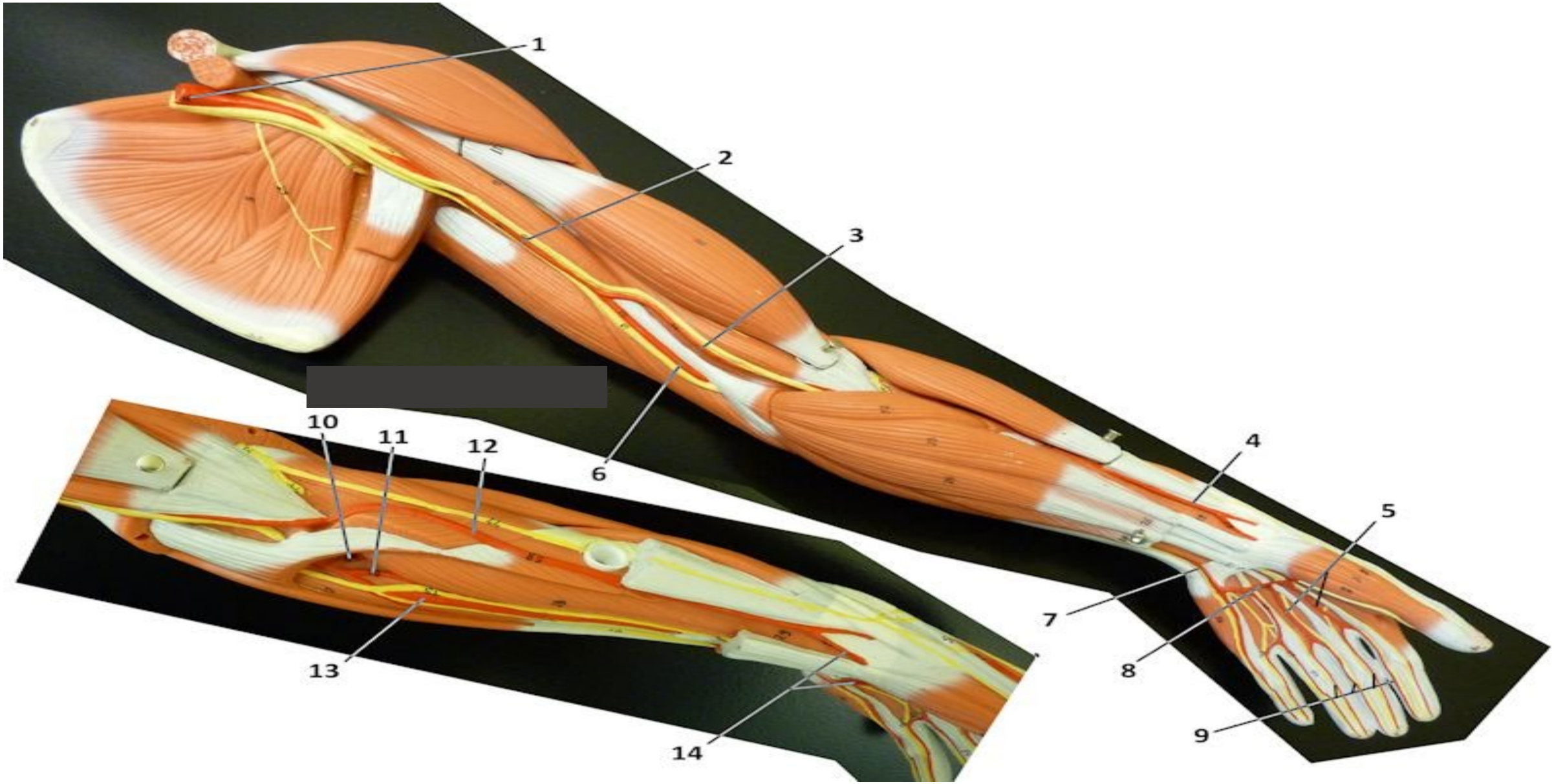


1.Radial artery (a.)
2.Ulnar a.
3.Superficial palmar arch
4.Common palmar digitals
5.Proper palmar digitals
6.Great saphenous vein (v.)
7.Anterior tibial a.
8.Small Saphenous v.
9.Arcuate a. (Superficial plantar arch)
10.Dorsal venous arch
11.Abdominal aorta
12.Common iliac a.
13.Internal iliac a.
14.External iliac a.
15.Lateral femoral circumflex a. (ascending branch)
16.Median sacral a.
17.Femoral a.
18.Lateral femoral circumflex a. (descending branch)
19.Popliteal a. (notice: behind the knee)
20.Anterior tibial a.
21.Posterior tibial a.
22.Dorsal pedal a.
23.Medial plantar a.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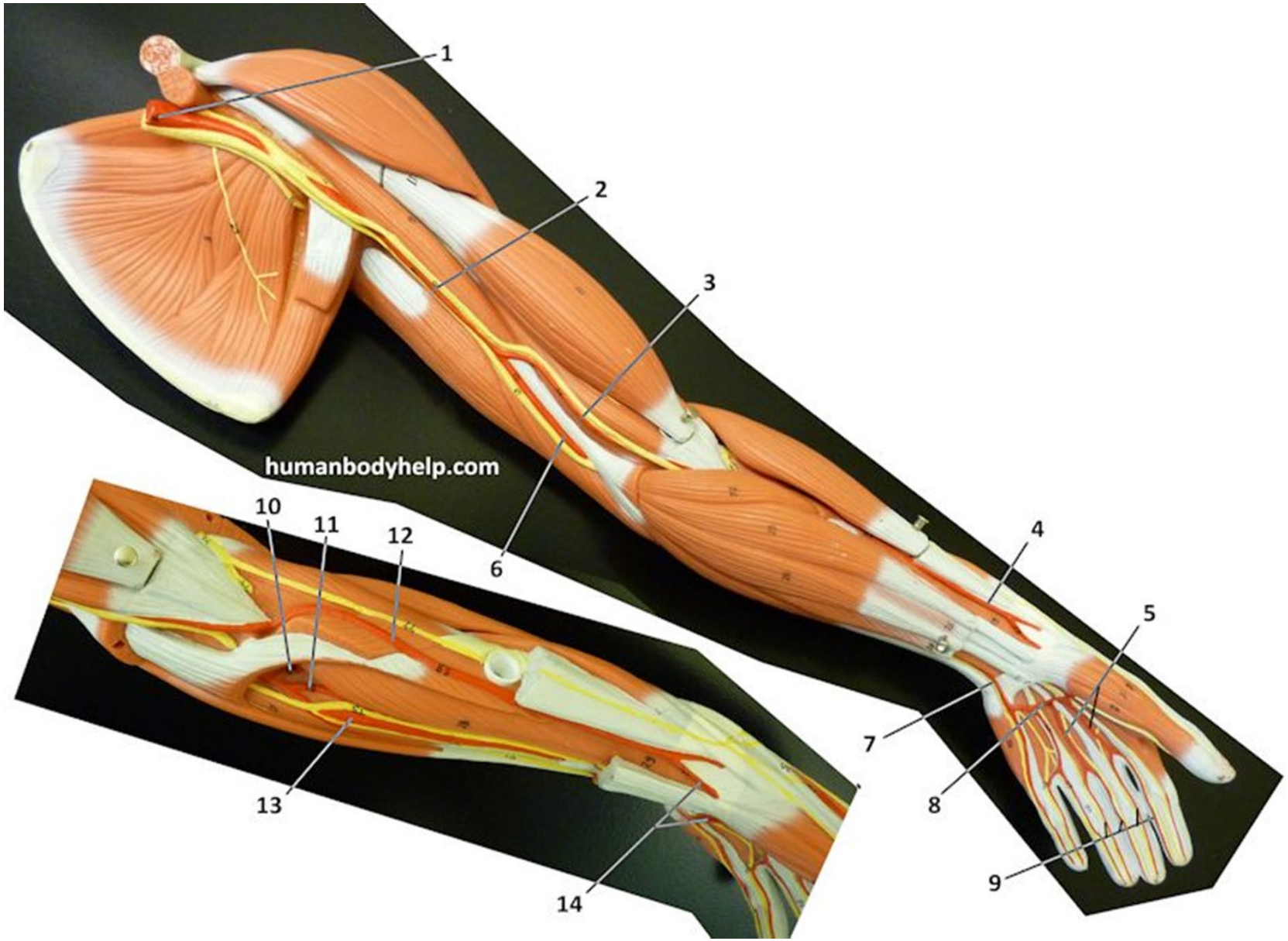
1.Axillary artery (a.)
2.Brachial a.
3.Radial a.
4.Radial a.
5.Common palmar digital a's
6.Ulnar a.
7.Ulnar a.
8.Superficial palmar arch
9.Proper palmar digital a's
10.Posterior interosseus a.
11.Anterior interosseus a.
12.Radial a.
13.Ulnar a.
14.Superficial palmar arch

