

# Cardiovascular system

καρδιαγγειακό σύστημα

# The pericardium

A fibroserous sac Encloses the heart and the root of the large blood vessels connected with it.

## Fibrous pericardium

### Inelastic layer

#### Dorsally:

Reaches the longus coli muscle.

#### Ventrally:

Attached to the sternum through sterno-pericardiac ligament (also pericardiophrenic lig. in dog).

N.B: Pericardium is covered by pericardial pleura (part from the mediastinal pleura) which is crossed by left phrenic nerve

## Serous pericardium

### Parietal layer

Lined the fibrous layer and attached to it.

### Visceral layer (Epicardium)

Encloses the heart and root of large blood vessels.

Between both layers there's the pericardial space, which is filled with serous fluid

# THE HEART

Shape

Irregular flattened cone shape

Size

0.4 % of the body weight

Position

In the middle of the mediastinal space, directed caudo-ventrally

Fixation

It is free in the pericardium; but it is attached dorsally from its base by the large blood vessels

# THE HEART

Two surfaces

- ✍ Atrial (Right or diaphragmatic)
- ✍ Auricular surface

Two Borders

- ✍ Right ventricular (cranial) border: convex and parallel to the sternum
- ✍ Left ventricular (caudal) border nearly vertical

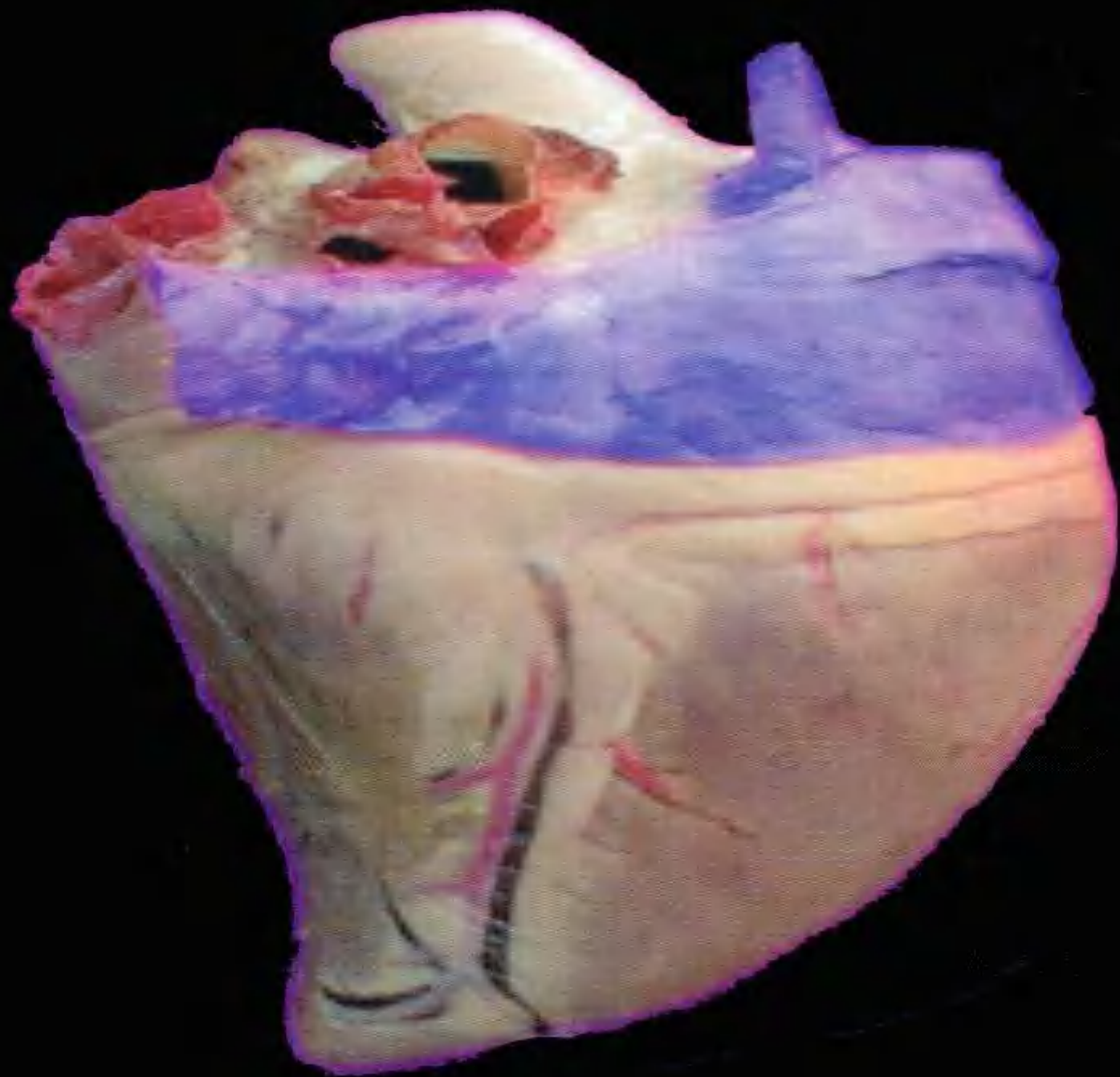
Base

Dorsally located

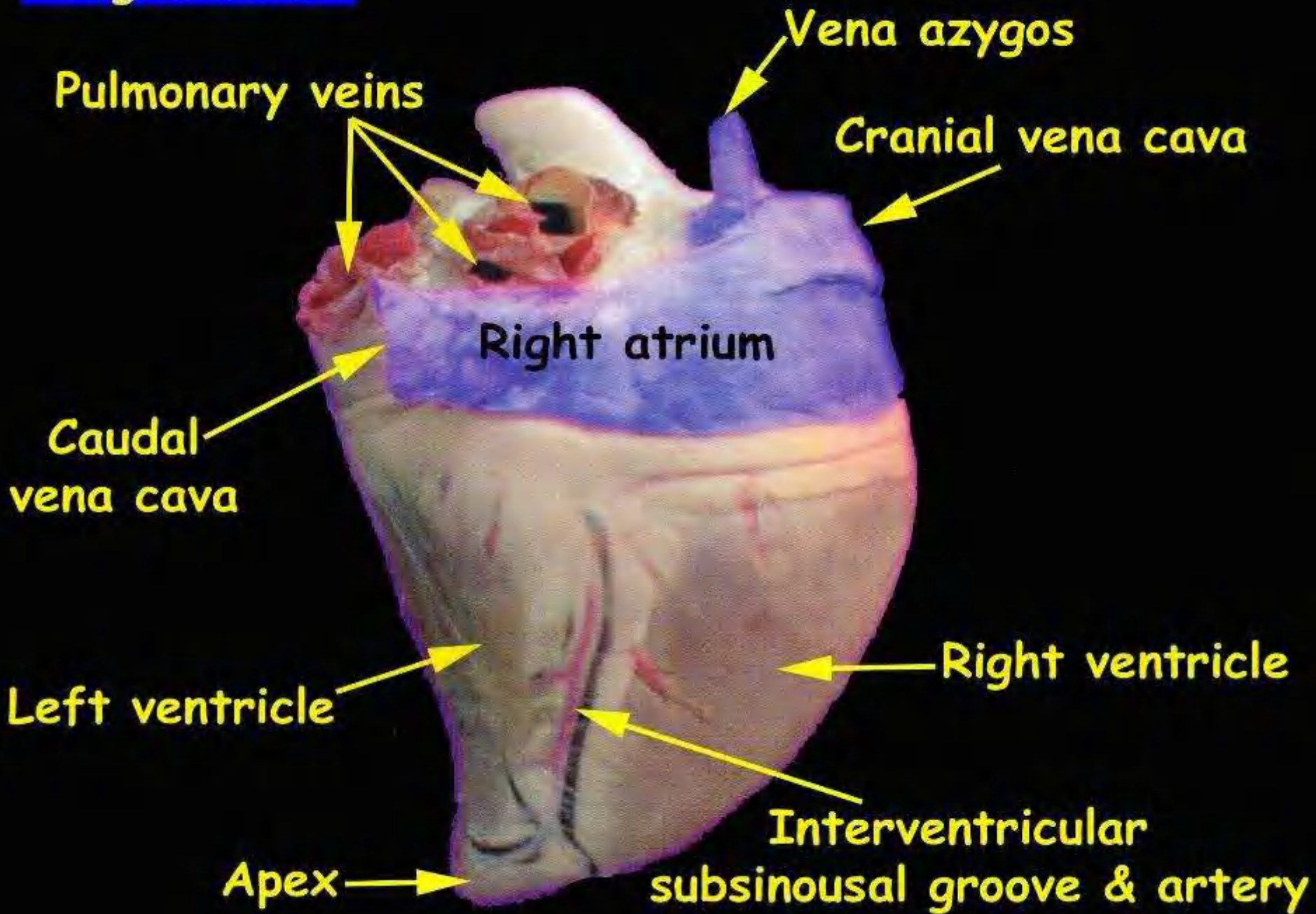
Apex

Ventrally, Centrally and dorsal to the last sternebra

Right surface  
of the heart

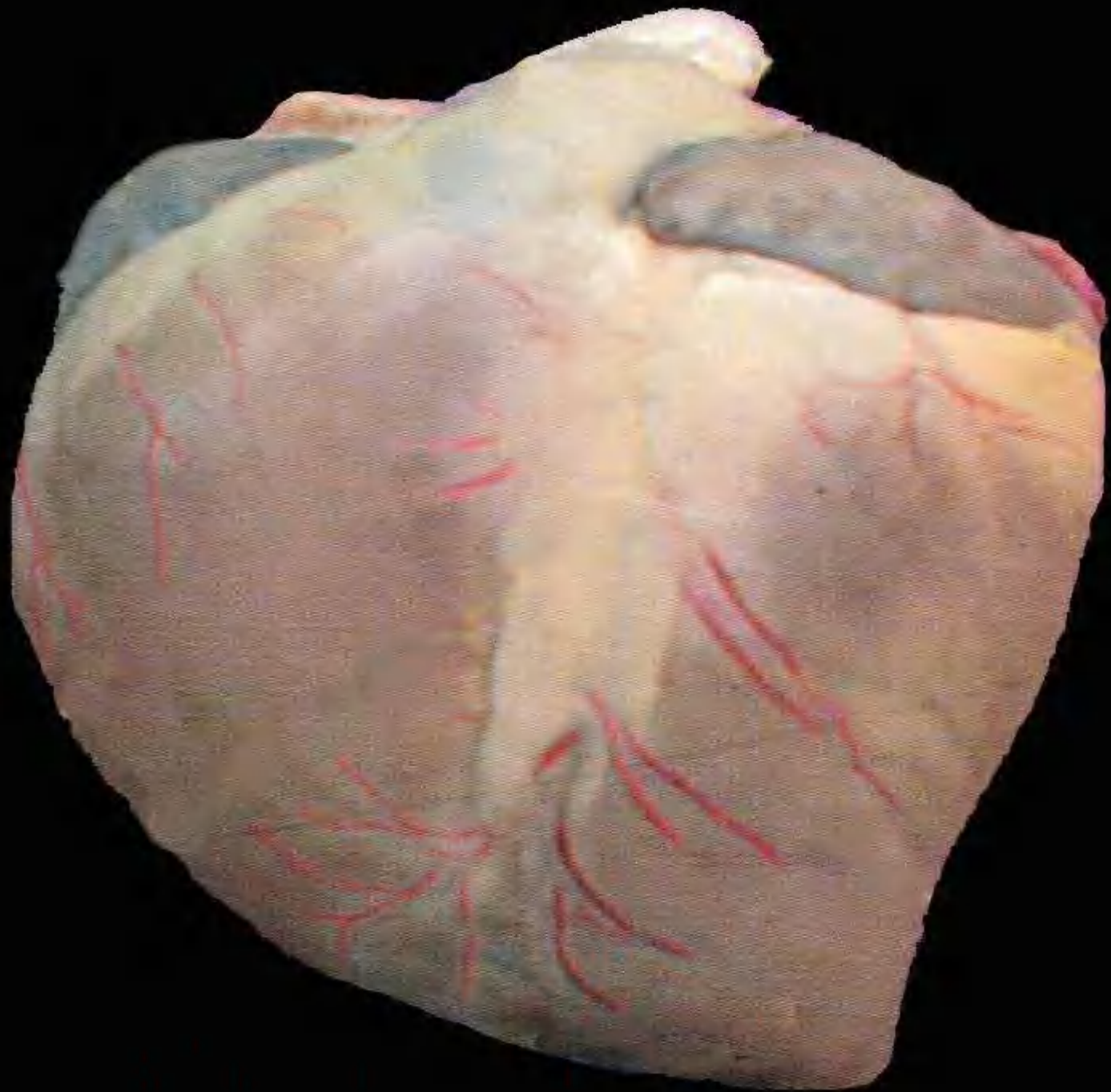


# Right View

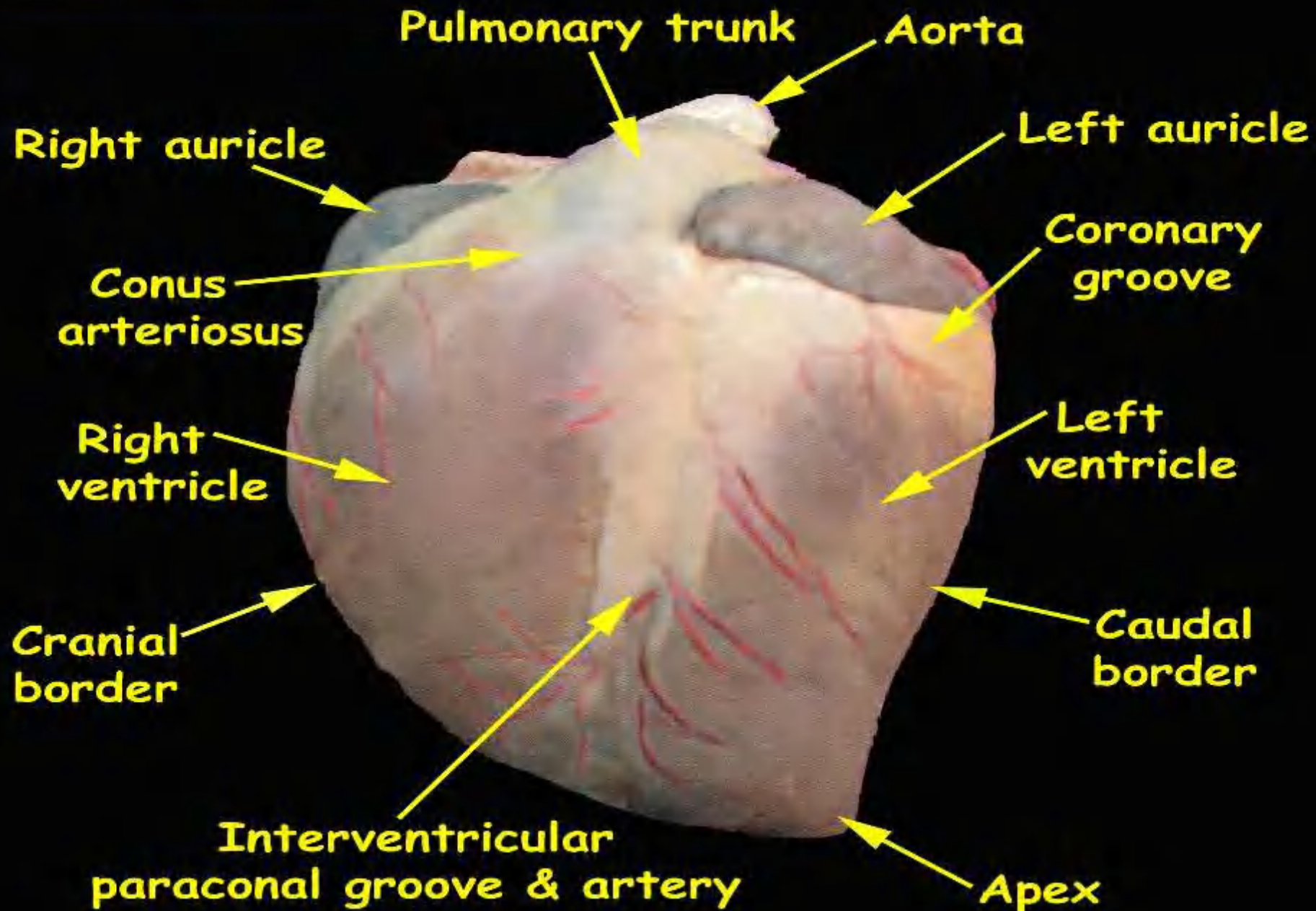


Left surface  
of the heart





## Left View



# Grooves of the heart

## Coronary grooves

📖 Indicate the division of the atria and ventricles

## Inter ventricular grooves

**Interventricular  
paraconal groove  
(Left)**

- 📖 Cranially located
- 📖 Reaches the apex
- 📖 Opposite to the 4th intercostal space

**Interventricular  
Subsinousal groove  
(Right)**

- 📖 Caudally located
- 📖 Not reaches the apex
- 📖 Opposite to the 5th and 6th intercostal spaces

# THE RIGHT ATRIUM

📁 It forms the cranial part of the base.