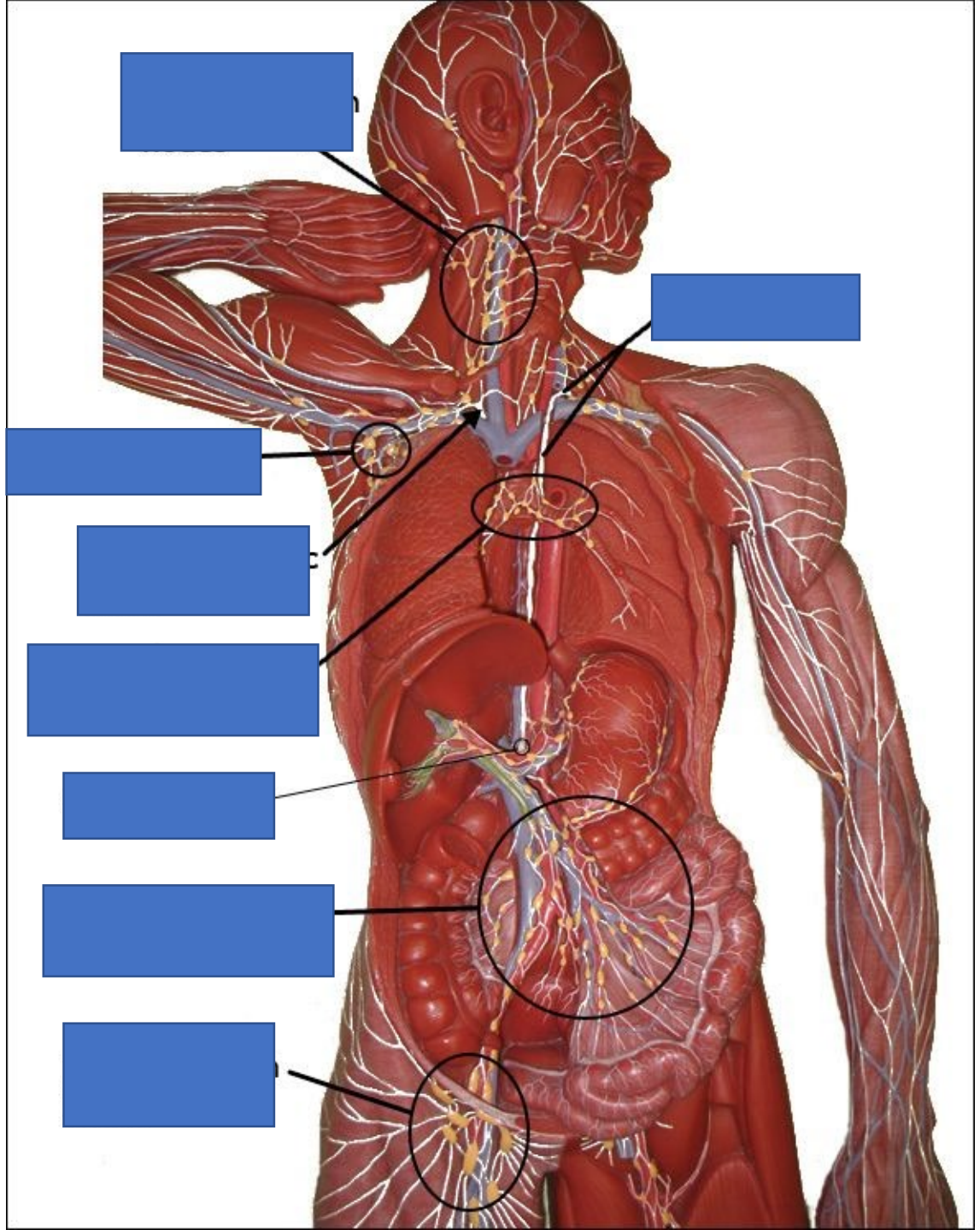


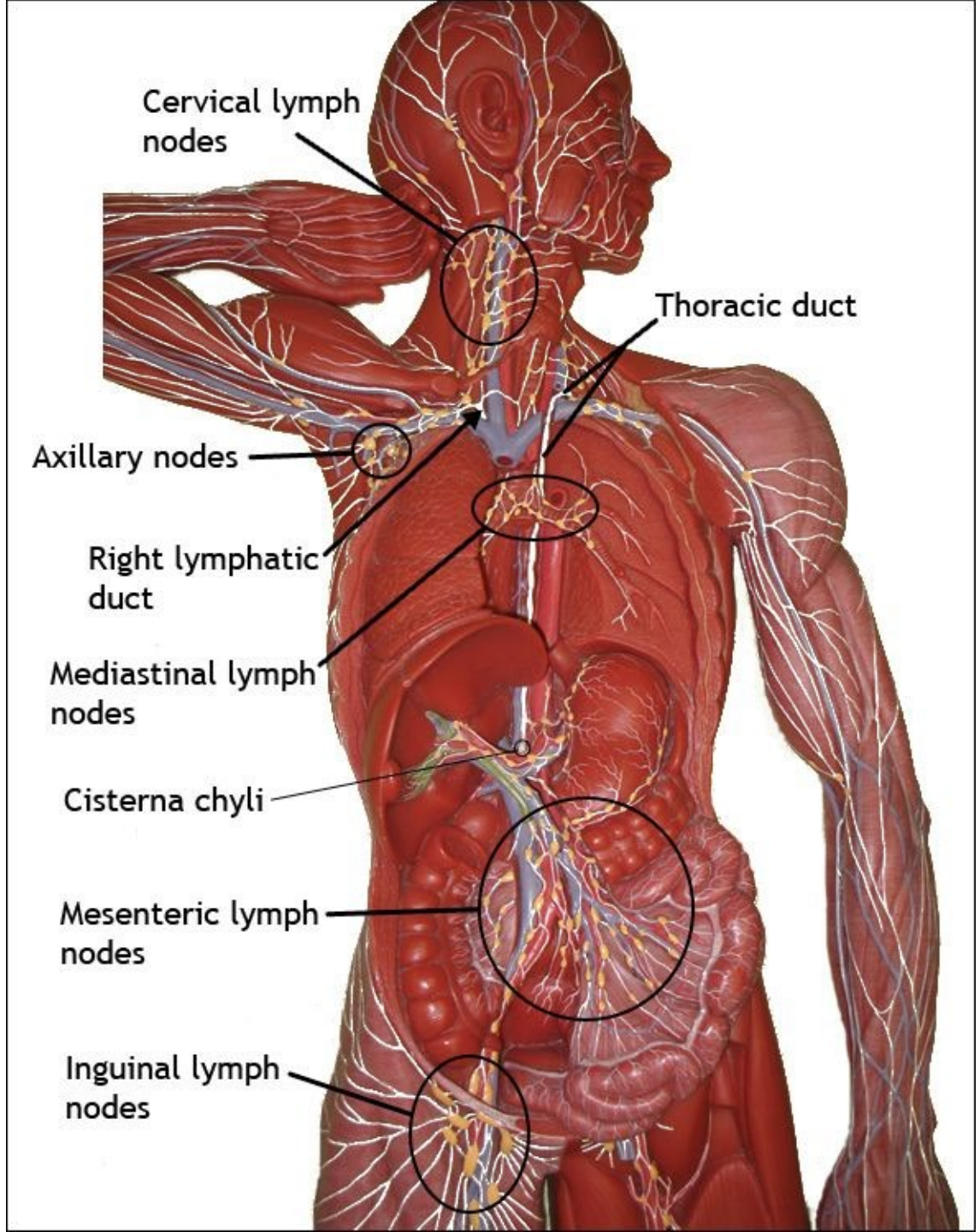
A) SA Node
B) Purkinje fibers
C) AV node
D) AV bundle

1) The pacemaker of the heart.
2) Found in the interventricular septum.
3) Network found in the ventricular mycocardium.
4) The point in the condution system of the heart where the impulse is temporarily delayed.

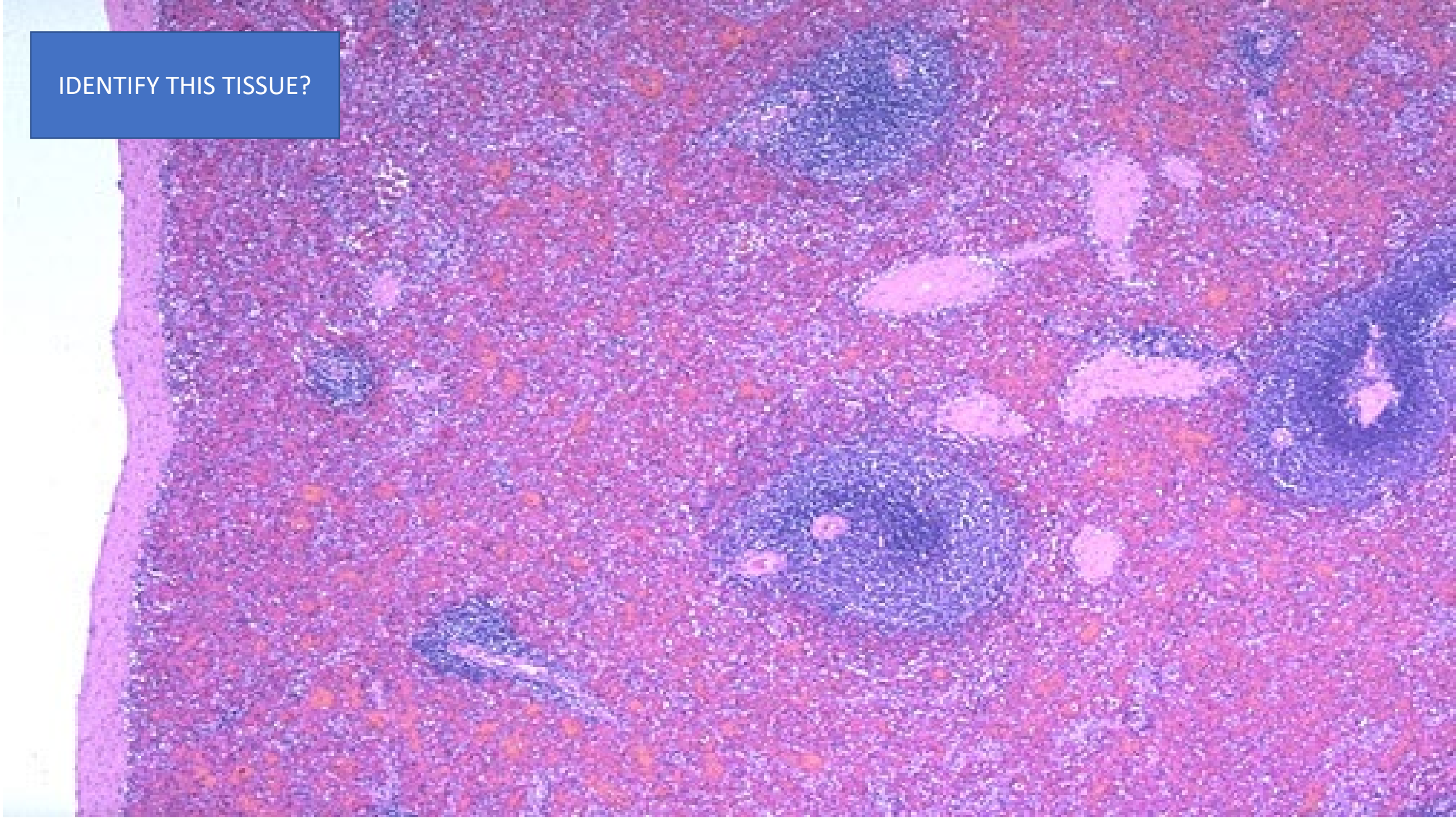
A) SA Node
B) Purkinje fibers
C) AV node
D) AV bundle

1) The pacemaker of the heart.
Answer: A
2) Found in the interventricular septum.
Answer: D
3) Network found in the ventricular mycocardium.
Answer: B
4) The point in the condution system of the heart where the impulse is temporarily delayed.
Answer: C

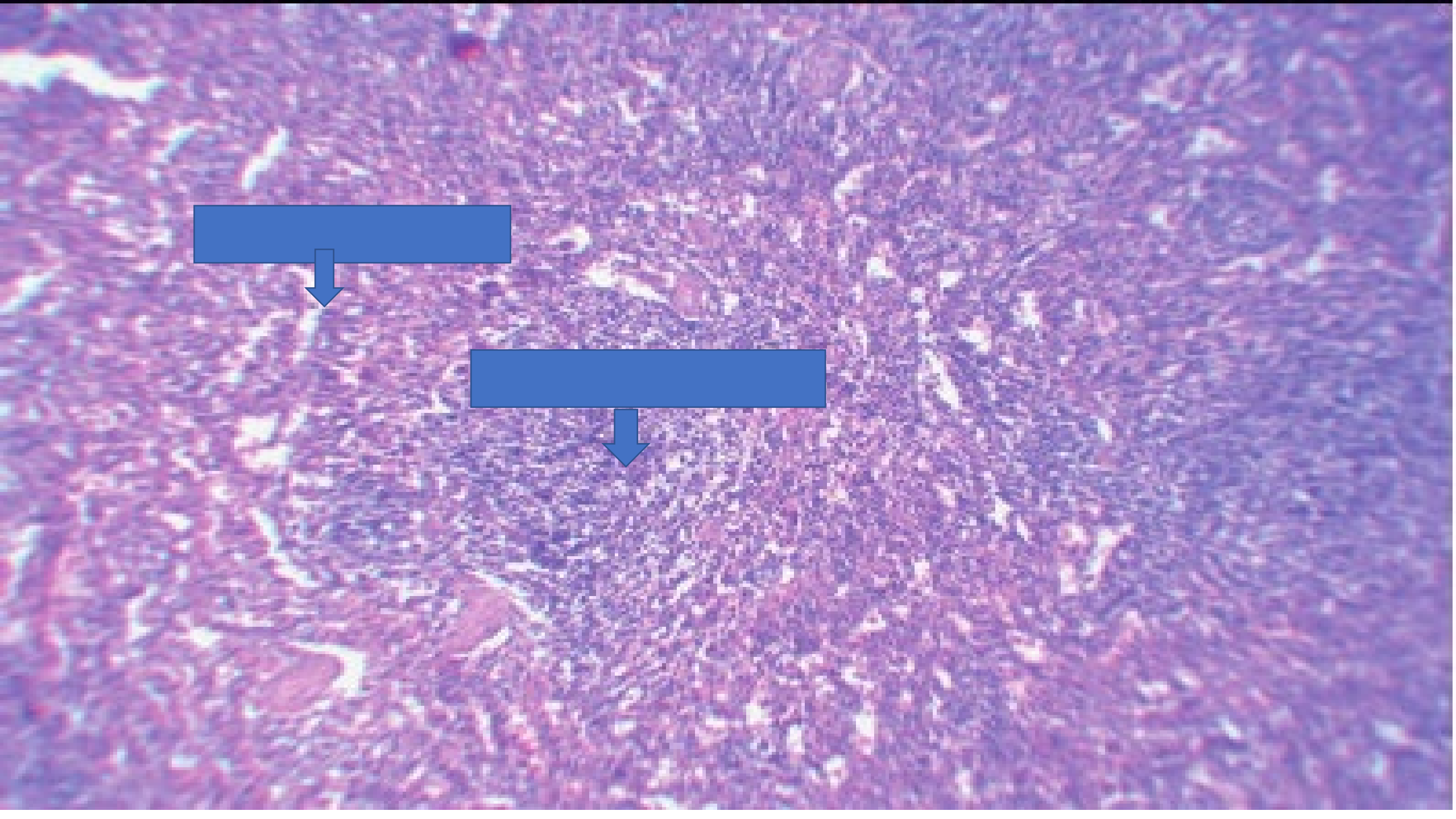


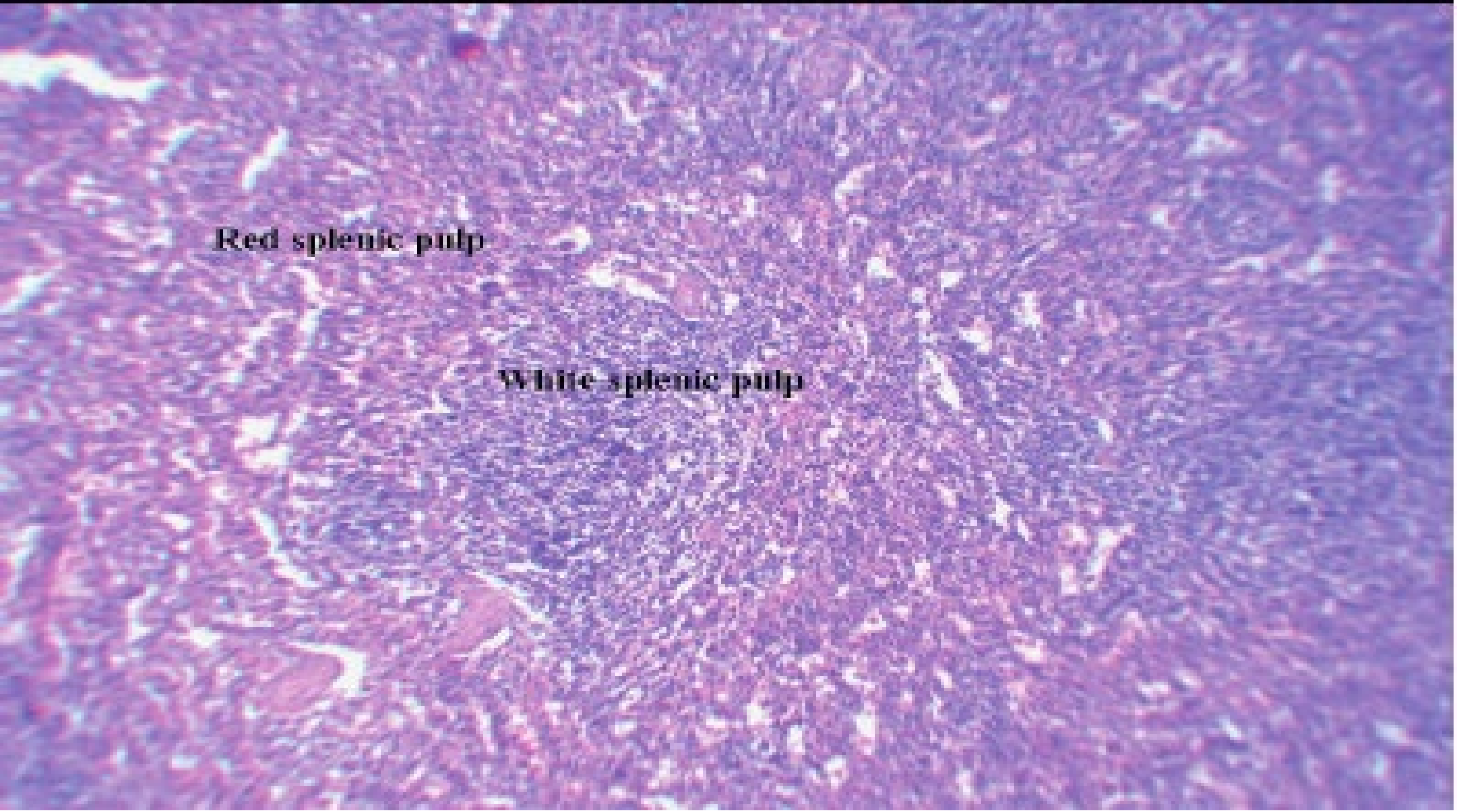

Cervical lymph nodes
Thoracic duct
Axillary nodes
Right lymphatic duct
Mediastinal lymph nodes
Cisterna chyli
Mesenteric lymph nodes
Inguinal lymph nodes

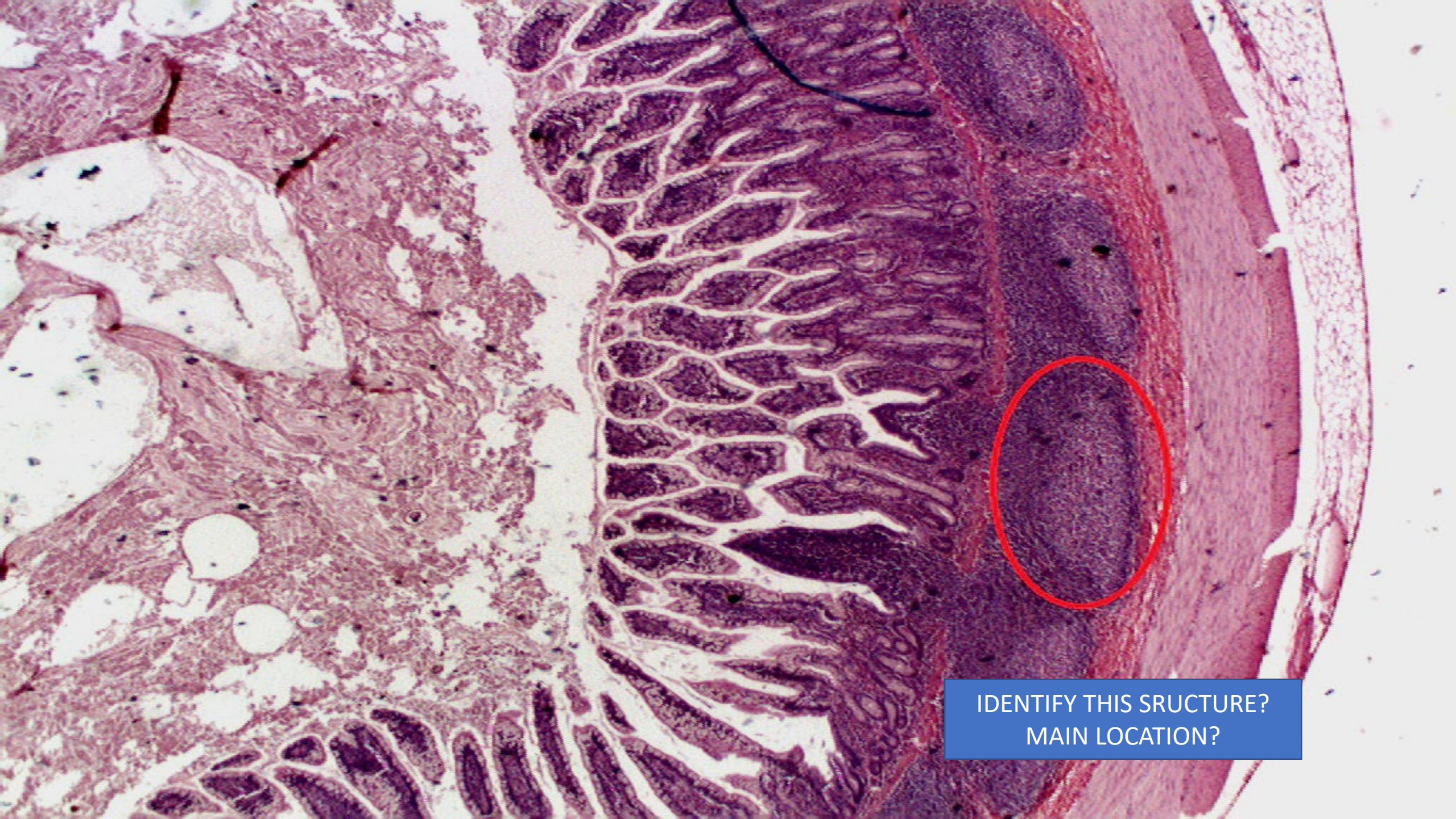
IDENTIFY THIS TISSUE?