🌀 The internal atrial wall is covered by the endocardium.

📖 The wall is being smooth except the right and the auricle, which represented muscular ridges (pectinate muscle).

🖋️ There are small bands enclosed by the M. pectinate end dorsally at the concave terminal crest.

➔ Between the opening of the cranial and caudal vena cavae there is the intervenous tubercle.

✂️ In the septal wall, there is the fossa oval.

# The right atrium

includes;



**Sinus venarum cavarum**

Part of the cavity between the cranial and caudal venae cavae.

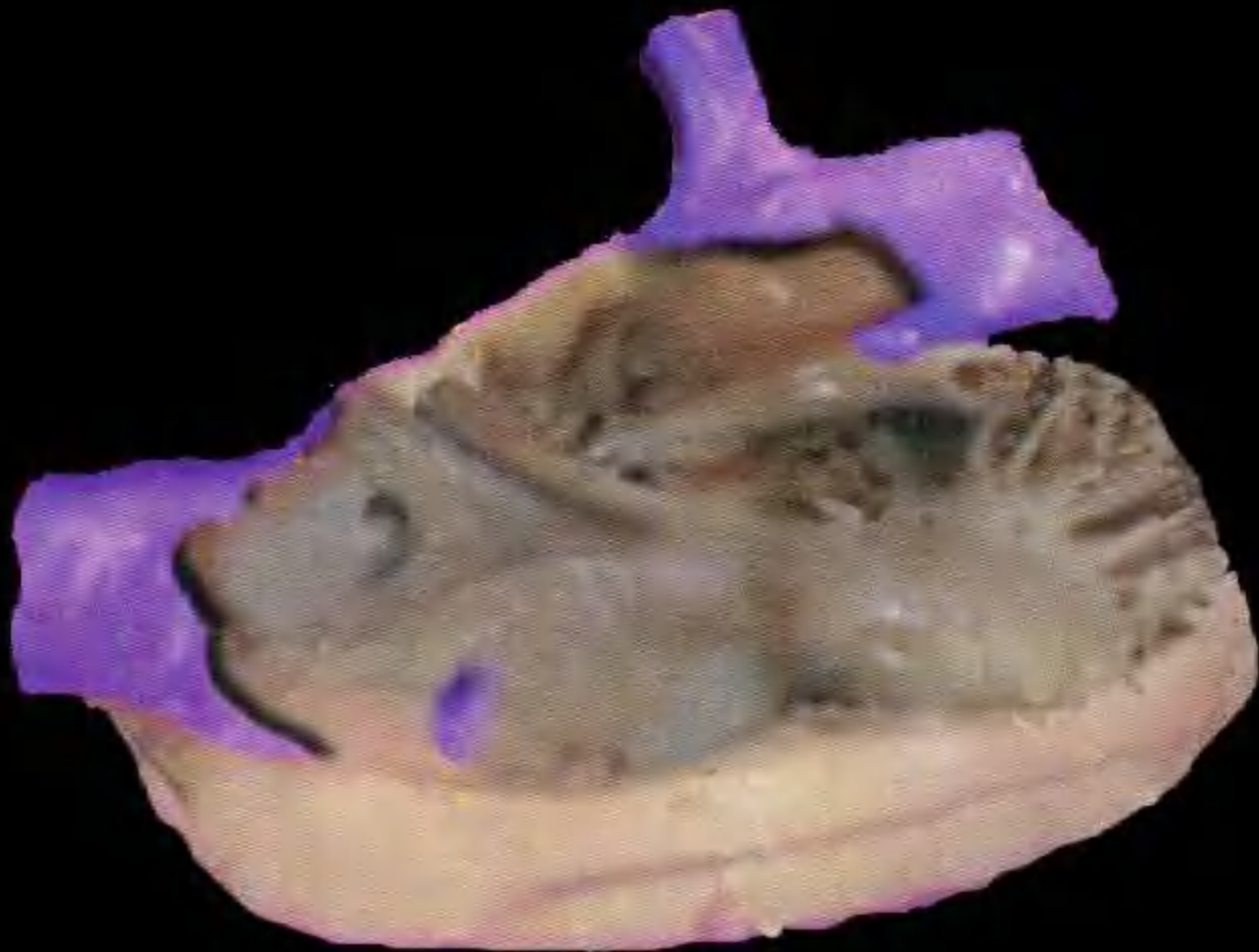


**Auricle**

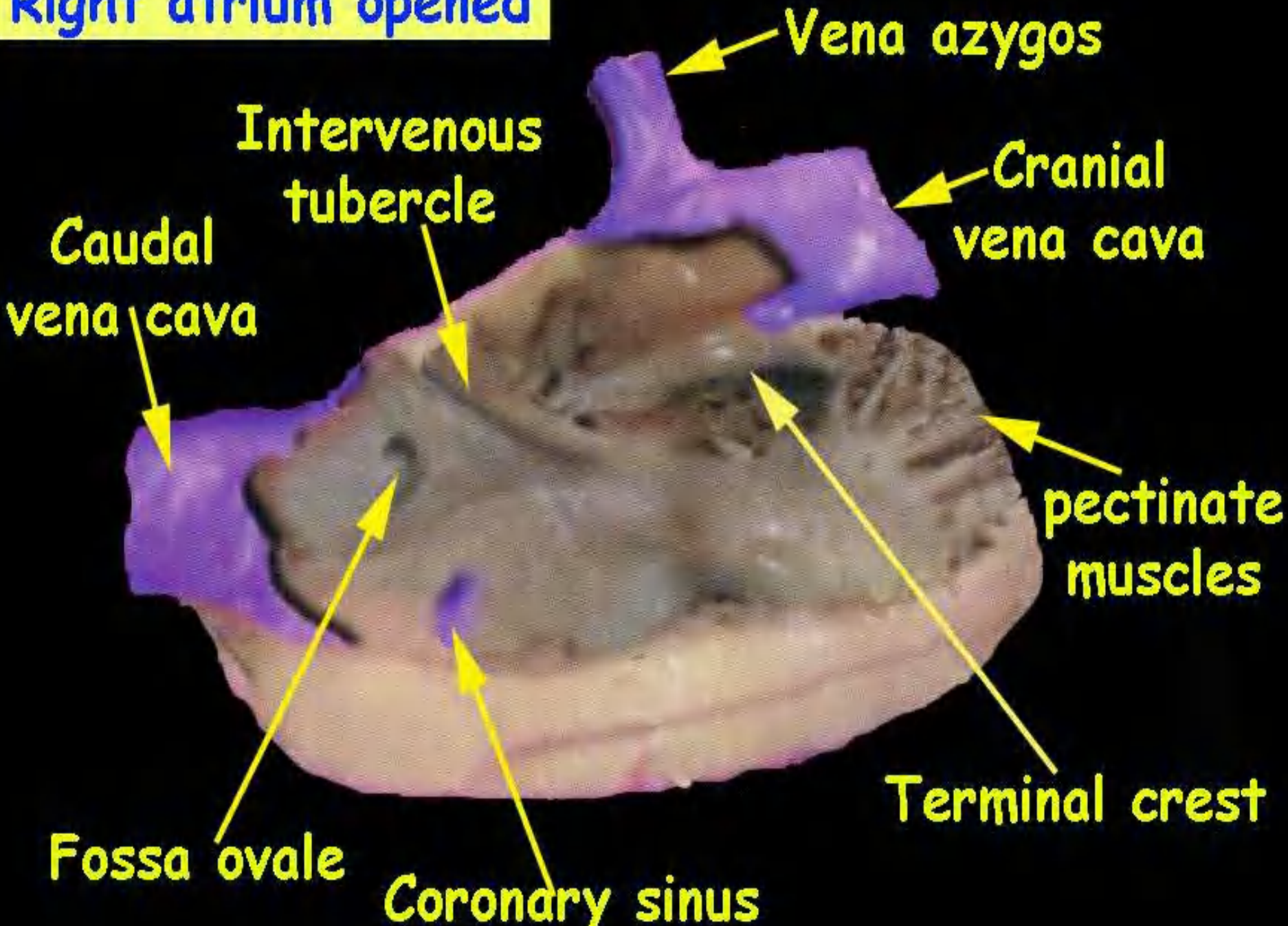
A conical diverticulum.

## Openings of the right atrium:

- 1- Opening of the cranial vena cava opposite to the 4th rib.
- 2- Opening of the caudal vena cava opposite to the 6th rib.
- 3- Opening of the right vena azygos: presents between the opening of cranial and caudal vena cavae.
- 4- Right atrioventricular opening.
- 5- Coronary sinus: ventral to the opening of the caudal vena cava into which coronary sinus of the heart opened and provided by small semi lunar valve.
- 6- Foramina venarum minimarum.



**Right atrium opened**



# THE RIGHT VENTRICLE

- ✂ Constitutes the cranial part of the ventricular mass.
- ✂ Not reaches the apex.
- ✂ Extends from the 3rd to the 5th ribs (right side).
- ✂ Triangular in outline and crescentic in cross-section.
- ✂ At the left, it projects to form the conus arteriosus, from which the pulmonary trunk arises.
- ✂ The conus arteriosus: is separated from the atrio-ventricular orifices by the Supra ventricular crest.
- ✂ The right atrioventricular orifice: is guarded by a tricuspid valve; its ventricular surface is attached by the Chordae tendinae, which extend from the papillary muscle on the septal and lateral walls.
- ✂ The Pulmonary orifice:  
is guarded by semilunar valve (Tricusped); each cusp faces one of the pulmonary sinuses.



☞ The septal surface is convex.

☞ The wall of the ventricle represents

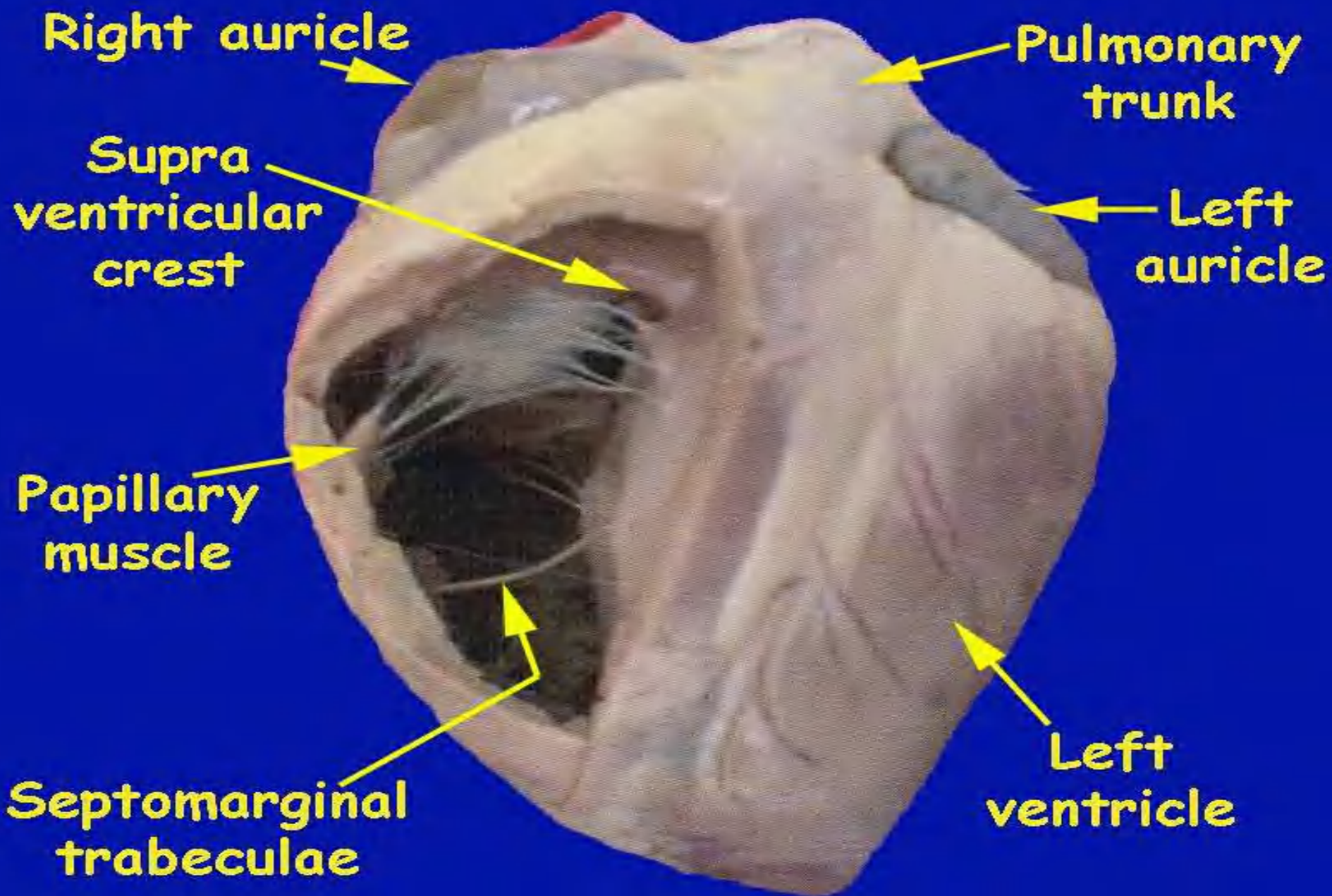
1- ridges or columns in relief

2- papillary muscle

3- moderator bands (septomarginal trabeculae)



## Right ventricle opened



# THE LEFT ATRIUM

 Forms the caudal part of the base, caudal to the pulmonary trunk and the ascending aorta.