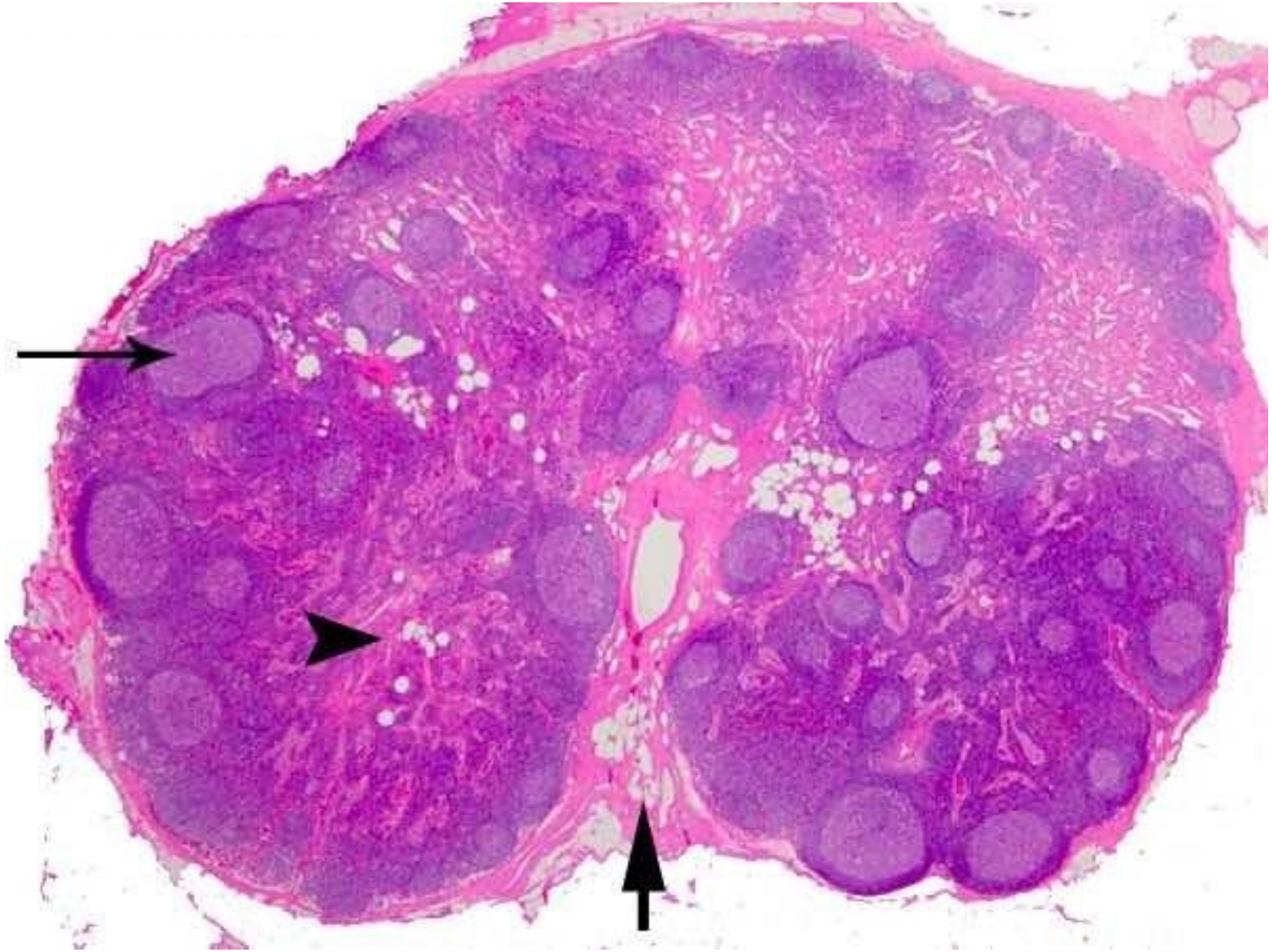
SPLEEN



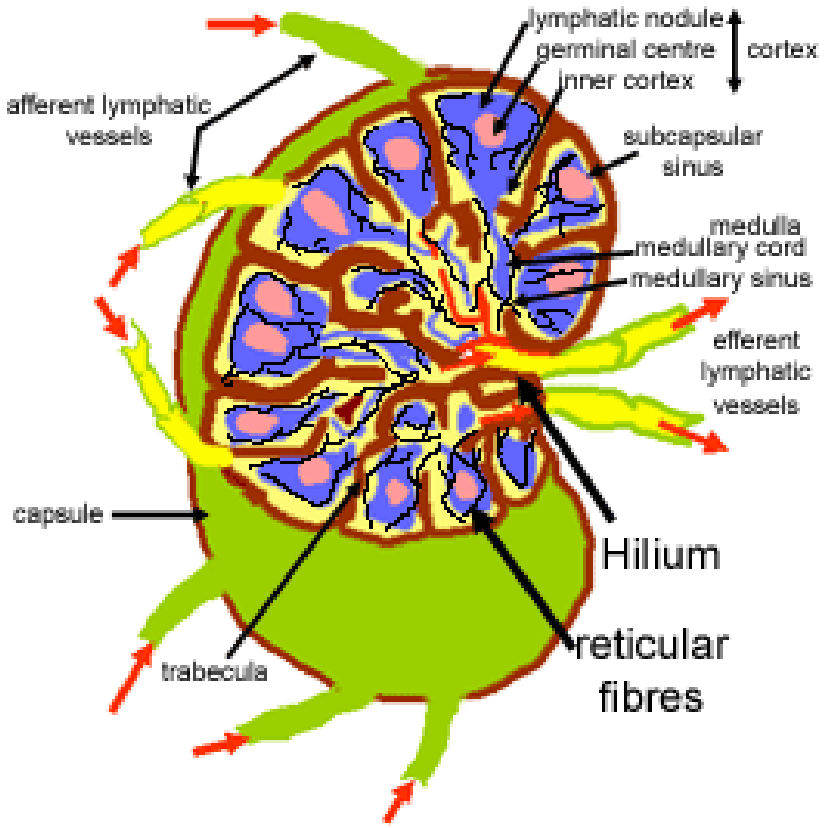

Red splenic pulp
White splenic pulp

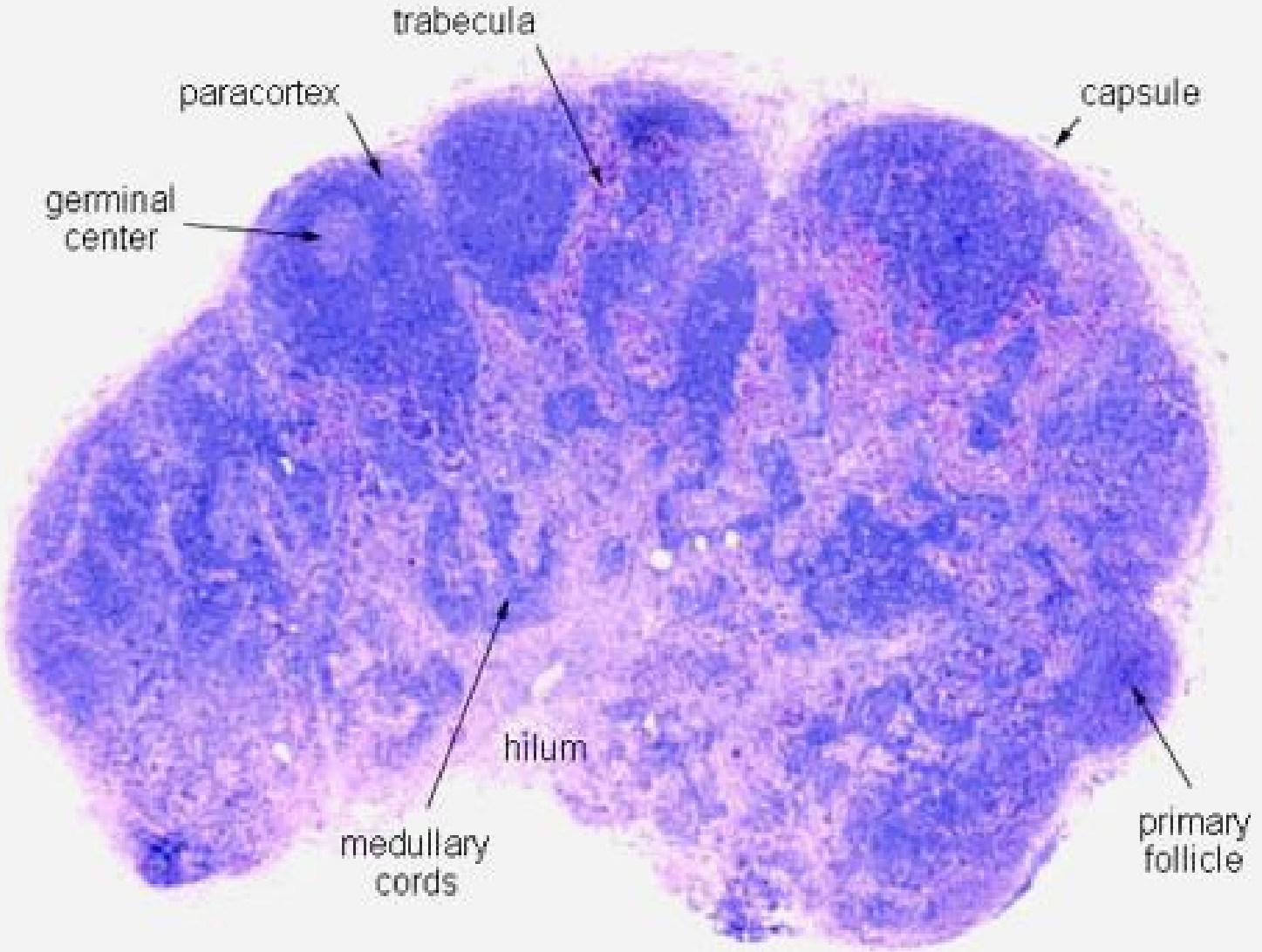

IDENTIFY THIS SRUCTURE?
MAIN LOCATION?

PEYER'S PATCH, ILEUM

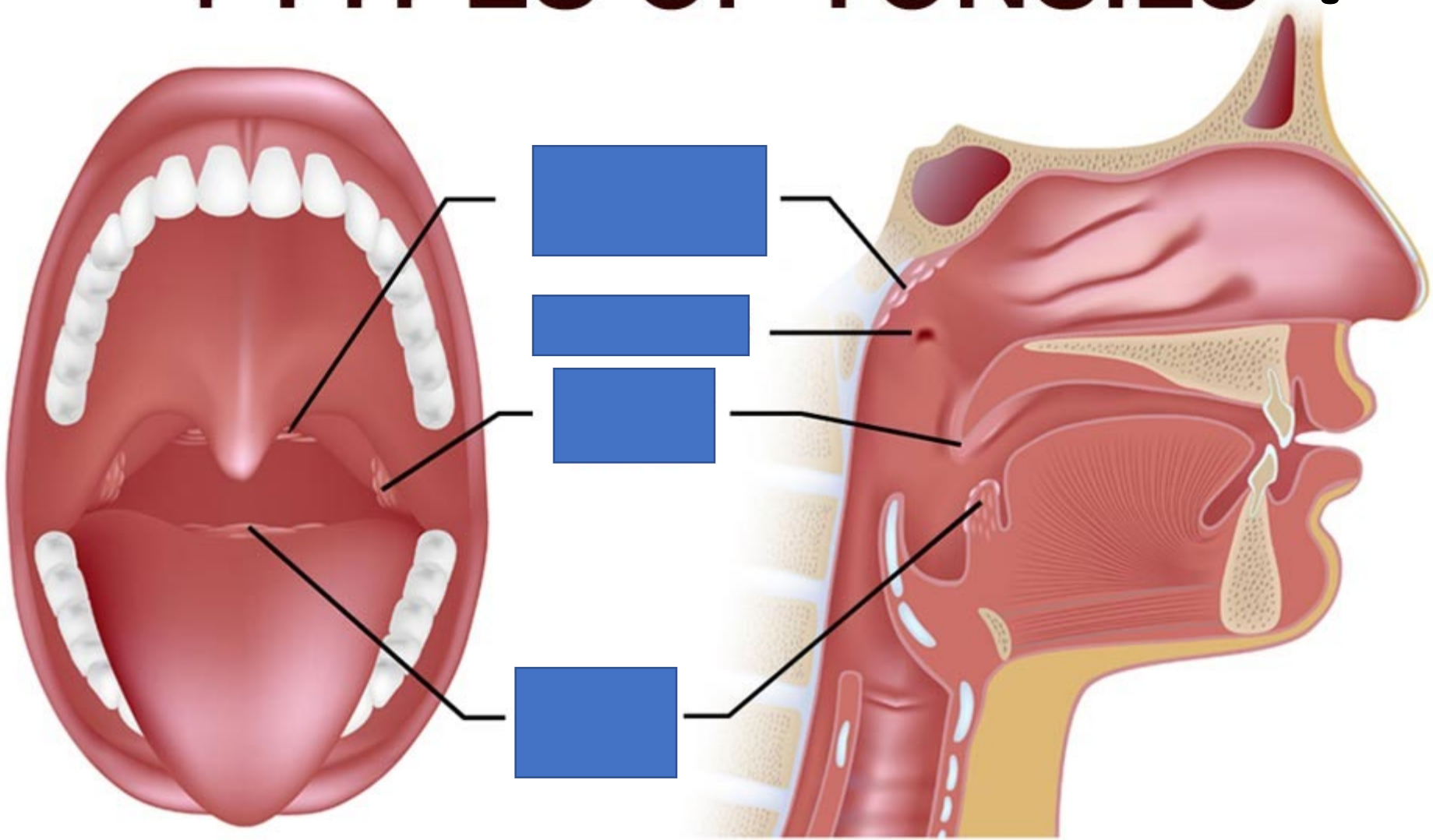


LYMPH NODE

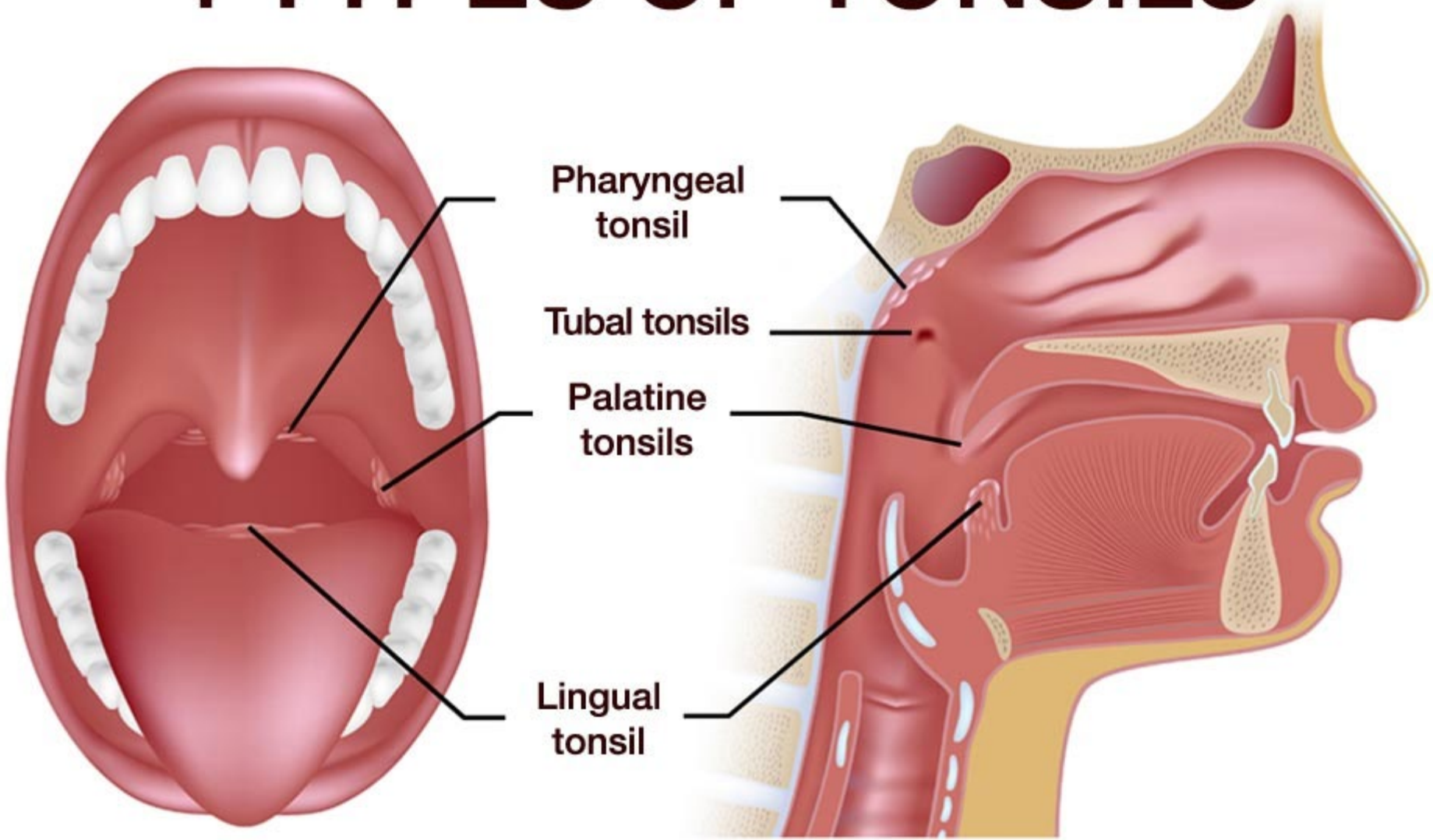

lymphatic nodule
germinal centre
inner cortex
cortex
afferent lymphatic vessels
subcapsular sinus
medulla
medullary cord
medullary sinus
efferent lymphatic vessels
capsule
Hilium
reticular fibres
trabecula

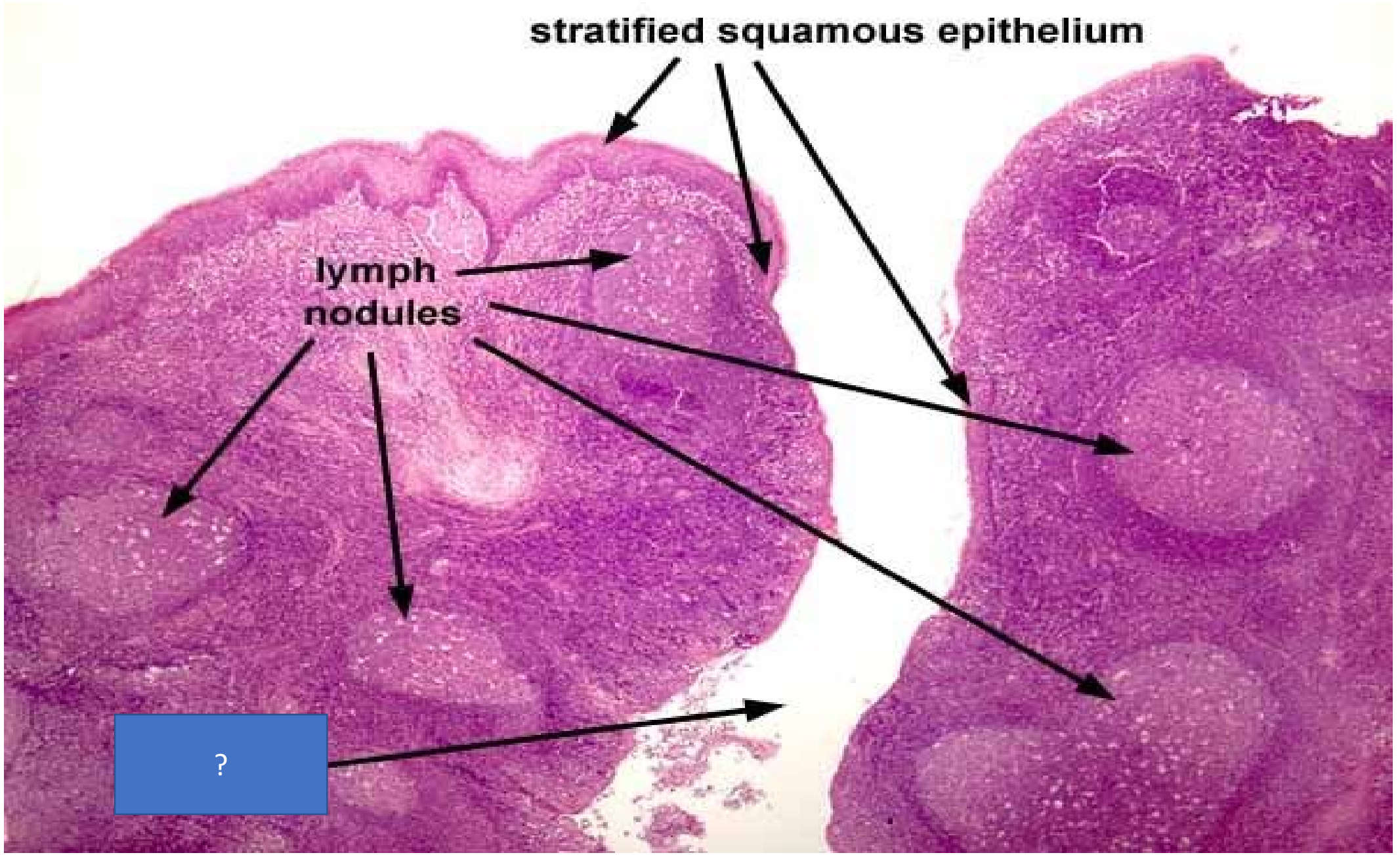

trabecula
paracortex
capsule
germinal center
hilum
medullary cords
primary follicle

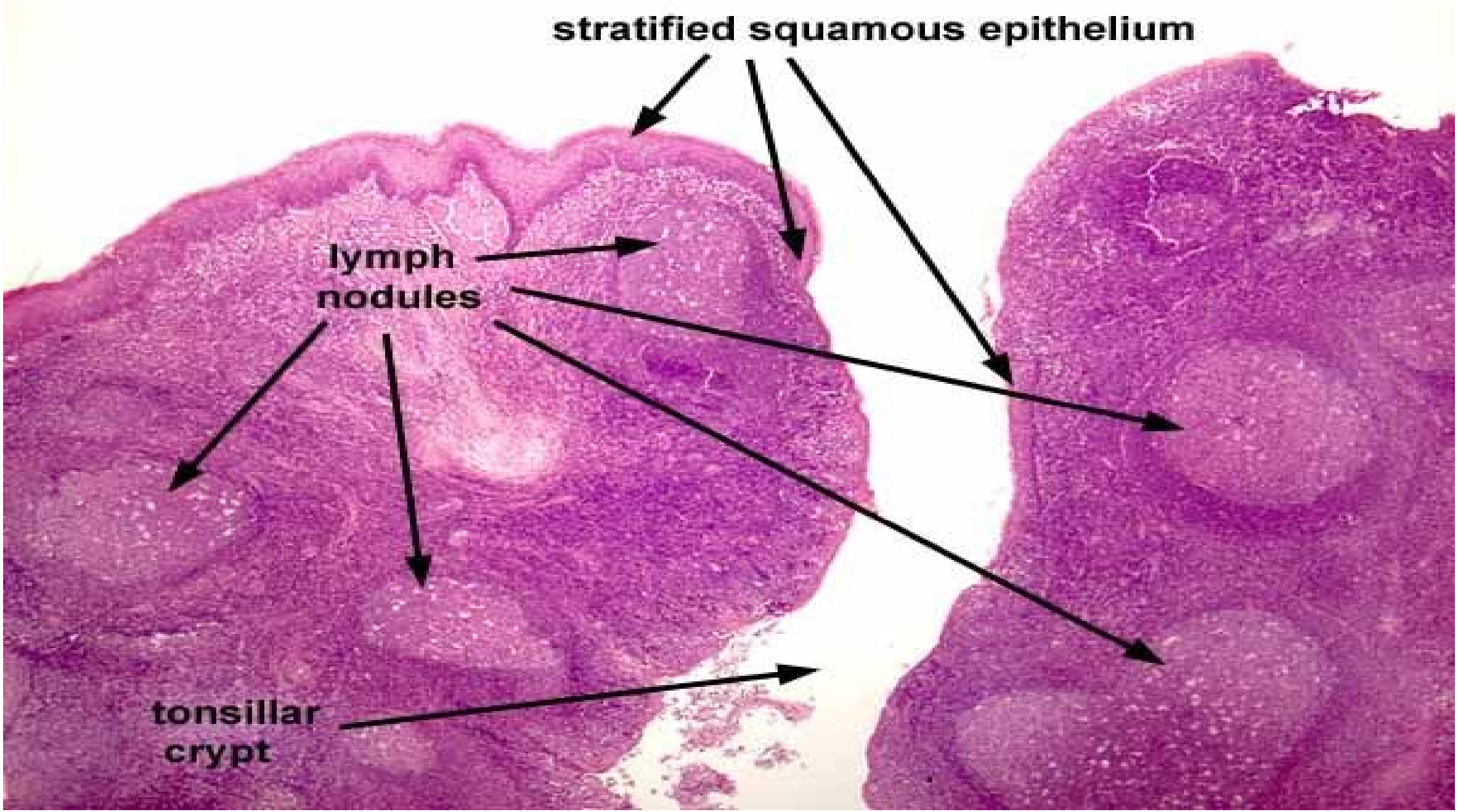
4 TYPES OF TONSILS ?