 The inner surface of the auricle represents the pectinate muscle.

## Openings of the left atrium:

- \* 7:8 pulmonary veins
- \* Atrioventricular opening

# THE LEFT VENTRICLE

- 🌸 Forms the left caudal part of the ventricular mass.
- 🗑️ Regular conical shape.
- 🗑️ Thicker wall.
- 🗑️ Forms the apex of the heart.
- 🗑️ The septal wall is concave.
- ✍️ The atrioventricular opening is guarded by bicusped (Mitral) valve.
- 🕒 The chordae tendenae are fewer and larger.
- ✉️ Two large moderator bands.
- 📁 Narrow cavity in the dead subject.

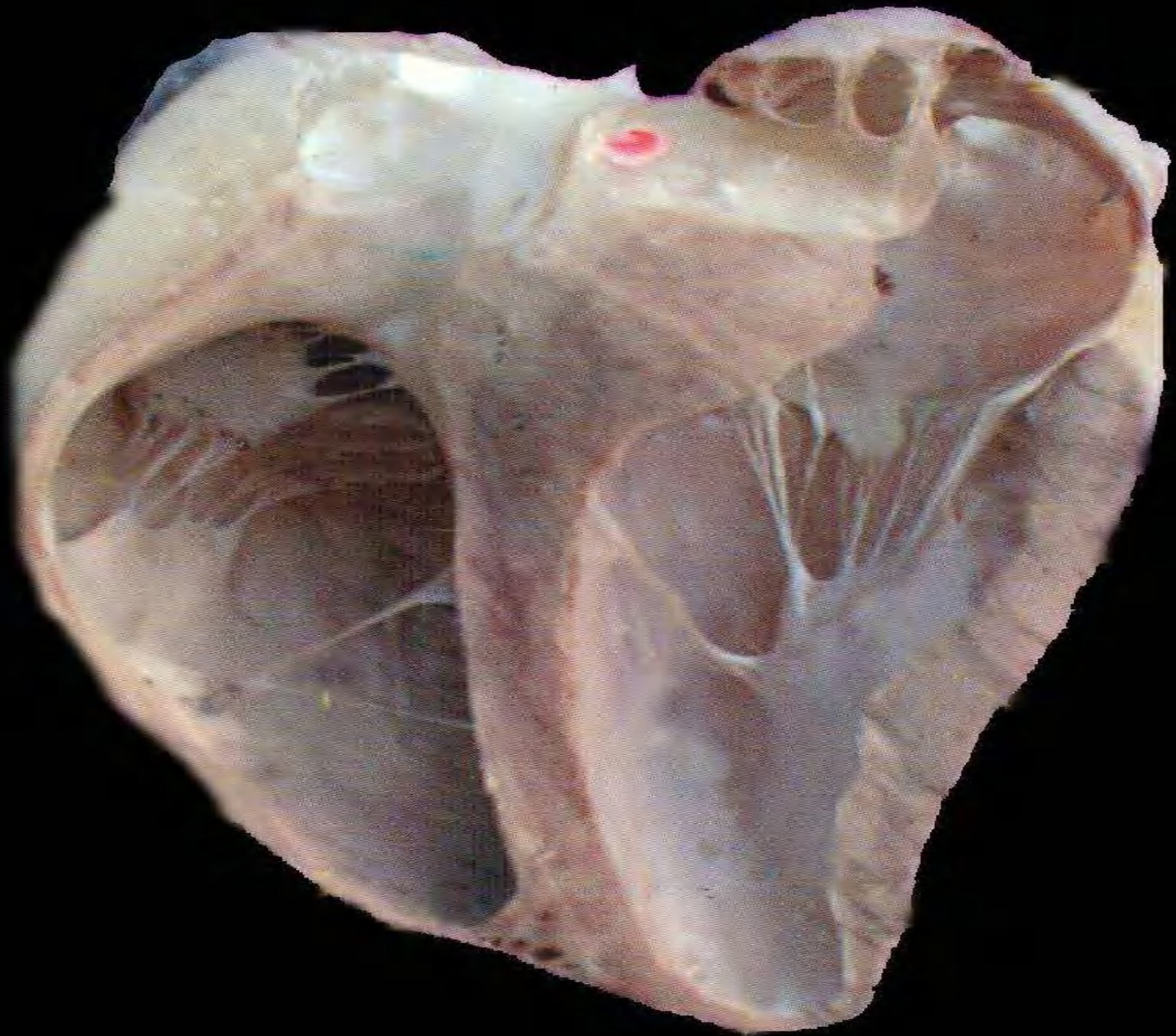
## The right ventricle

- 1- Forms the cranial part of the ventricular mass.
- 2- Triangular in outline & crescentic in C.S.
- 3- Not reaches the apex.
- 4- The atrioventricular opening is guarded by tricusped valve.
- 5- The septal wall is concave
- 6- The chordae tendinae are numerous and short.
- 7- Thinner wall.
- 8- From it arises the pulmonary trunk.
- 9- Represented venous blood.
- 10- In dead animals, it has wider cavity.

## The left ventricle

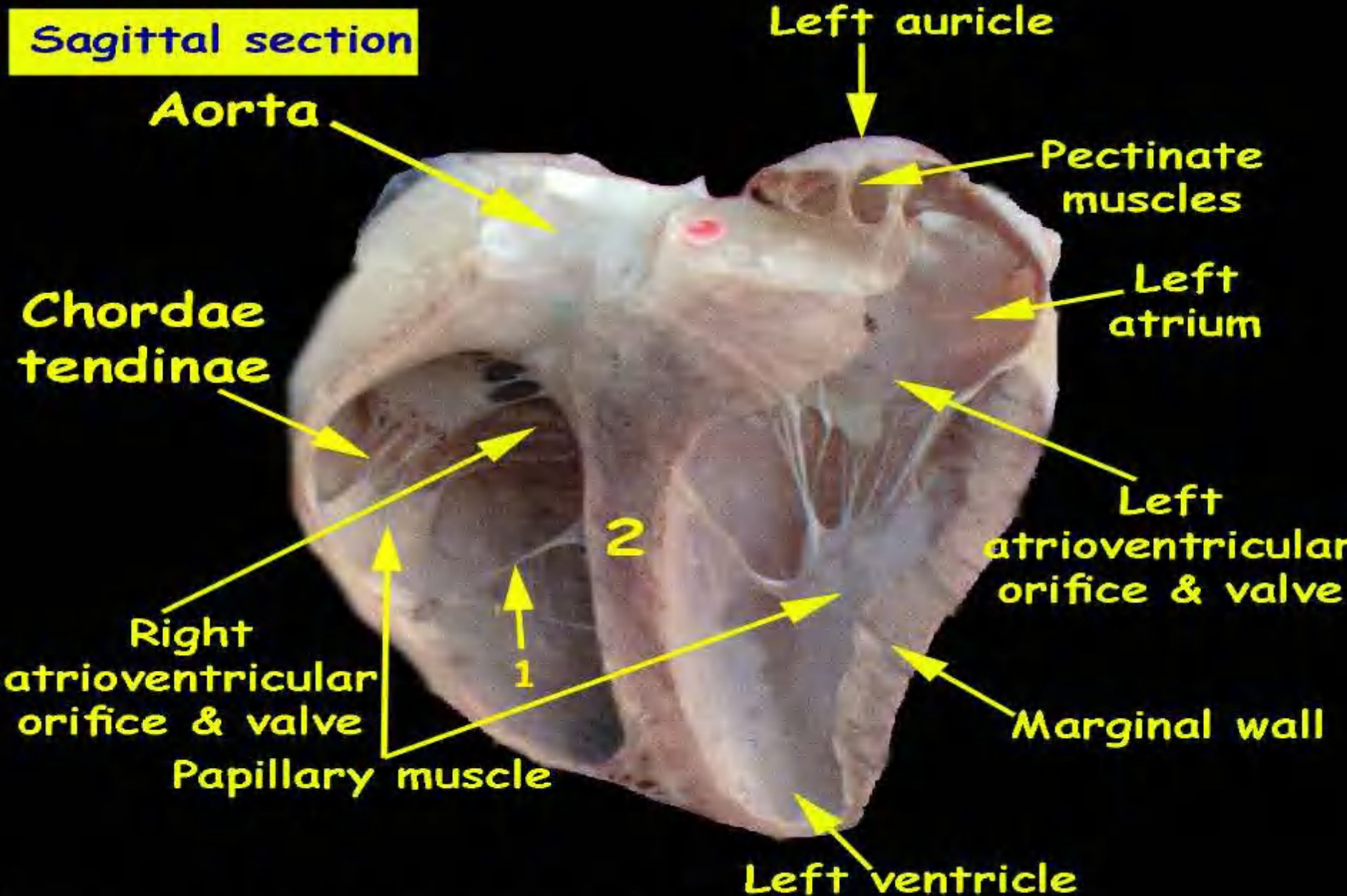
- 1- Forms the caudal part.
- 2- Regular cone shape & rounded in C.S.
- 3- Forms the apex.
- 4- Bicusped (Mitral valve).
- 5- The septal wall is concave
- 6- Fewer and long.
- 7- Thicker wall.
- 8- From it arises the ascending aorta.
- 9- Represented arterial blood.
- 10- In dead animals, it has narrow cavity.