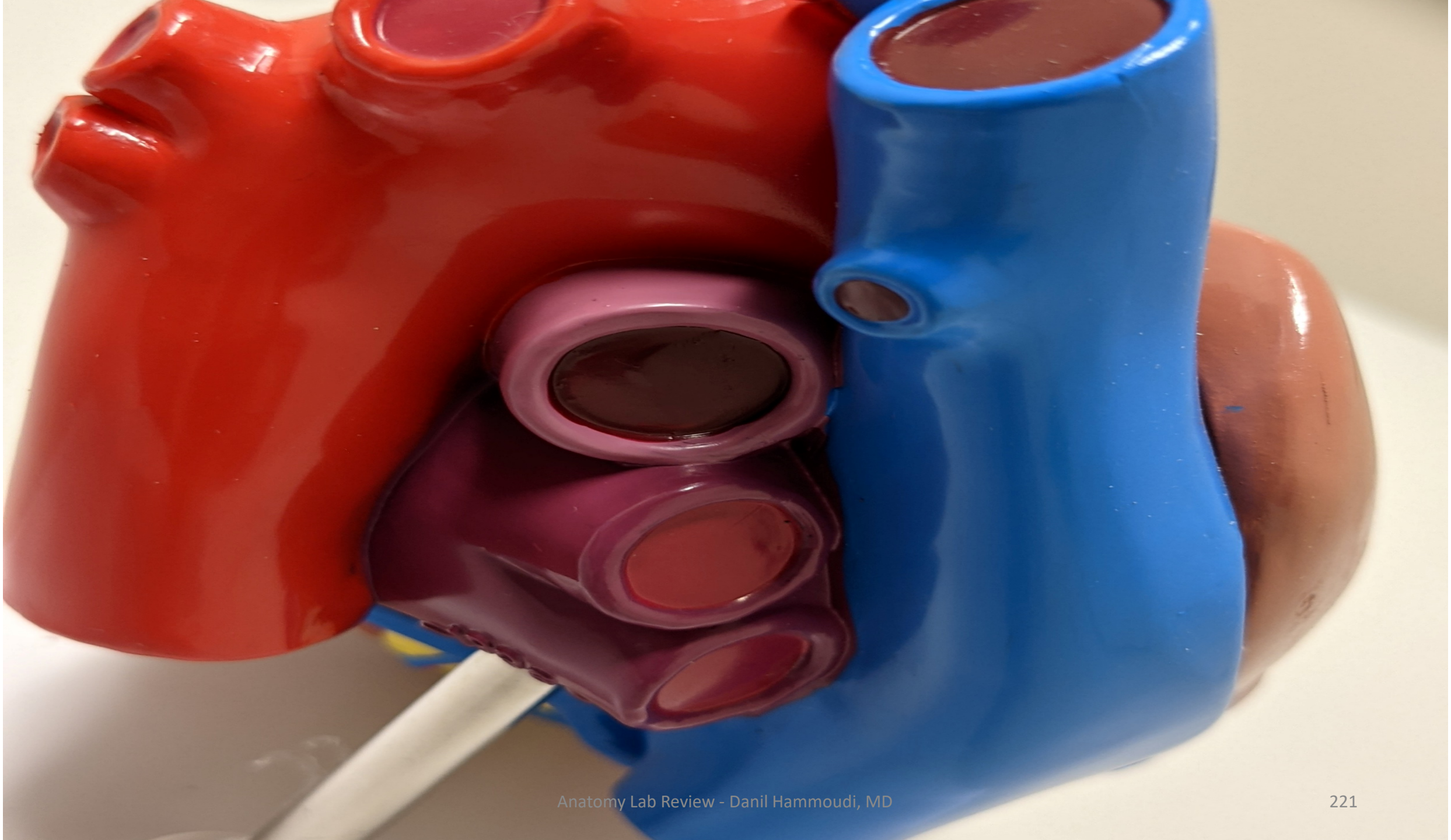
4 TYPES OF TONSILS

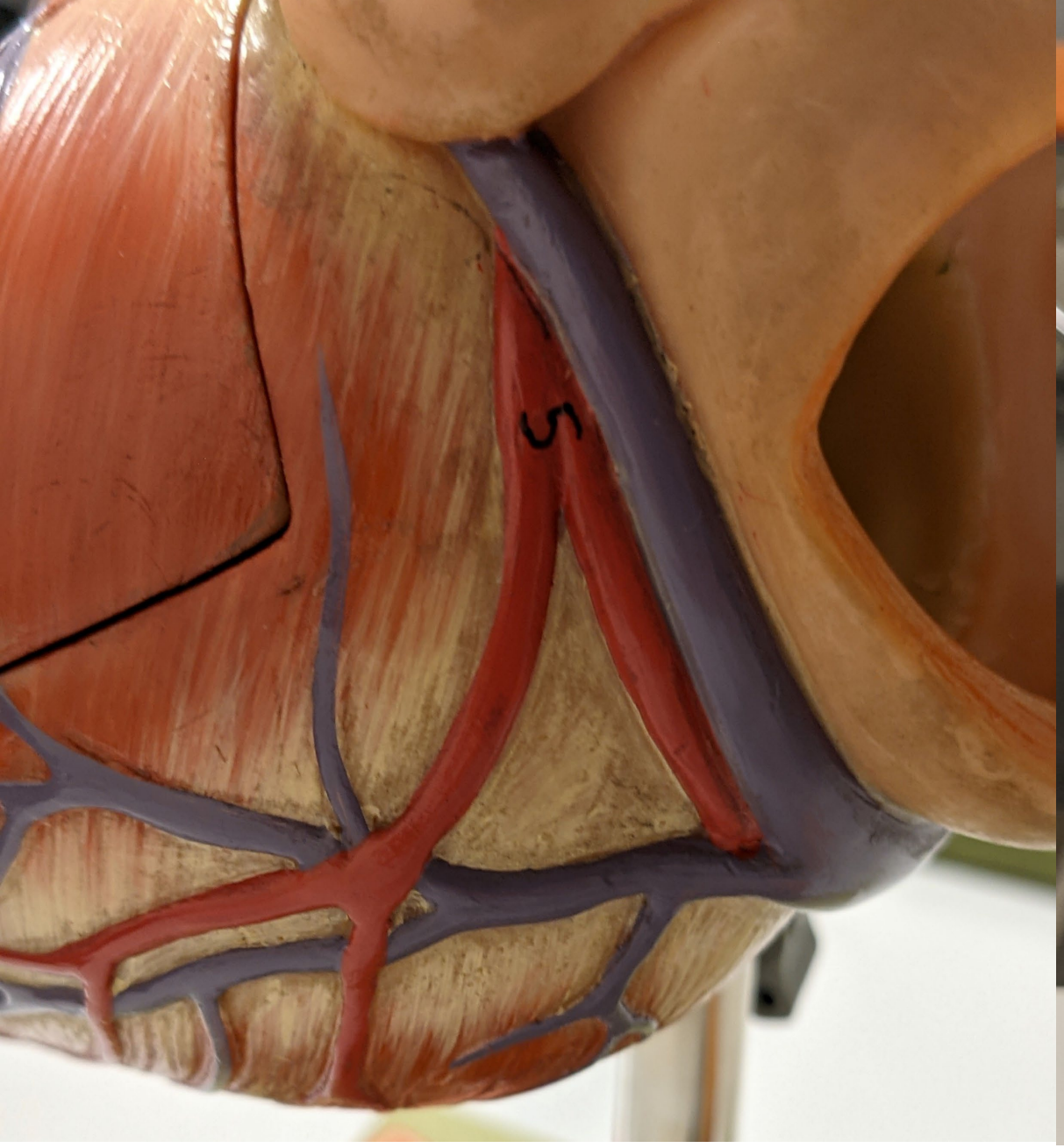



stratified squamous epithelium
lymph nodules
?