Sagittal section  
of the heart





**Sagittal section**



Left auricle

Aorta

Pectinate muscles

Left atrium

Chordae tendinae

Left atrioventricular orifice & valve

Right atrioventricular orifice & valve

Marginal wall

Papillary muscle

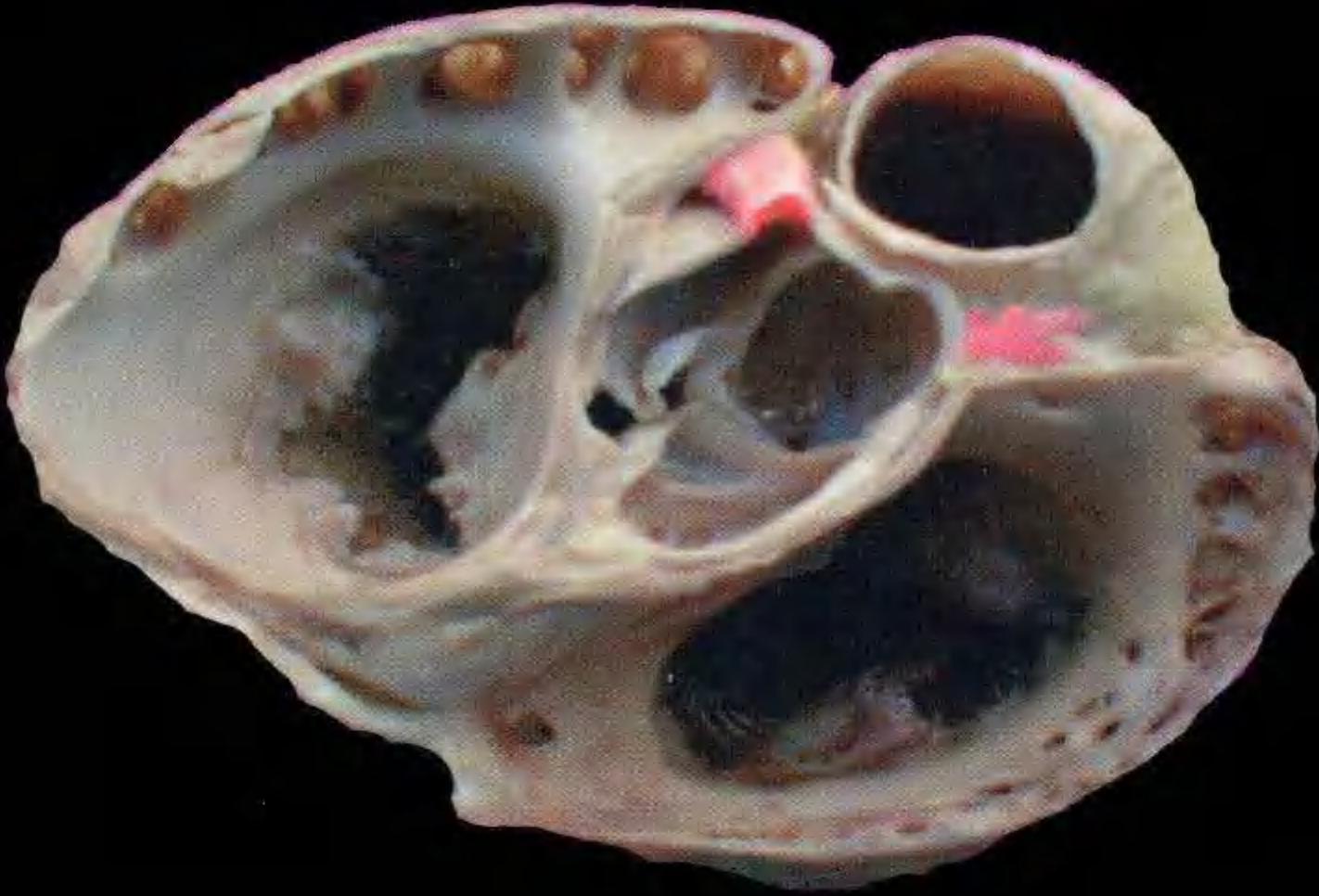
Left ventricle

2

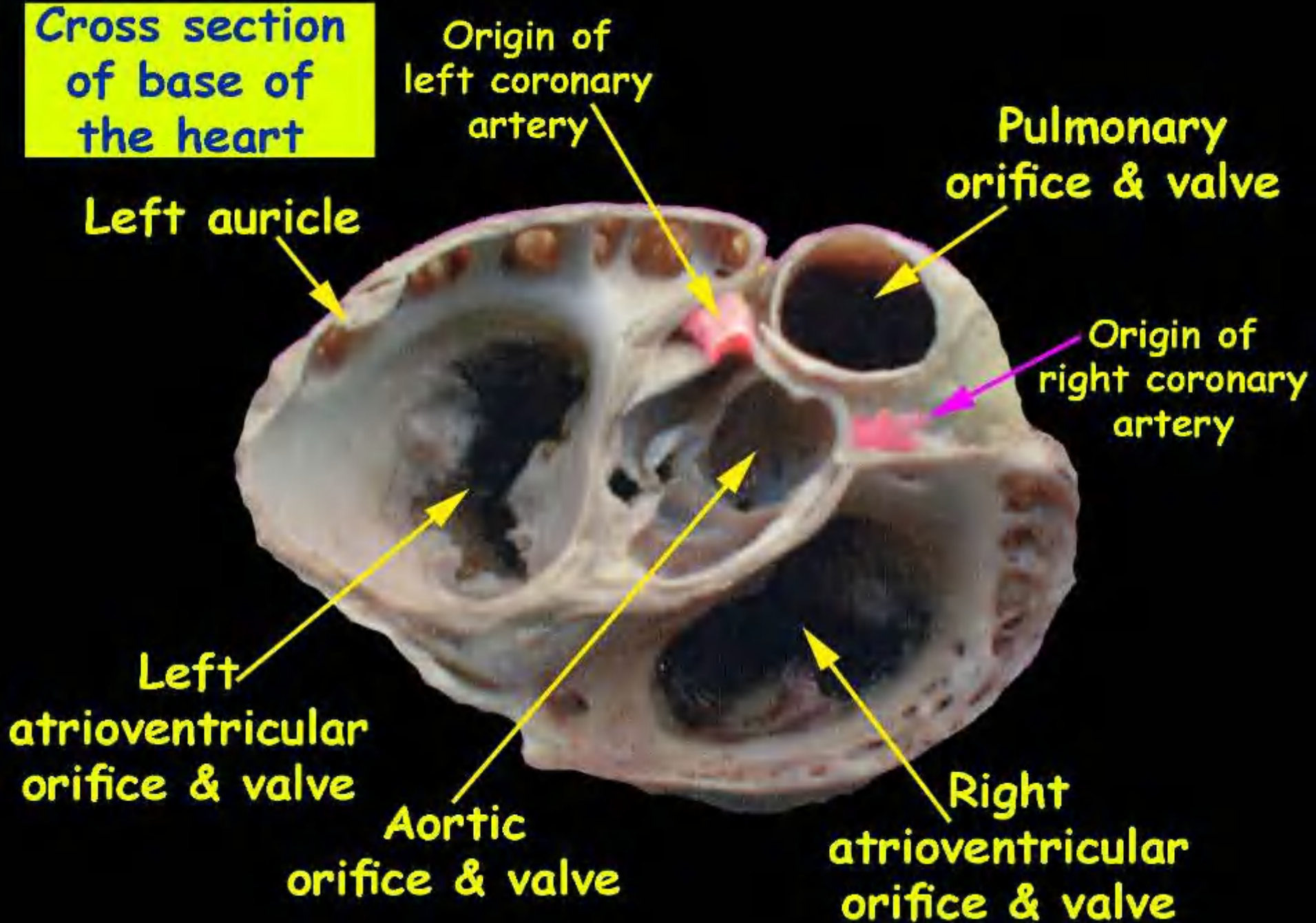
1

- 1- Septomarginal trabeculae
- 2- Interventricular setum

Cross section  
of the base



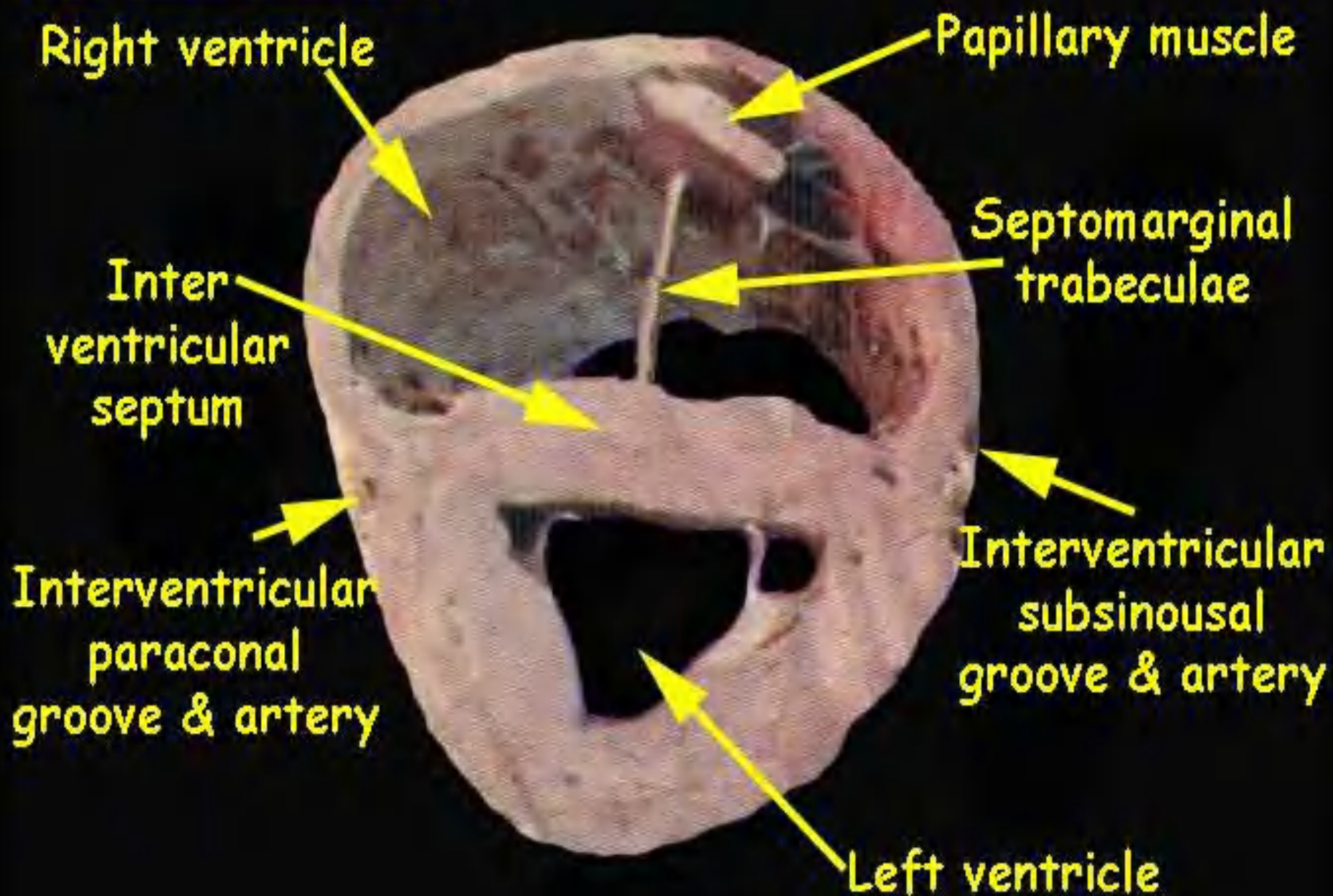
**Cross section  
of base of  
the heart**



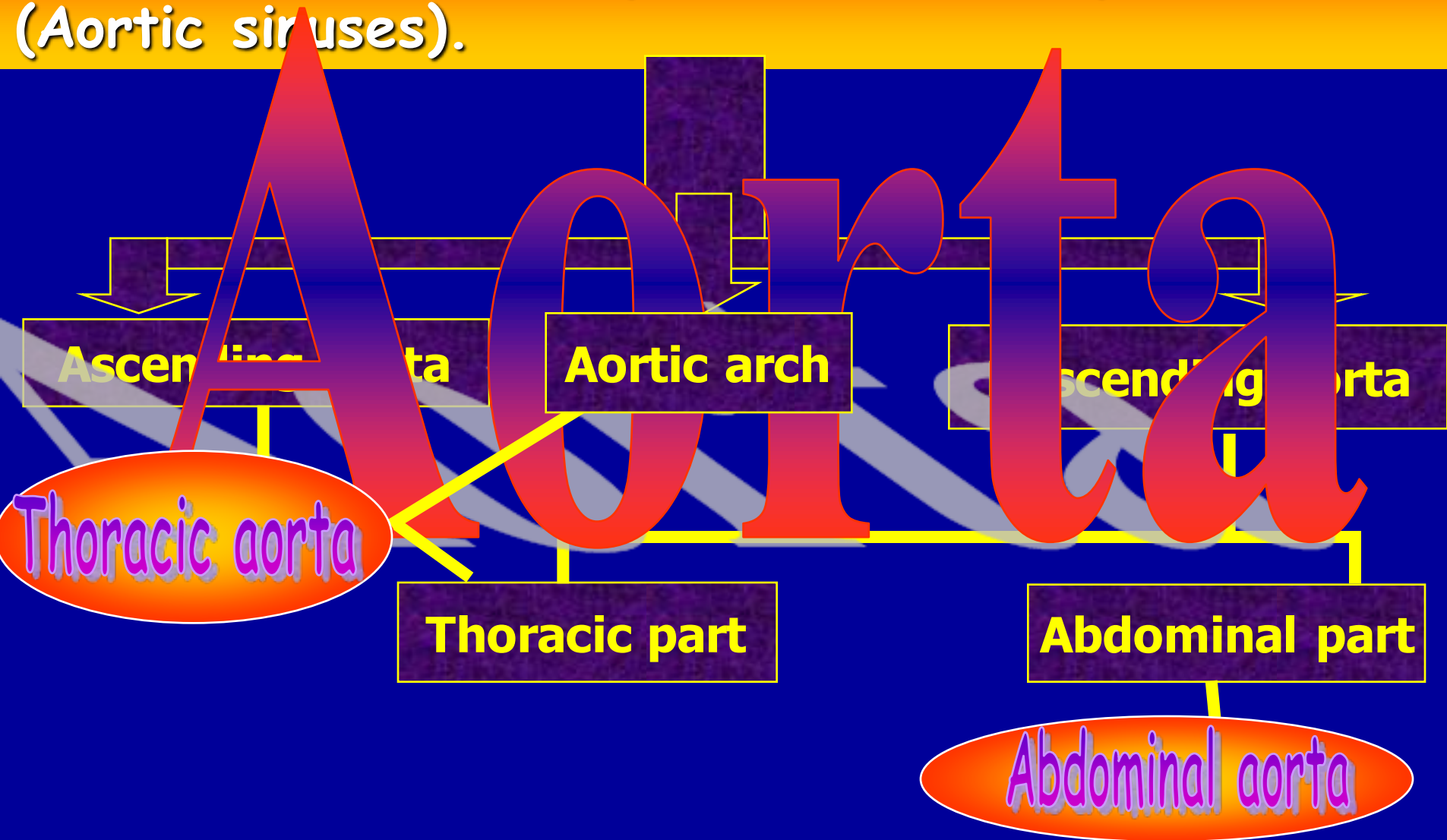
Cross section  
in ventricles



## C.S. in ventricles



 The main systemic arterial trunk. It begins at the base of the left ventricle by a dilatation (Aortic Bulb) which represented three pouch-like (Aortic sinuses).





# Branches of the thoracic aorta

# Coronary arteries

## ✦ Right coronary artery

It originates from the right aortic sinus, passes in the coronary groove to reach the level to the inter-ventricular subsinuosal groove where it gives;

📖 **Septal branches**

📖 **Circumflex branch**

Then it turns down in the groove as

📖 **interventricular subsinuosal branch** till the apex of the heart.

\*\*\*\*\*

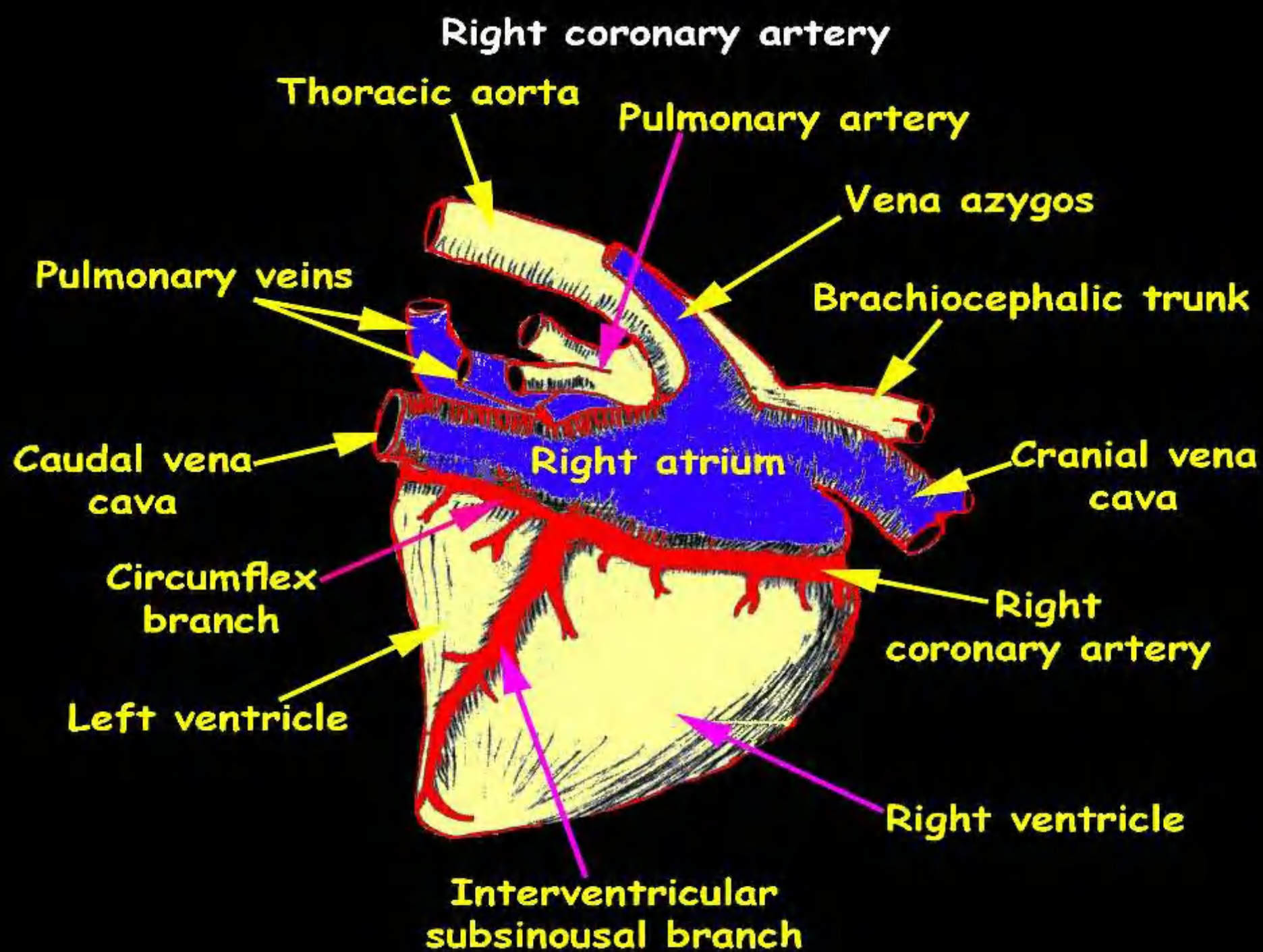
## ✦ Left coronary artery:

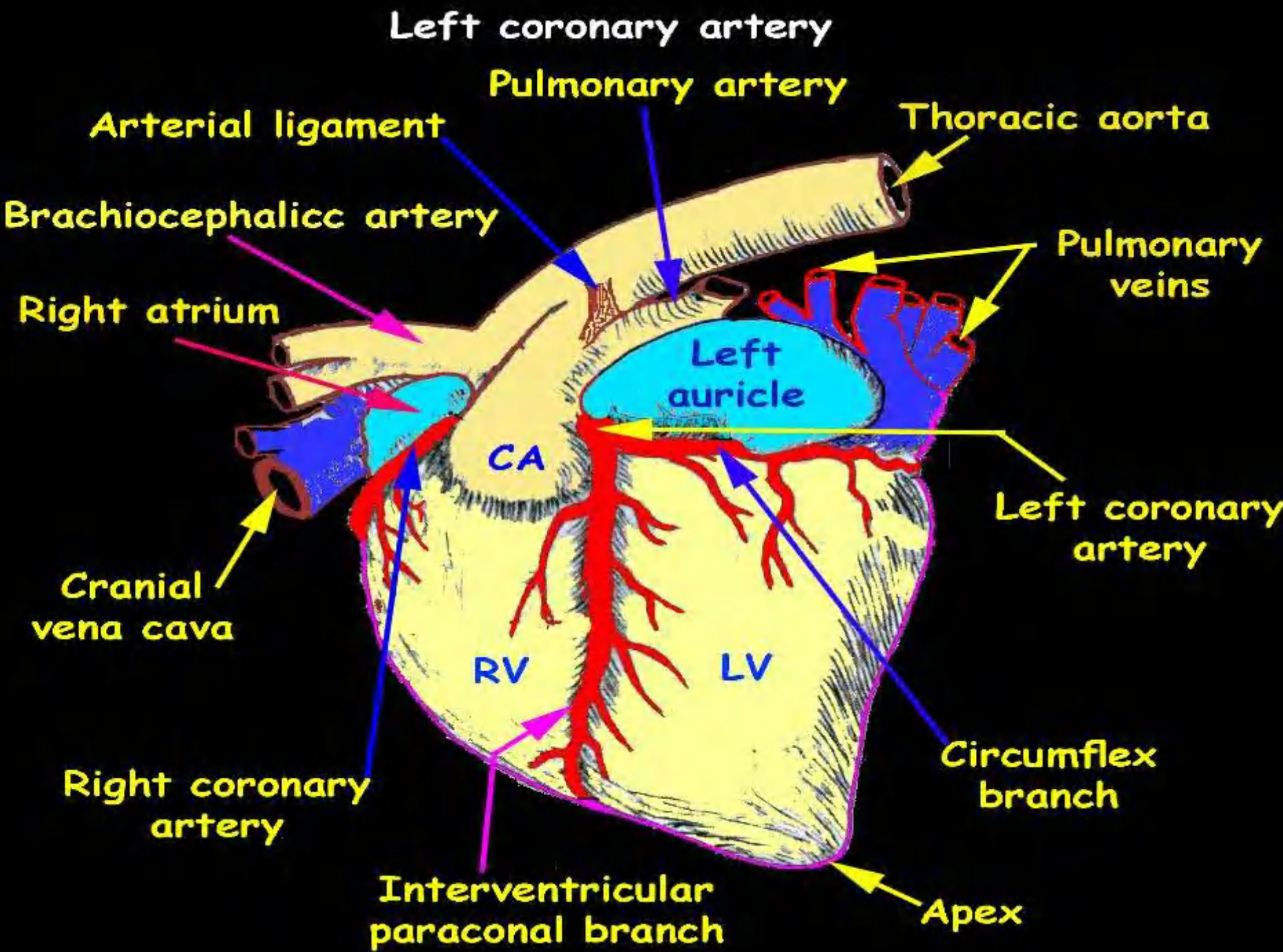
It originates from the left aortic sinus, it divides into;

📖 **Septal branches.**

📖 **Interventricular paraconal branch.**

📖 **Circumflex branch** winds to the right and anastomoses with the circumflex branch of the right coronary artery.





# Aorta

I- Ascending aorta

II- Aortic arch

III- Descending aorta

I- Common brachiocephalic trunk.

II- Left subclavian A.

1- Costocervical A.

A- Supreme intercostale A.

B- Dorsal scapular A.

2- Deep cervical A.

3- Vertebral A.

4- Internal thoracic A.

a- Venteral intercostal As.

B- Pericardiophrenic A.

c- Musculophrenic A.

d- Cranial epiastric A.

**5- External thoracic A.**

**6- Superficial cervical A.**

III- Brachiocephalic trunk.

**1 , 2 , 3 (right)**

IV- Right subclavian A.

**4, 5, 6 (right)**

V- Bicarotid trunk.

**Right and left common carotid arteries**

### III- Descending aorta:

7- Bronchooesophageal trunk

Bronchial A.

Oesophageal A.

8- Dorsal intercostal As. (6-18)

9- Cranial phrenic A.

## 2- Brachiocephalic trunk:

Left subclavian artery

Brachiocephalic trunk

Bicarotid trunk

Right subclavian artery.

3- **Bronchoesophageal trunk:** Arises from the dorsal aspect of the thoracic aorta, opposite to the 6<sup>th</sup> thoracic vertebra.

**Bronchial branch:** to the lung

**Oesophageal branch:** to the esophagus, it anastomoses with the caudal oesophageal artery of the left gastric A.

## 4- Dorsal intercostal arteries:

17 pairs:

1<sup>st</sup> → deep cervical A.

2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and may be 5<sup>th</sup> → supreme intercostale of the costocervical.

6<sup>th</sup>----- 17<sup>th</sup> → Thoracic aorta.

18<sup>th</sup> (Costo abdominal A.)

## Dorsal intercostal

Dorsal Br. Spinal branch

Muscular branch

Ventral Br. Lateral branch

Medial branch

5- **Cranial phrenic artery:** to the diaphragm



Brachiocephalic trunk

# Brachiocephalic trunk

Originates from the convexity of the aortic arch, passes cranially in the mediastinum opposite to the 2nd intercostal space, it gives:

**The left subclavian artery:**

Opposite to the 1st rib it gives:

**Bicarotid trunk** and then it continues as **Right subclavian artery**

# The left subclavian and the brachiocephalic trunk

gives;

## 1- Costocervical trunk:

The right usually arises commonly with the deep cervical artery; while the left sometimes do such.

### a- Small twigs to;

Trachea, Pleura and mediastinal lymph nodes.

### b- Supreme intercostale:

2nd, 3rd, 4th and may be 5th dorsal intercostal arteries.

### c- Dorsal scapular artery:

to the withers, it anastomoses with the deep cervical artery.

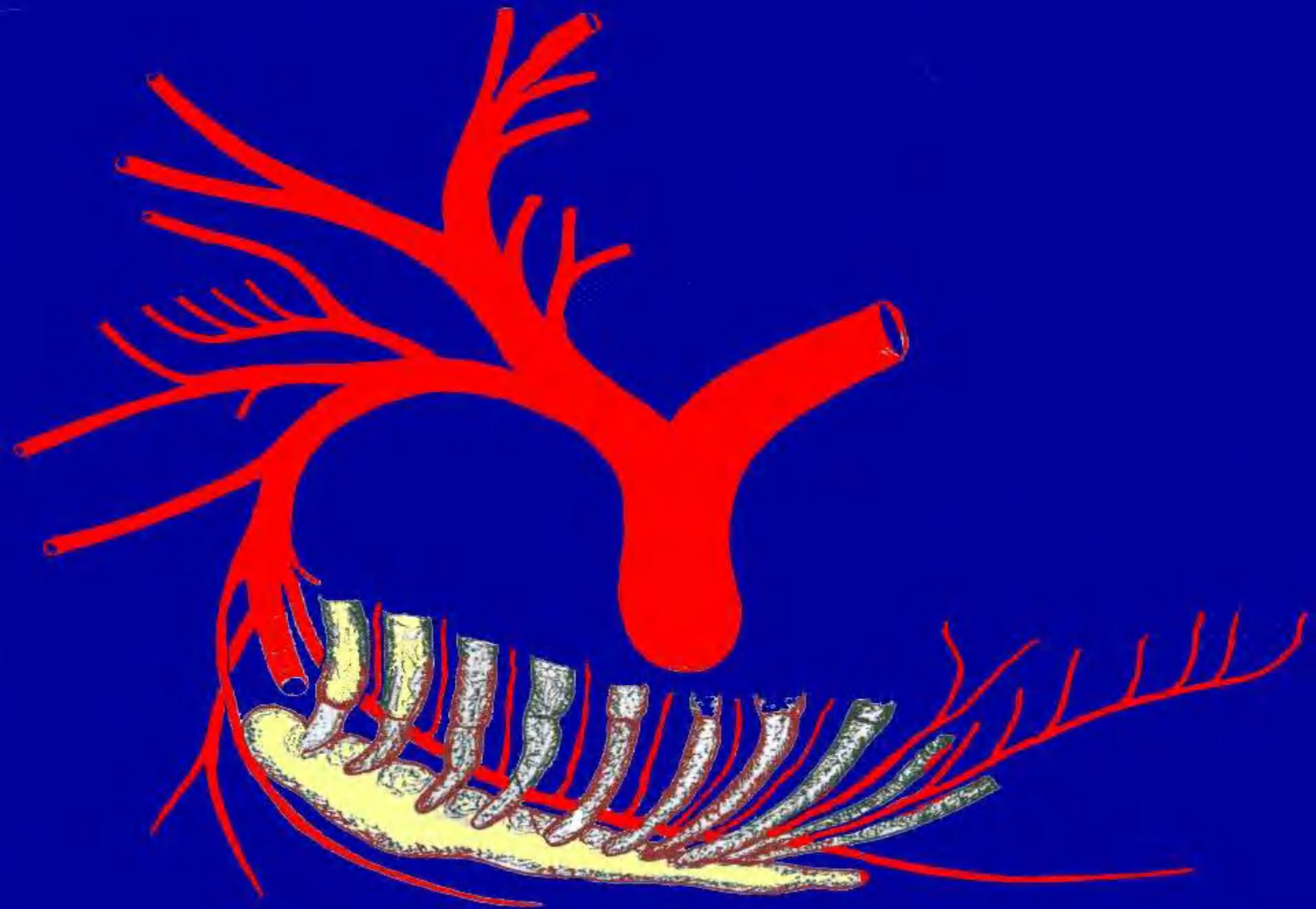
## 2- Deep cervical artery

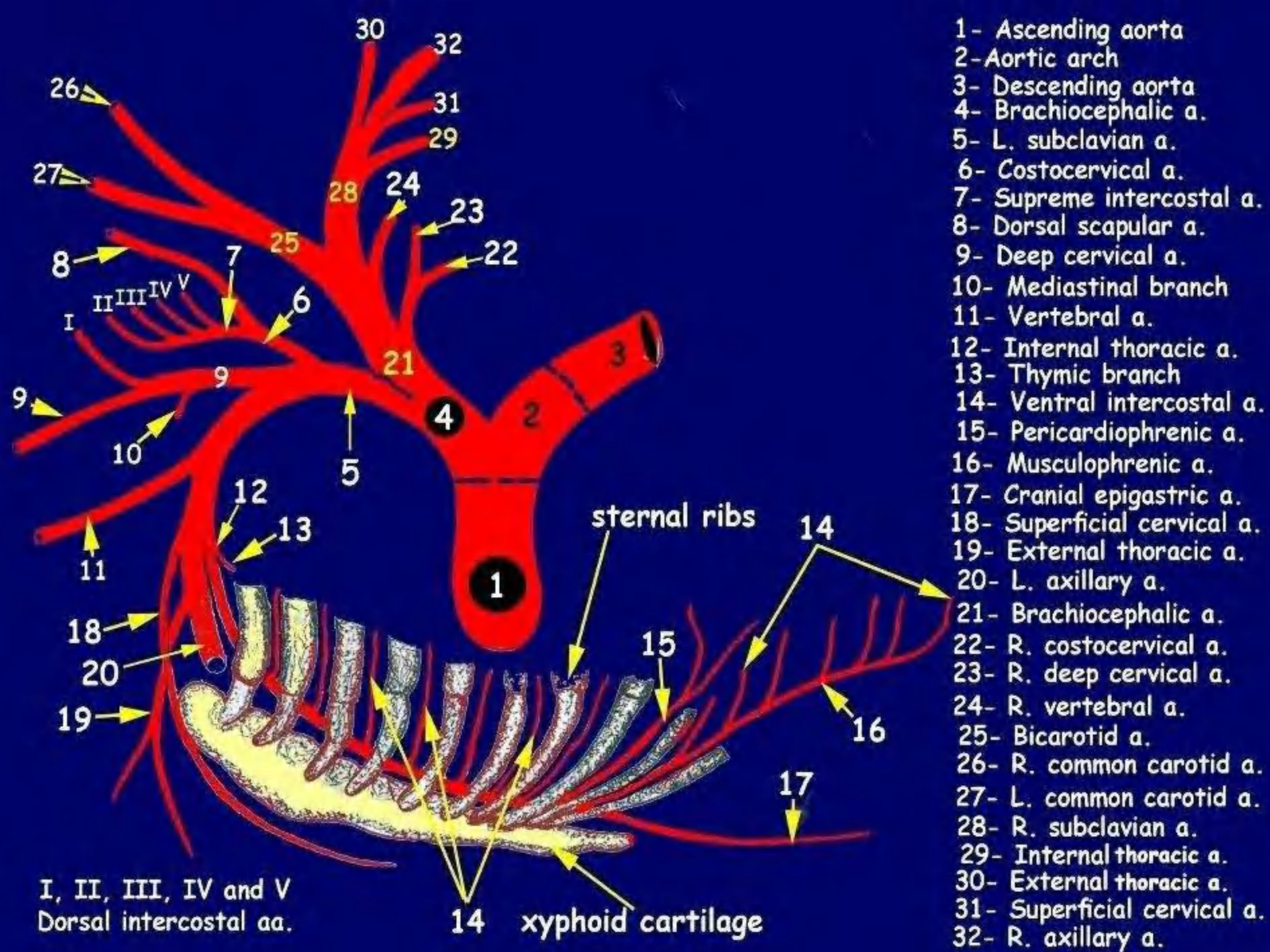
Ascends cranially in the neck region between the M. spinalis, ligamentum nuchae and the M. Semispinalis capitis.

**At the axis,** it anastomoses with the vertebral artery

**At the 1st intercostal space,**  
it gives the 1<sup>st</sup> dorsal intercostal artery.

**BRACHIOCEPHALIC TRUNK**





- 1- Ascending aorta
- 2- Aortic arch
- 3- Descending aorta
- 4- Brachiocephalic a.
- 5- L. subclavian a.
- 6- Costocervical a.
- 7- Supreme intercostal a.
- 8- Dorsal scapular a.
- 9- Deep cervical a.
- 10- Mediastinal branch
- 11- Vertebral a.
- 12- Internal thoracic a.
- 13- Thymic branch
- 14- Ventral intercostal a.
- 15- Pericardiophrenic a.
- 16- Musculophrenic a.
- 17- Cranial epigastric a.
- 18- Superficial cervical a.
- 19- External thoracic a.
- 20- L. axillary a.
- 21- Brachiocephalic a.
- 22- R. costocervical a.
- 23- R. deep cervical a.
- 24- R. vertebral a.
- 25- Bicarotid a.
- 26- R. common carotid a.
- 27- L. common carotid a.
- 28- R. subclavian a.
- 29- Internal thoracic a.
- 30- External thoracic a.
- 31- Superficial cervical a.
- 32- R. axillary a.

I, II, III, IV and V  
Dorsal intercostal aa.