stratified squamous epithelium
lymph nodules
tonsillar crypt

Practice

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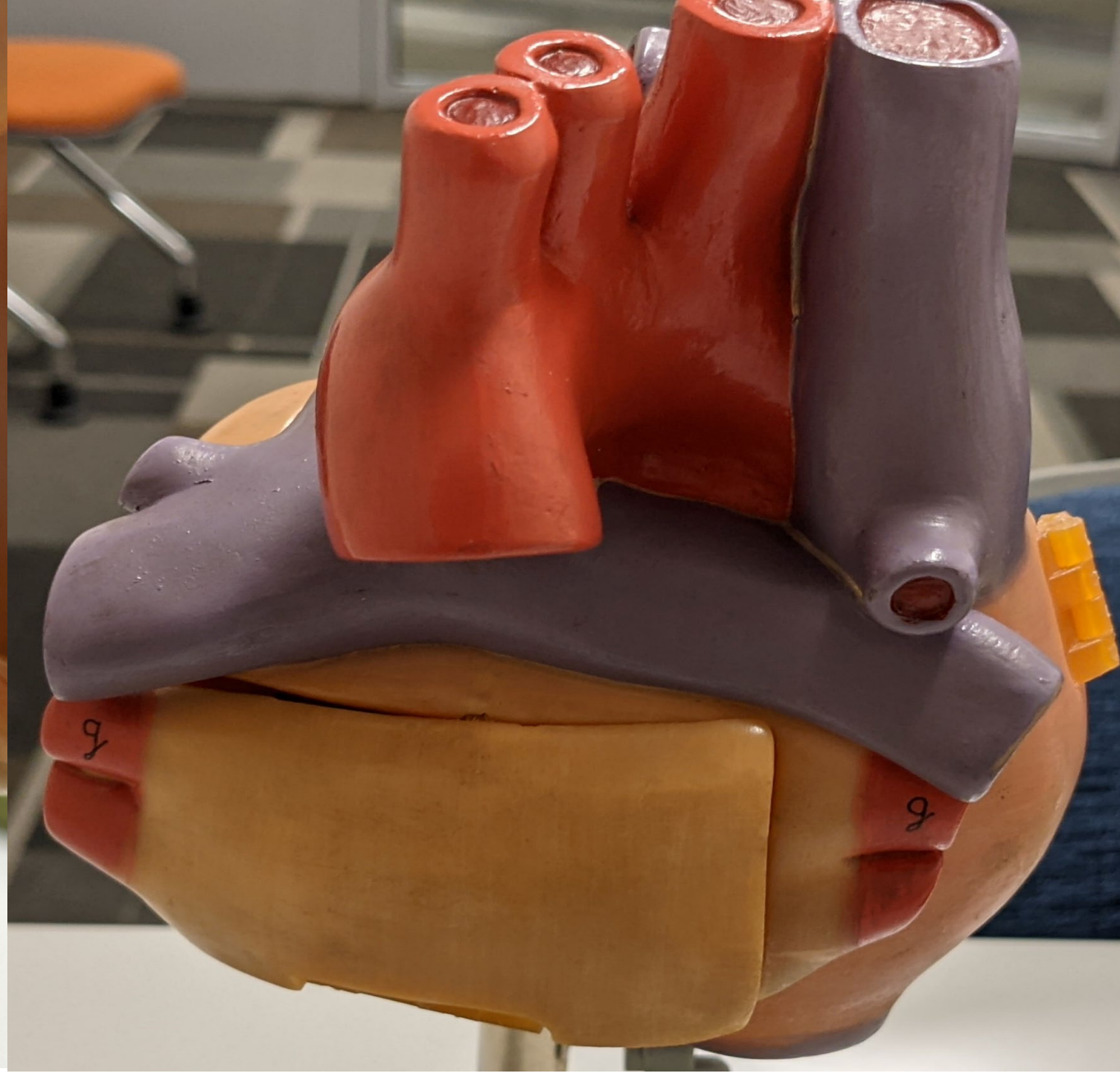
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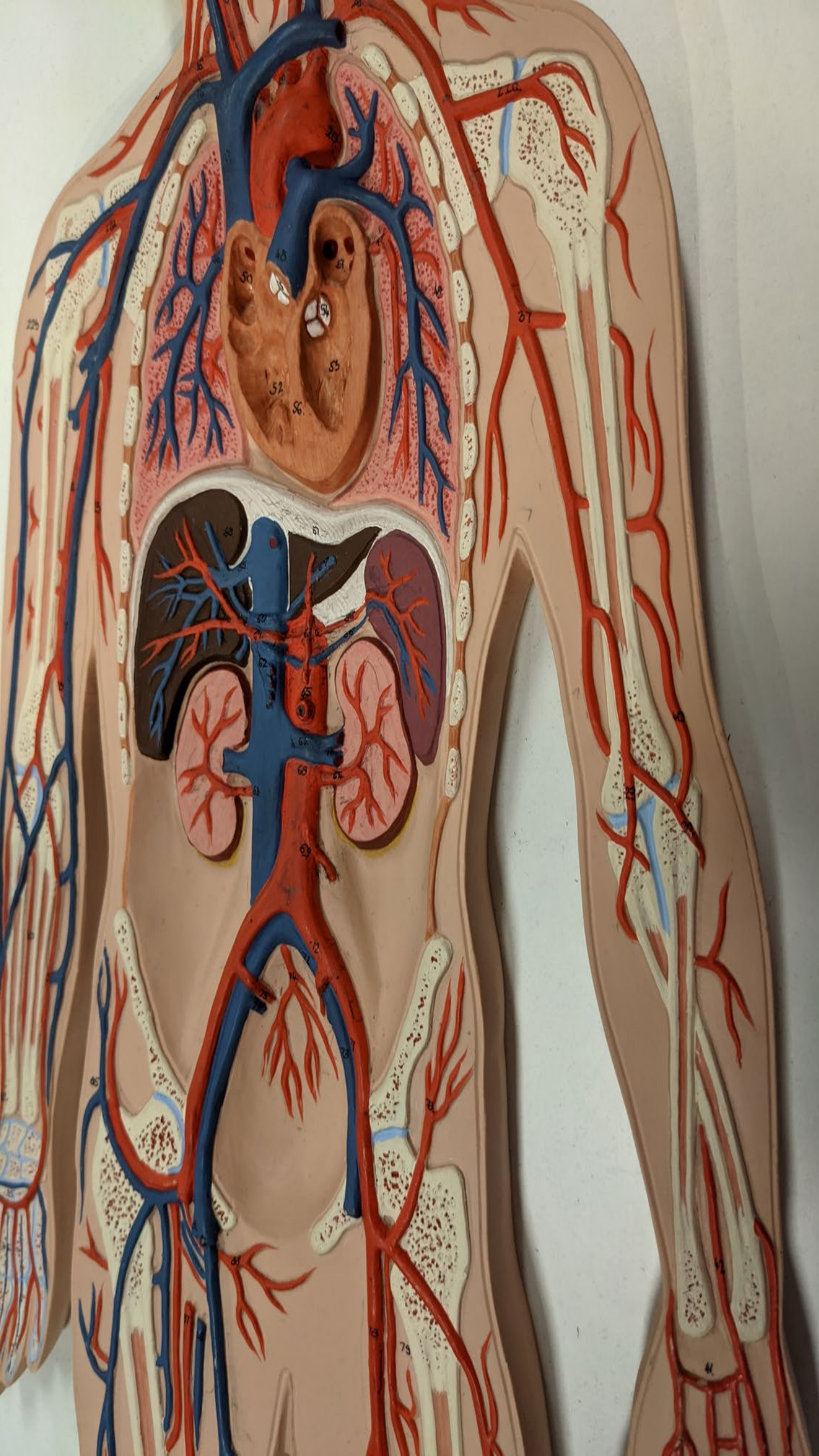