14 xiphoid cartilage

sternal ribs

## Vertebral artery

It Leaves the thorax, it passes ventral to the transverse process of the 7<sup>th</sup> cervical vertebra and then proceeds cranially passing through the transverse foramina of the cervical vertebrae,

### At the atlantic fossa:

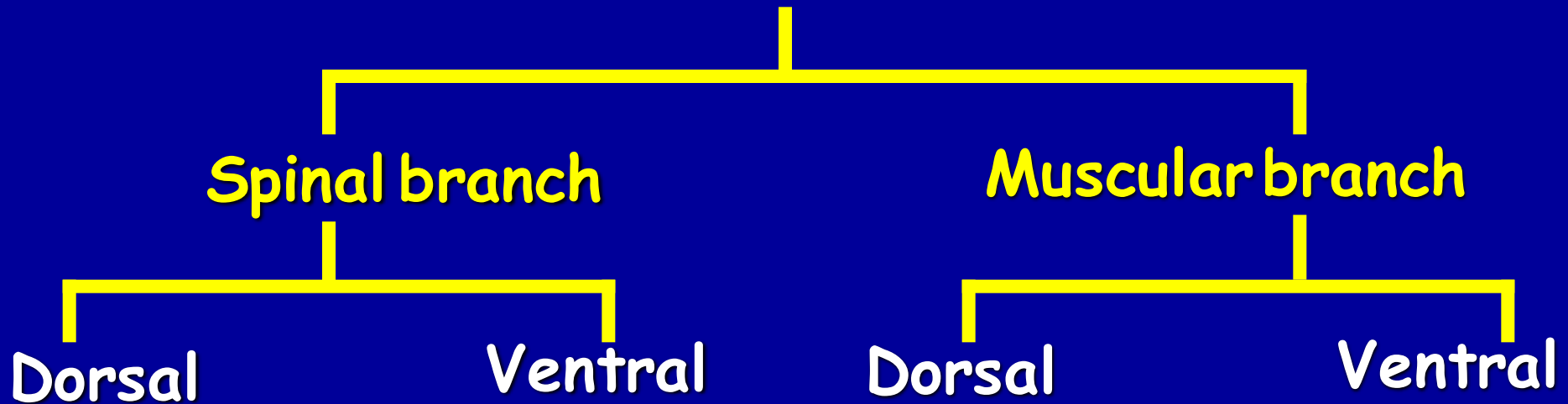
it anastomoses with the occipital artery and then passes through the alar foramen and then the lateral vertebral foramen of the atlas.

### Inside the vertebral canal:

it joins the artery of the opposite side to form the cranially coursing basilar artery.



# Collateral branches of the vertebral artery:



# Branches from the left and right subclavian arteries

## 4- Internal thoracic A.

it gives:

a - Ventral intercostal As.

- sternal branches

b- Pericardiophrenic A.

The right passes in the plica vena cavae, while the left passes in the mediastinum.

It supplies the pericardium, pleura diaphragm,

c- Thymic branch:

in the young animals to the thymus gland.

d- Cranial epigastric A.

anastomoses with the caudal epigastric A.

## e- Musculophrenic artery:

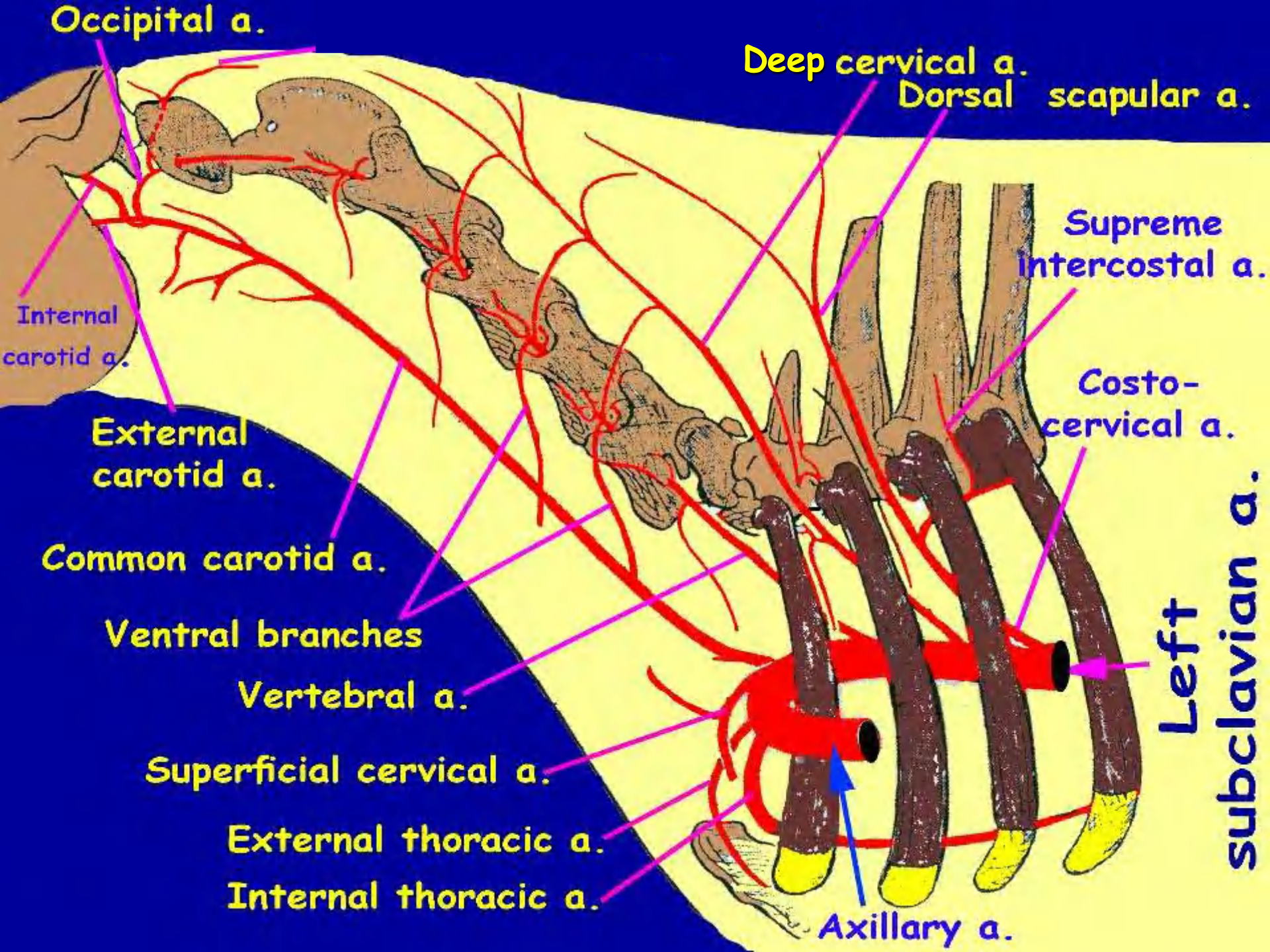
- Ventral intercostal As.
- phrenic branch
- Small twigs to the transverse abdominal muscle

## 5- External thoracic artery:

## 6- Superficial cervical artery:

- a- **Deltoid branch:** to the brachiocephalic and pectoral muscles.
- b- **Ascending branch:** to the omohyoid M., brachicephalic M. and caudal deep cervical Lns.

# Arterial blood supply of the thoracic region



Occipital a.

Deep cervical a.

Dorsal scapular a.

Supreme intercostal a.

Costo-cervical a.

Left subclavian a.

Axillary a.

External thoracic a.

Internal thoracic a.

Superficial cervical a.

Vertebral a.

Ventral branches

Common carotid a.

External carotid a.

Internal carotid a.

**Arterial blood supply  
of the thorax (Left view)**

Dorsal intercostal aa.

Dorsal scapular a.

Cranial phrenic a.

First dorsal intercostal a.

Internal thoracic a.

Vertebral a.

Superficial cervical a.

External thoracic a.

Ventral intercostal a.

Perforating branches

Musculophrenic a.

Pericardiophrenic a.

1- Aortic arch

2- Brachiocephalic trunk

3- Thoracic aorta

4- L. subclavian a.

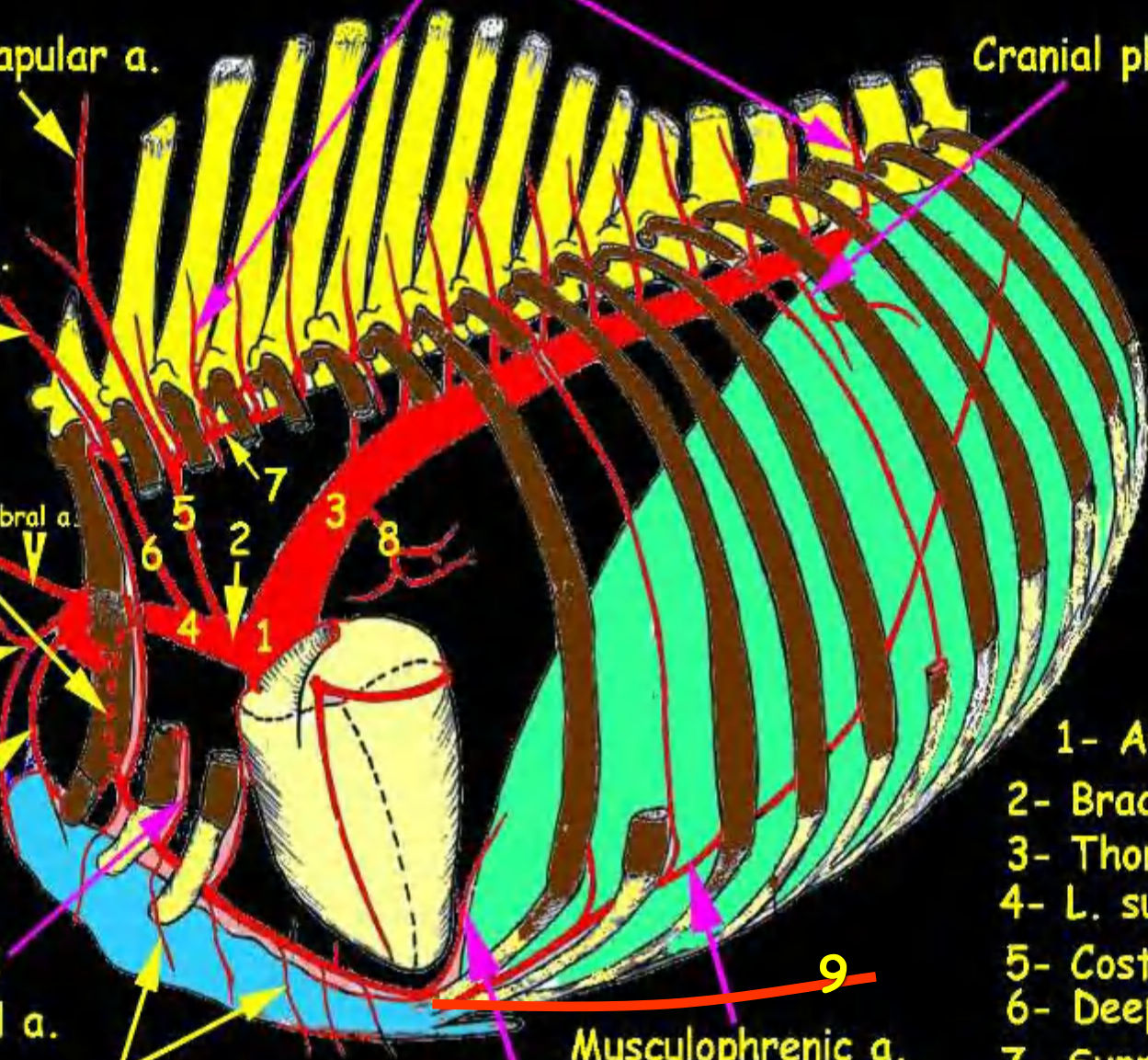
5- Costocervical a.

6- Deep cervical a.

7- Supreme intercostal a.

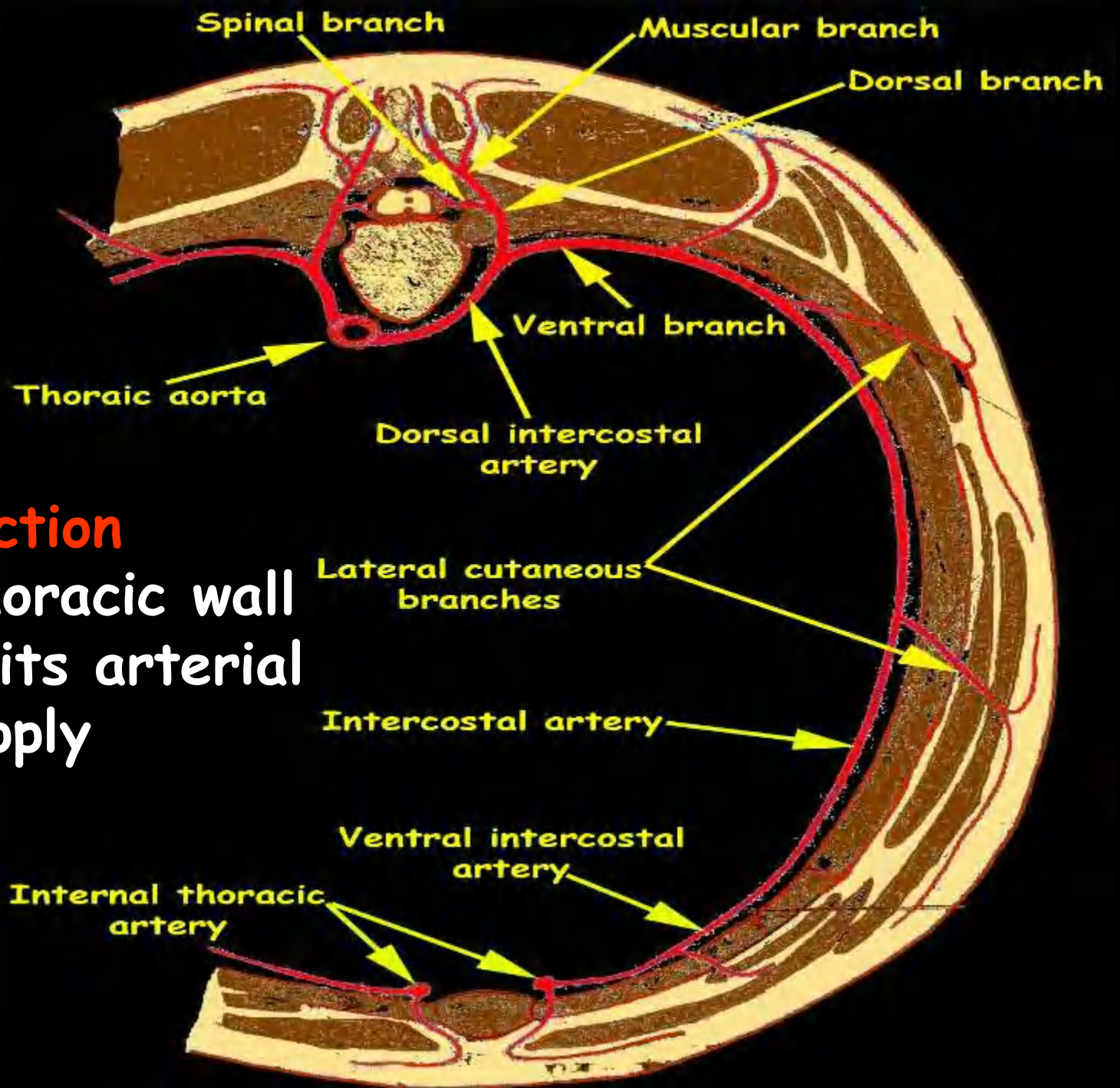
8- Bronchooesophageal a.