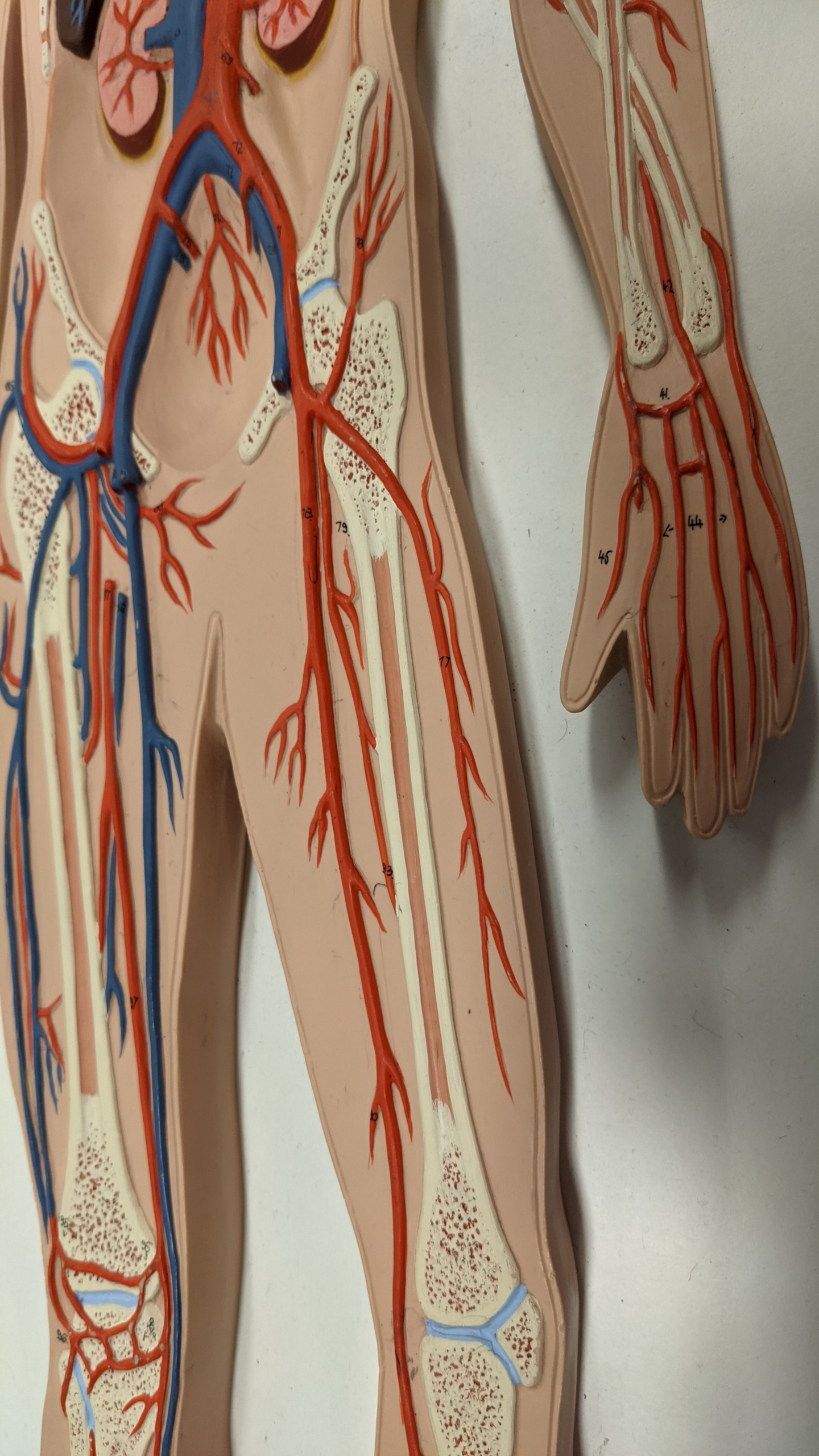
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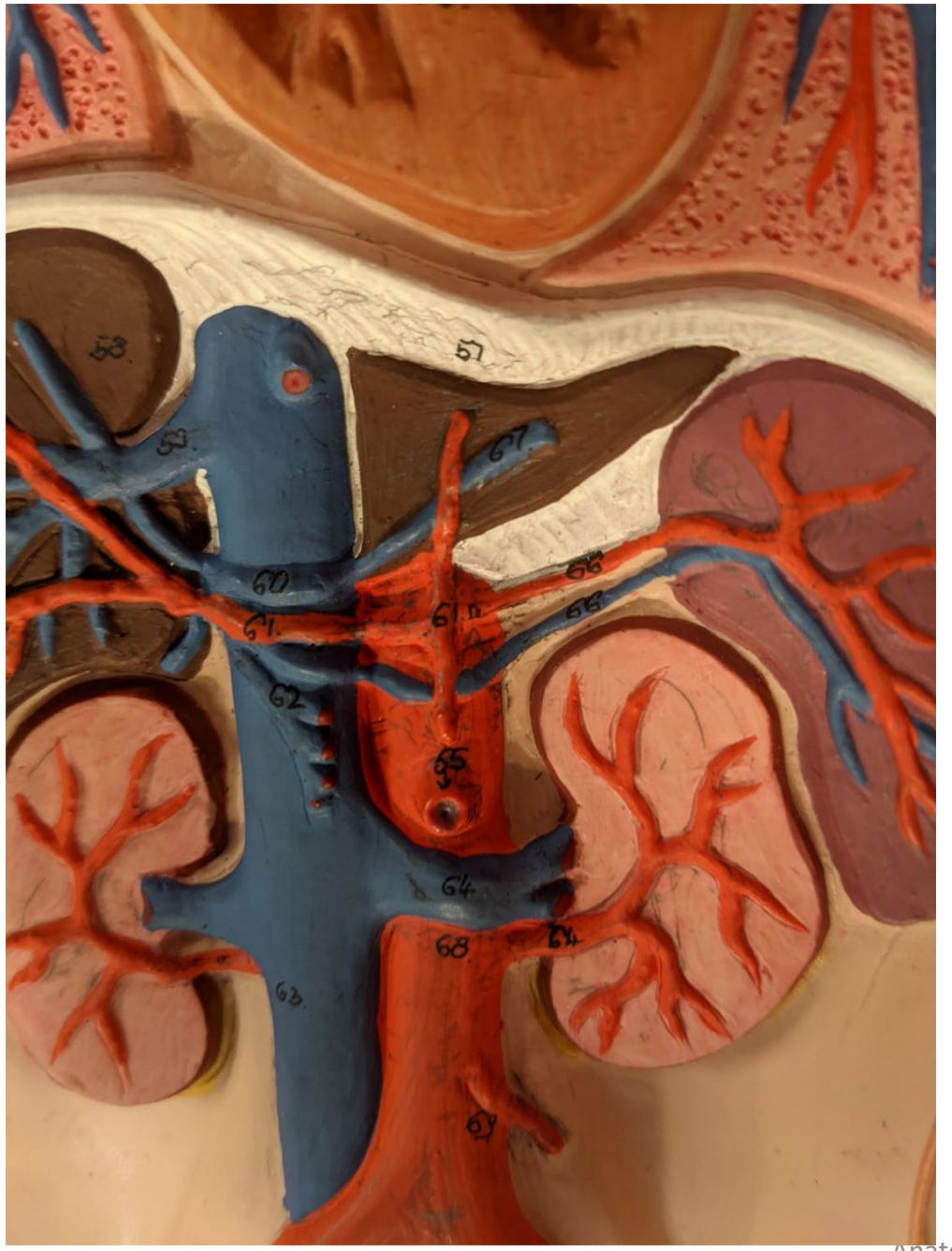
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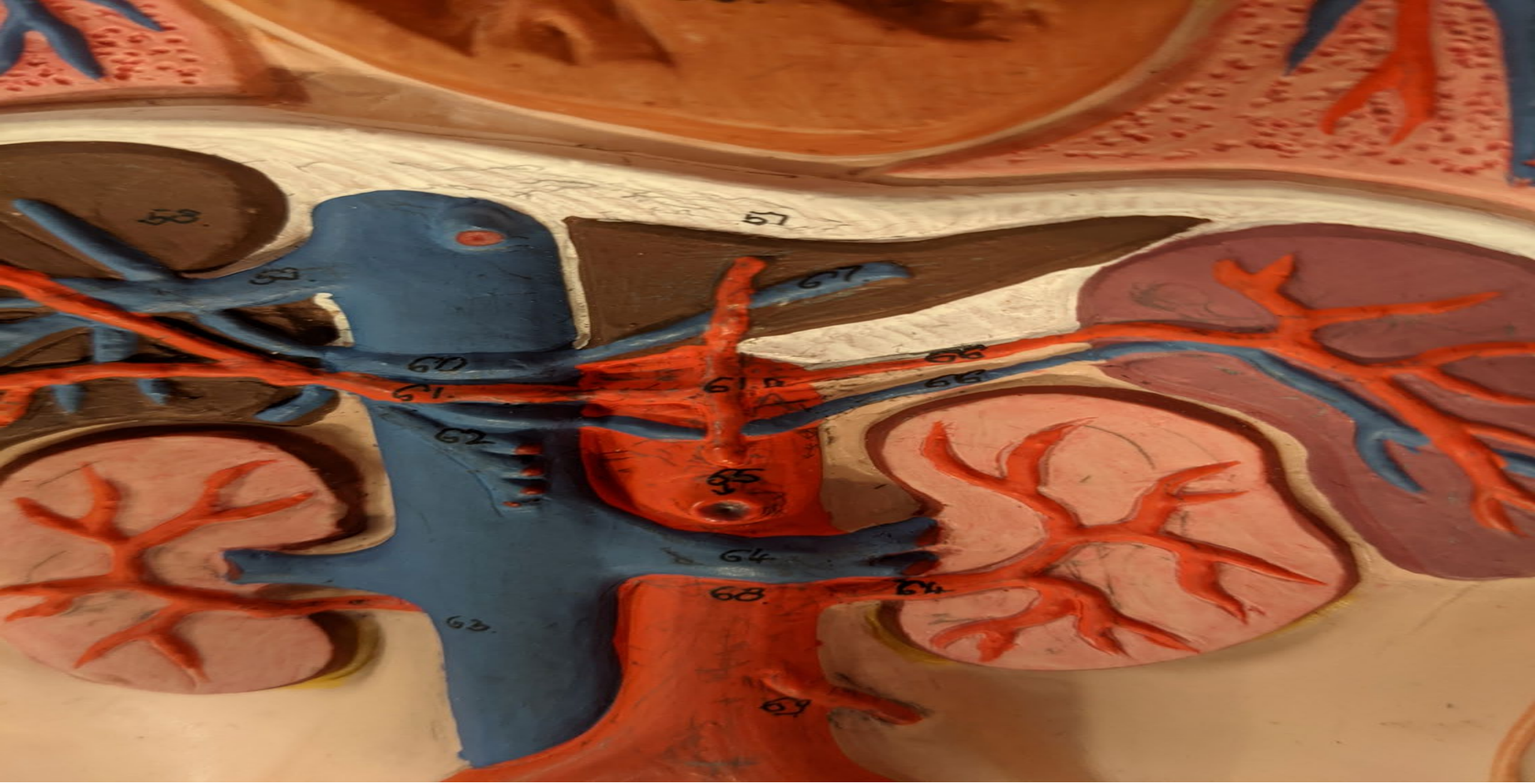
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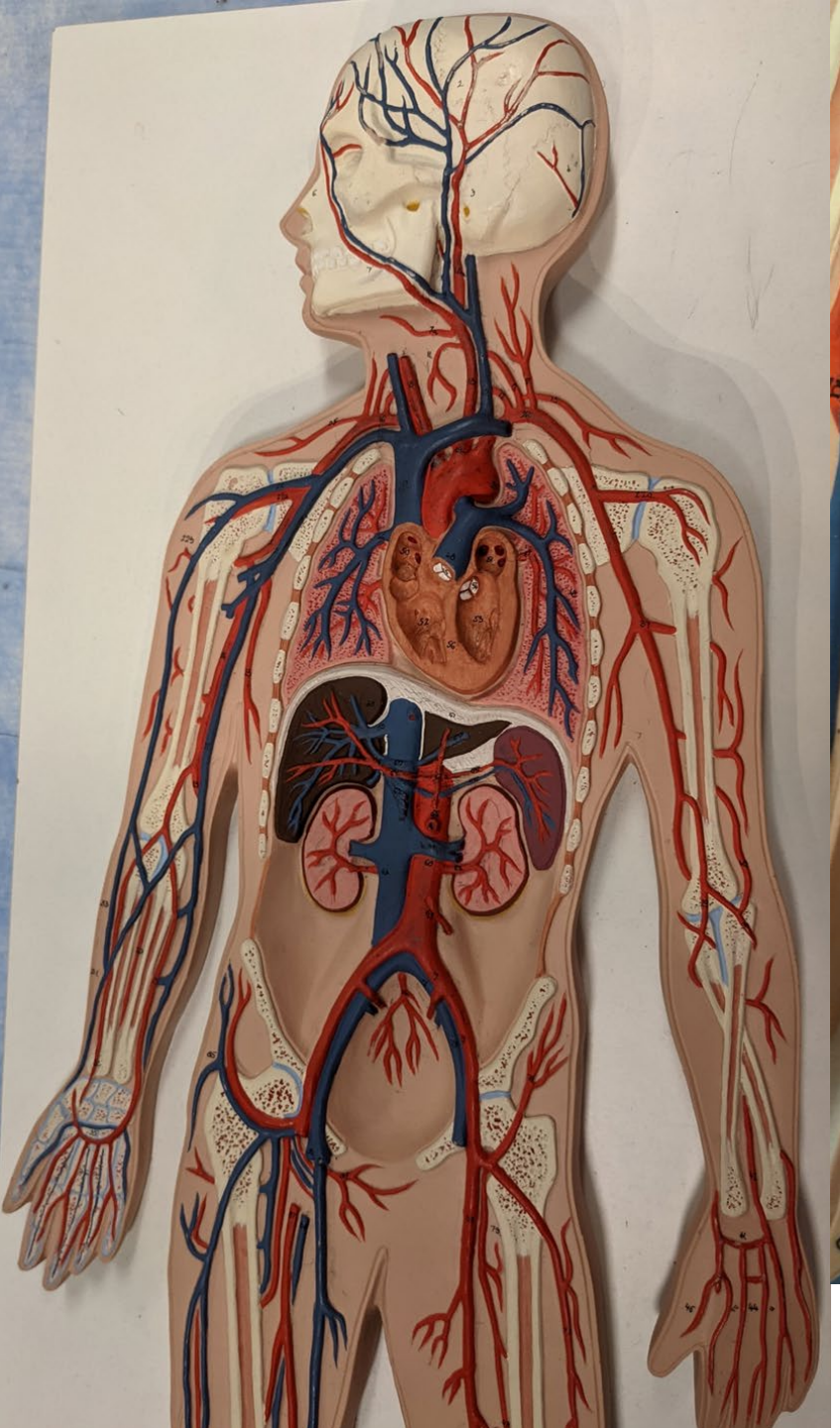

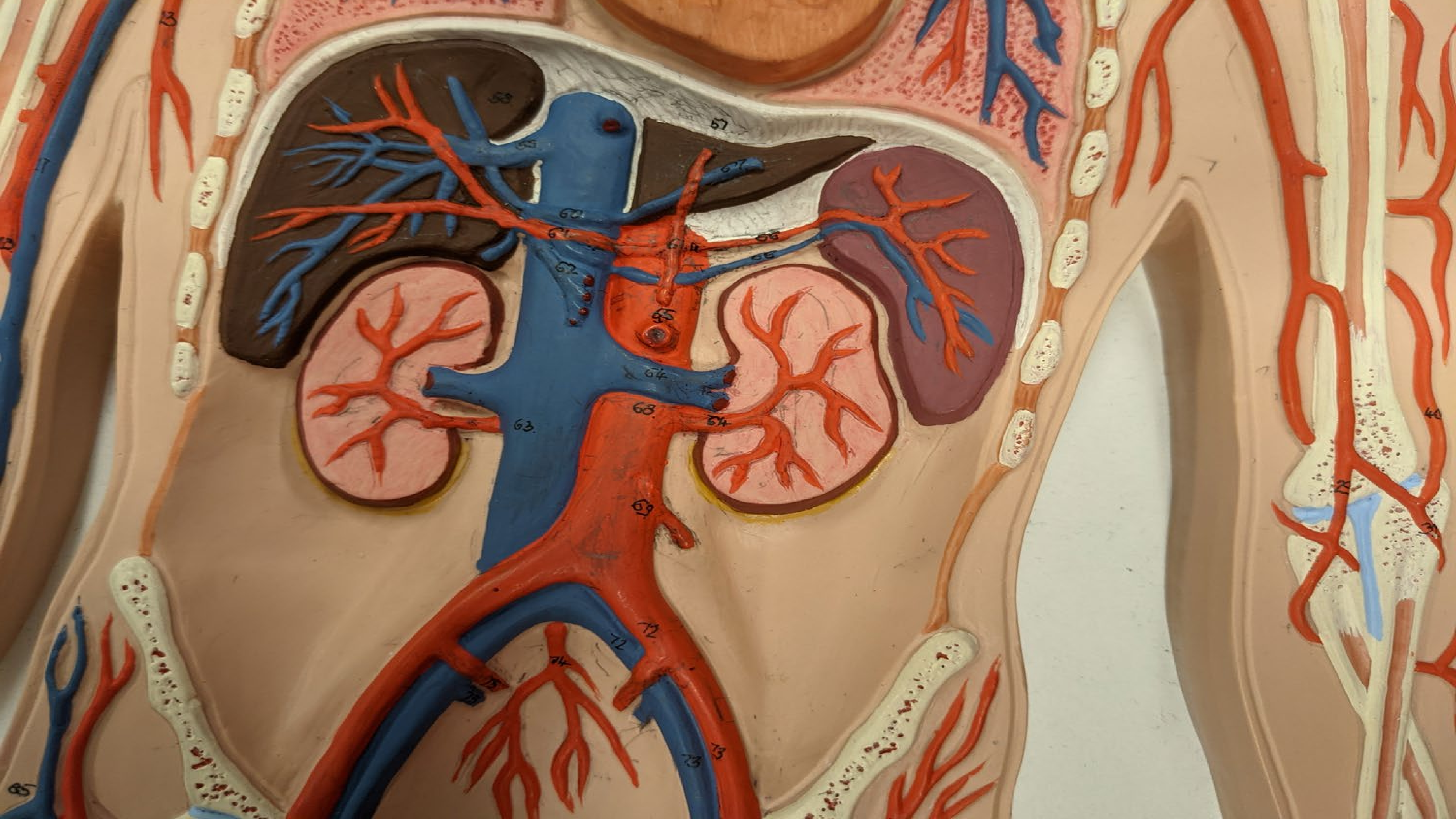
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