9- Cranial epigastric a.



**Cross section  
in the thoracic wall Showing  
its arterial blood supply**





**Cross section**  
in the thoracic wall  
Showing its arterial  
blood supply

# THE ABDOMINAL AORTA

# THE ABDOMINAL AORTA

Is the direct continuation the thoracic aorta after the latter passes through the aortic hiatus of the diaphragm.

## I- Collateral branches:

### Visceral branches

- Celiac A.
- Cranial mesenteric A.
- Renal As.
- Caudal Mesenteric A.
- Testicular (ovarian) As.

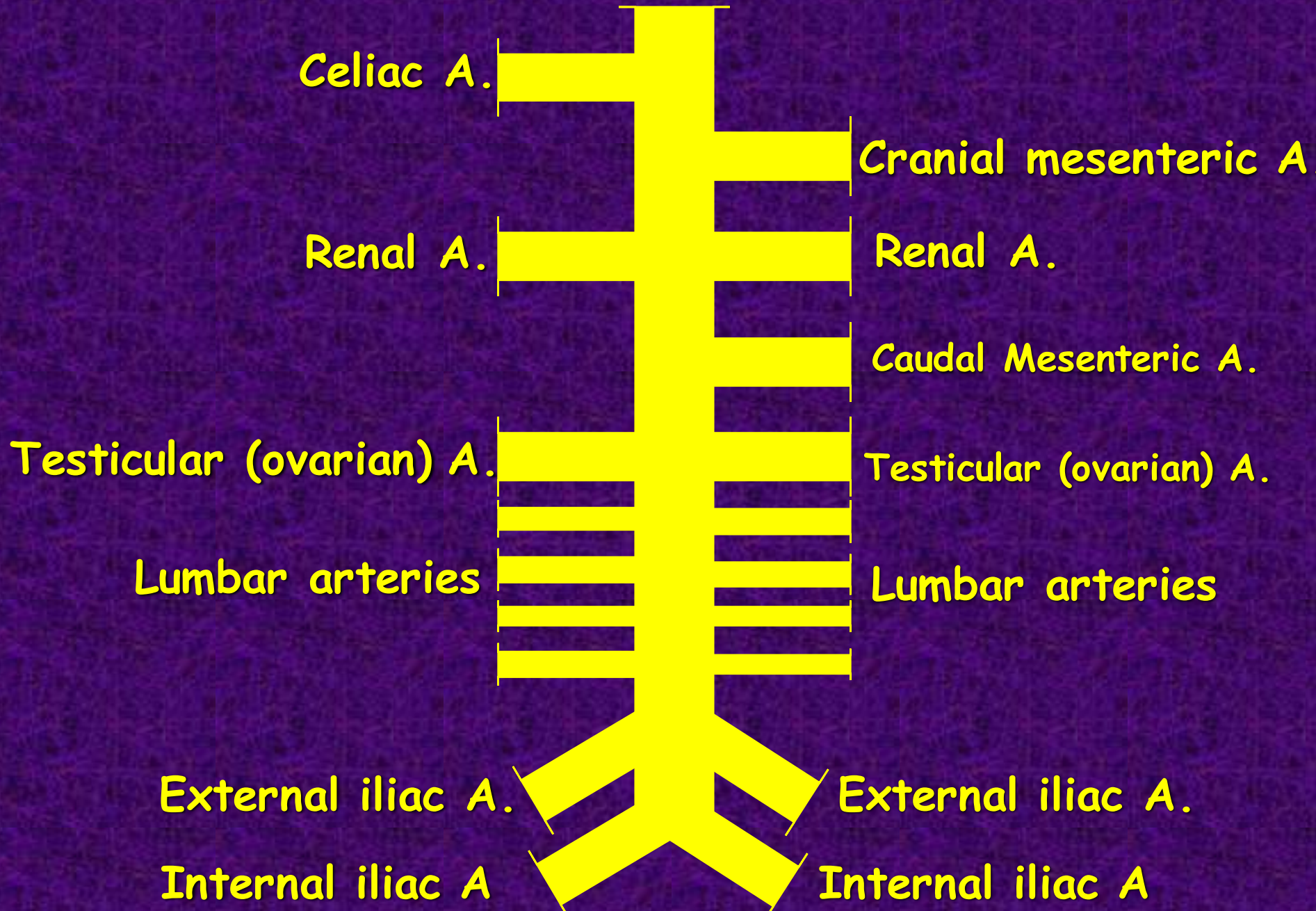
### Parietal branches:

- Lumbar As.

## II-Terminal branches

- External iliac As.
- Internal iliac As.
- Middle coccygeal A

# Abdominal aorta



Celiac artery

# Celiac artery

- Arises from the ventral aspect of the abdominal aorta.
- About 1 cm. in length.
- on the dorsal surface of the pancreas, it divides into;  
I- left gastric A.      II- Hepatic A.      III- splenic A.

## I- Left gastric artery:

gives off;

- Pancreatic branches..... to the pancreas.
- Esophageal branches.... to the esophagus.
- = Parietal branch.. to the parietal surface of the stomach.
- esophageal branch ..... to the oesophagus.
- = Visceral branch...to the visceral surface of the stomach.

## II- Hepatic artery:

Crosses obliquely ventral to the caudal vena cava and reaches the medial border of the portal vein.

it divides into;

Right branch..... 3:4 branches;  
left branch ..... 3:4 branches. } enter the portal fissure

### Collateral branches:

- Pancreatic branches..... to the pancreas
- Right gastric (pyloric) .... to the pyloric region of the stomach and the 1<sup>st</sup> duodenal part.

# Gastroduodinal artery

## a- Right gastroepiploic A.

-Gastric branch.....to the right part of the greater curvature of the stomach.

## b- Cranial pancreaticoduodinal A.

- Pancreatic branch .... to the pancreas

- Cranial duodenal A. .. anastomoses with the caudal pancreaticoduodinal artery of the cranial mesenteric A.

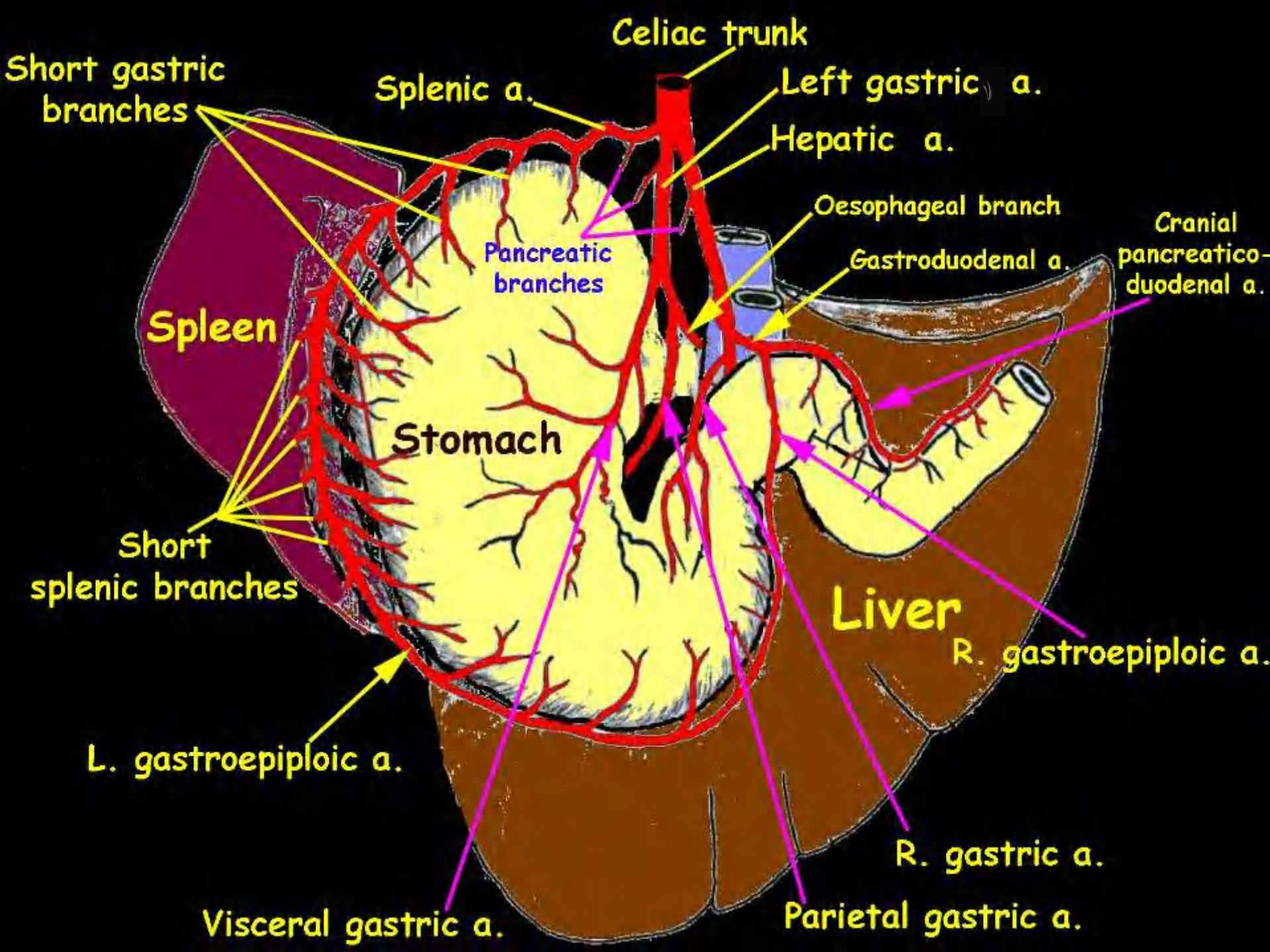


### III- splenic artery

- the largest branch of the collateral artery.
- It passes in the gastrosplenic ligament.
- it ends as left gastroepiploic artery, which anastomoses with the right one of the hepatic A.

### Collateral branches

- **Pancreatic branches** ..... to the pancreas.
- **Splenic branches** ..... to the substance of the spleen.
- **Short gastric branches** .... to the left part of the greater curvature of the stomach.



Cranial & caudal  
mesenteric arteries

## II THE CRANIAL MESENTERIC ARTERY

Arises from the ventral aspect of the abdominal aorta at the level of the first lumbar vertebra.

It gives off:

1- Caudal pancreatico-duodinal artery: anastomoses with the cranial pancreatico-duodinal artery of the hepatic A.

## 2- Jejunal arteries:

From 15-20 arteries form a series of arches from which terminal branches are distributed to the intestinal wall. the last Jejunal artery anastomoses with the ilial artery.

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## 3- Iliocecolic artery

a- **iliac artery:** anastomoses with the last jejunal A.

b- **Cecal artery:** to the lateral and medial surfaces of the cecum.

c- **Colic branch:** to the ventral colon (right and left)

#### 4- Common trunk:

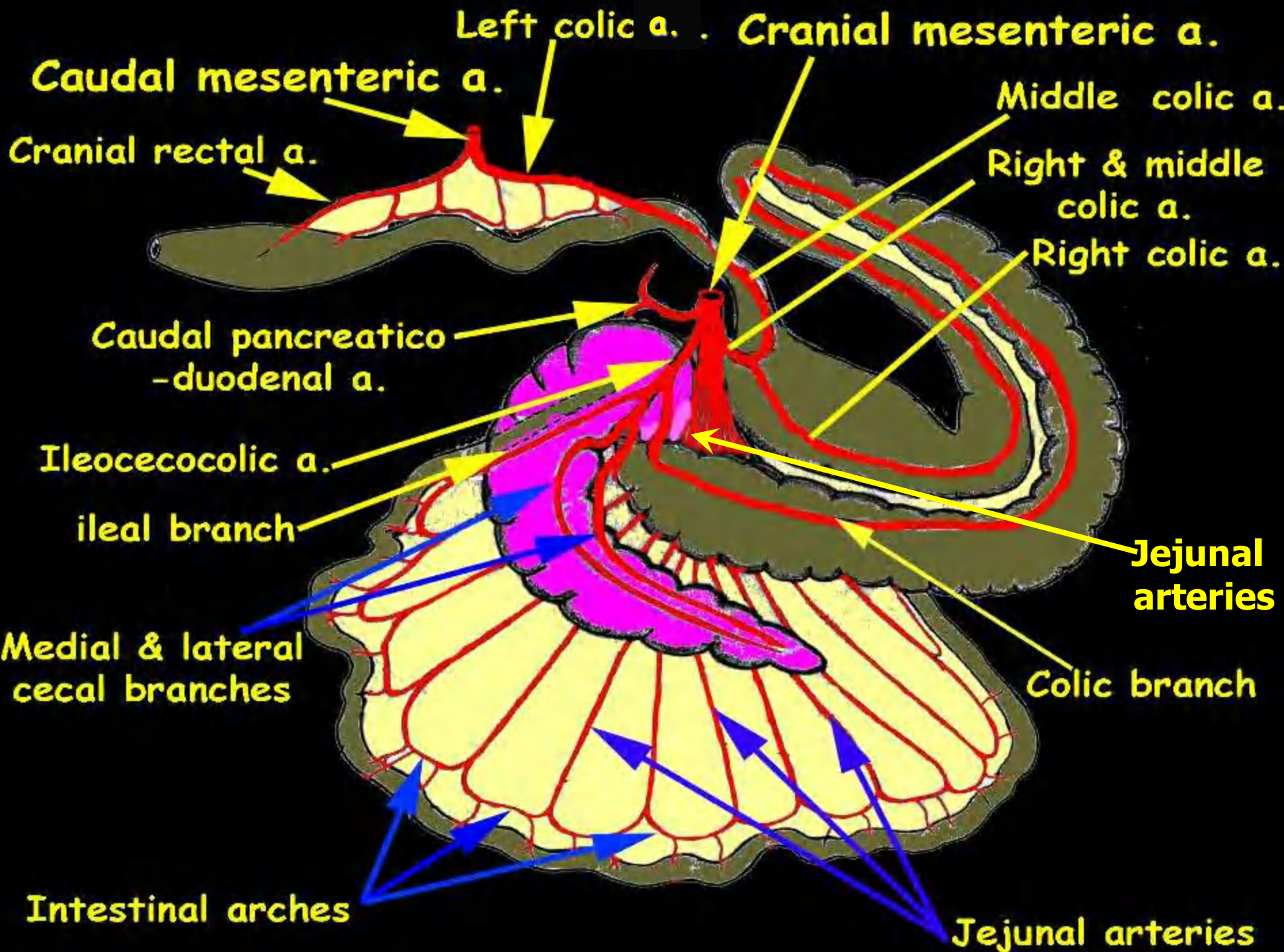
for

- **Right colic artery:-**  
to the dorsal colon (right and left)
  - **Middle colic artery:-**  
to the transverse and the origin of the descending colon.
- 

#### IV- The caudal mesenteric artery:

arises from the ventral aspect of the abdominal aorta.

- 1- **Left colic artery** .... to the descending colon
- 2- **Cranial rectal artery** .... anastomoses with the internal pudendal artery.



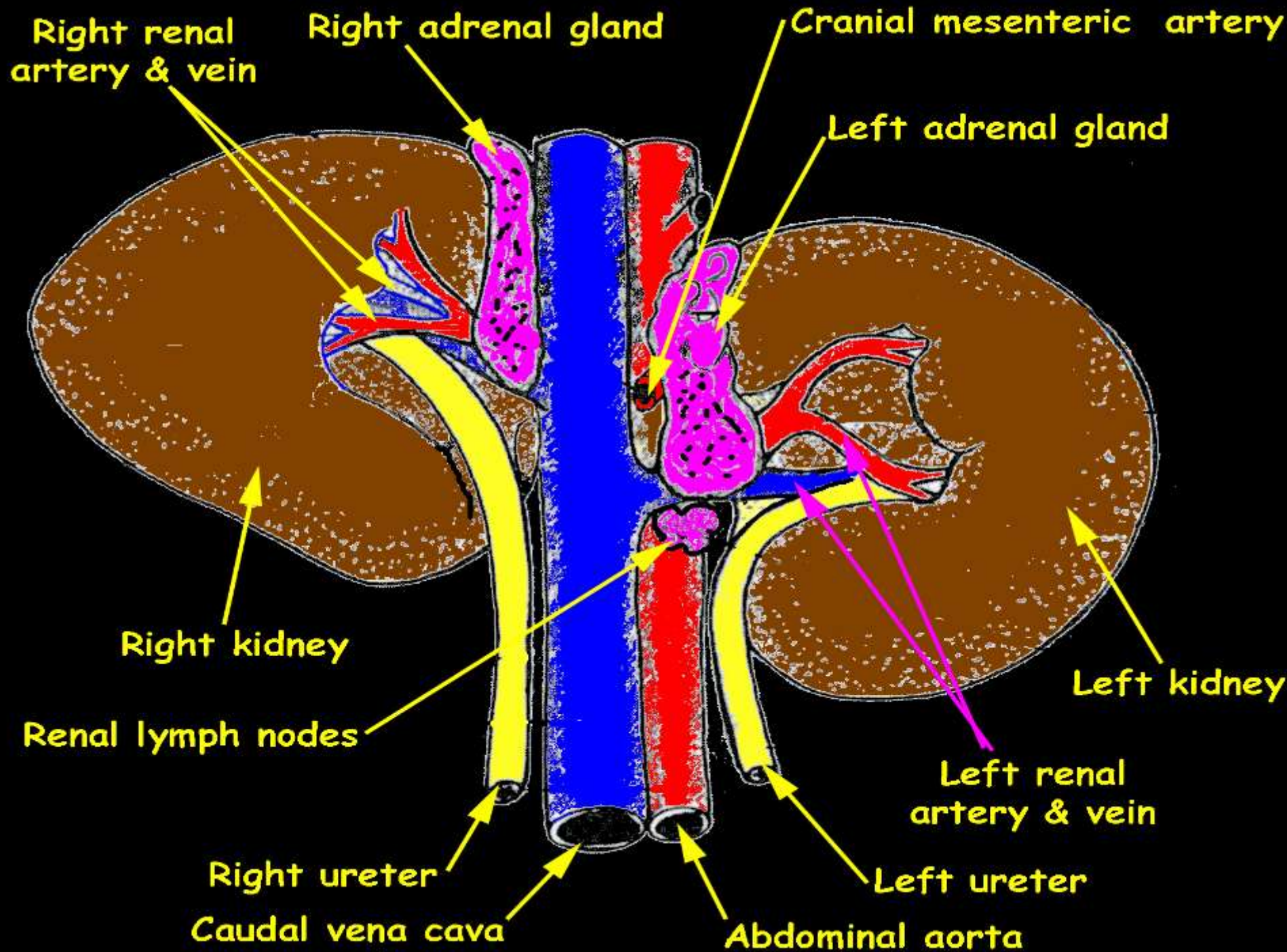
**Renal arteries**



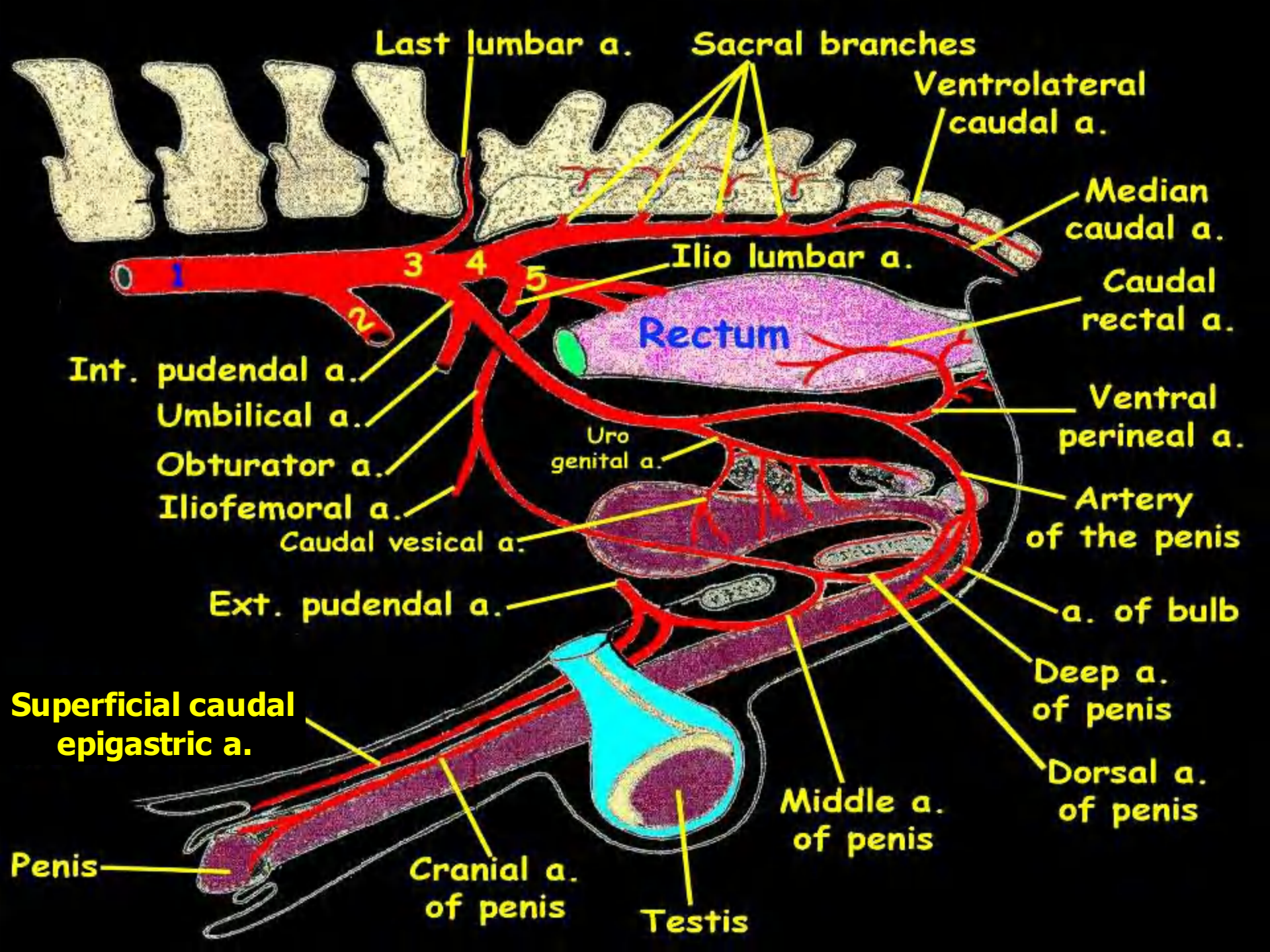
### III- Renal arteries:

The right artery is longer than the left one as it crosses the caudal vena cava.

Each of the right and left renal arteries divides into 5-8 branches which enter the renal hilus.

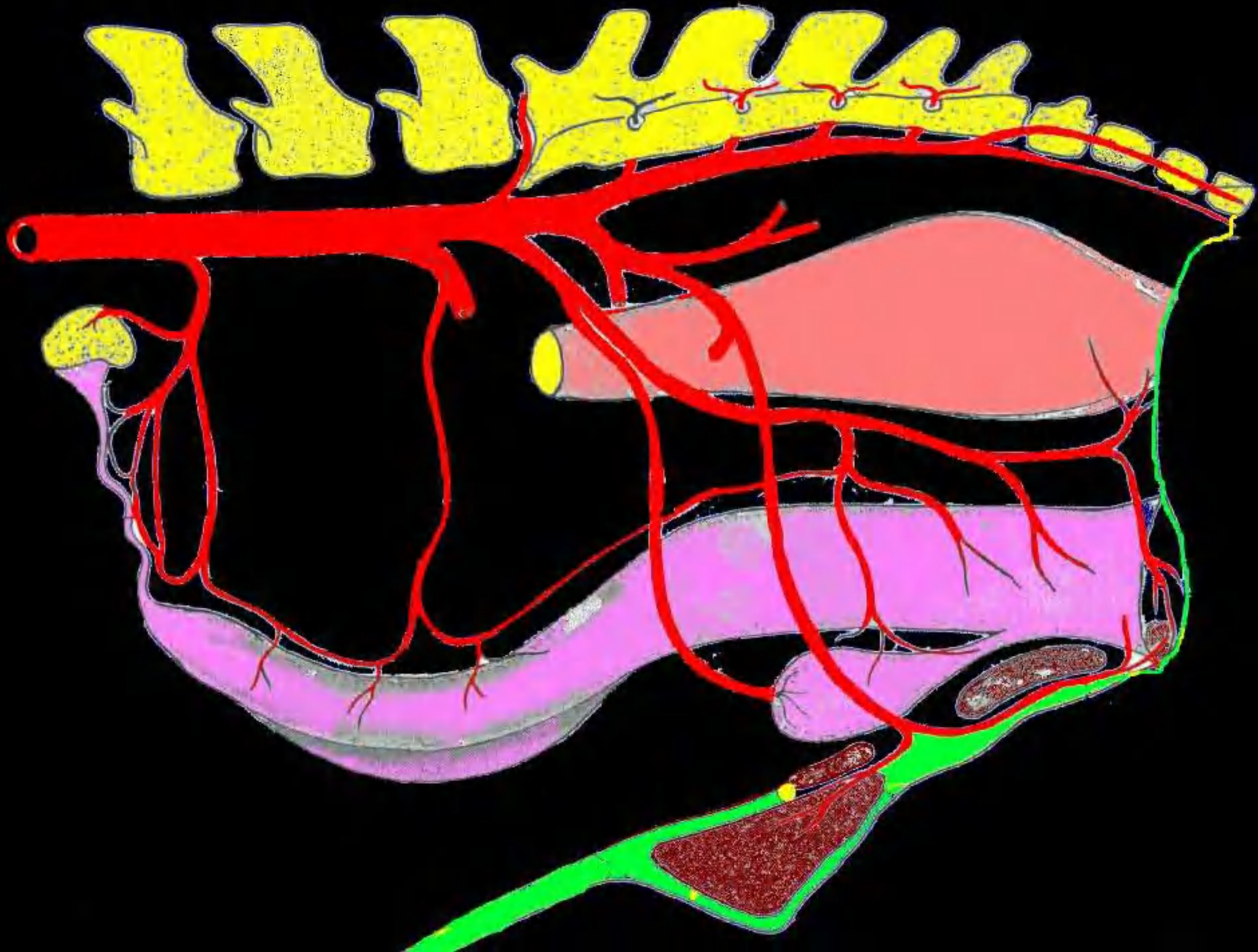


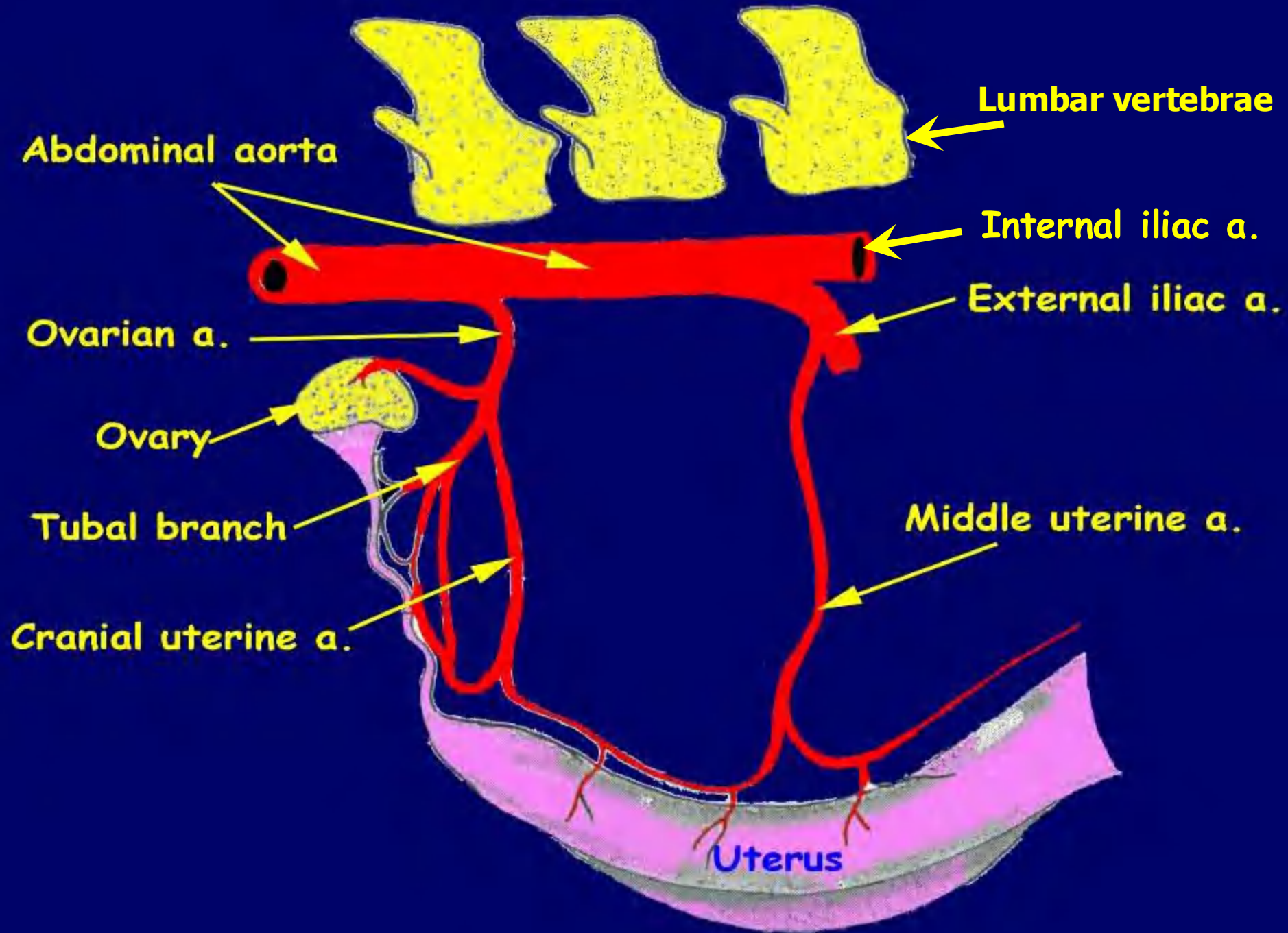
**Internal iliac artery  
in stallion**

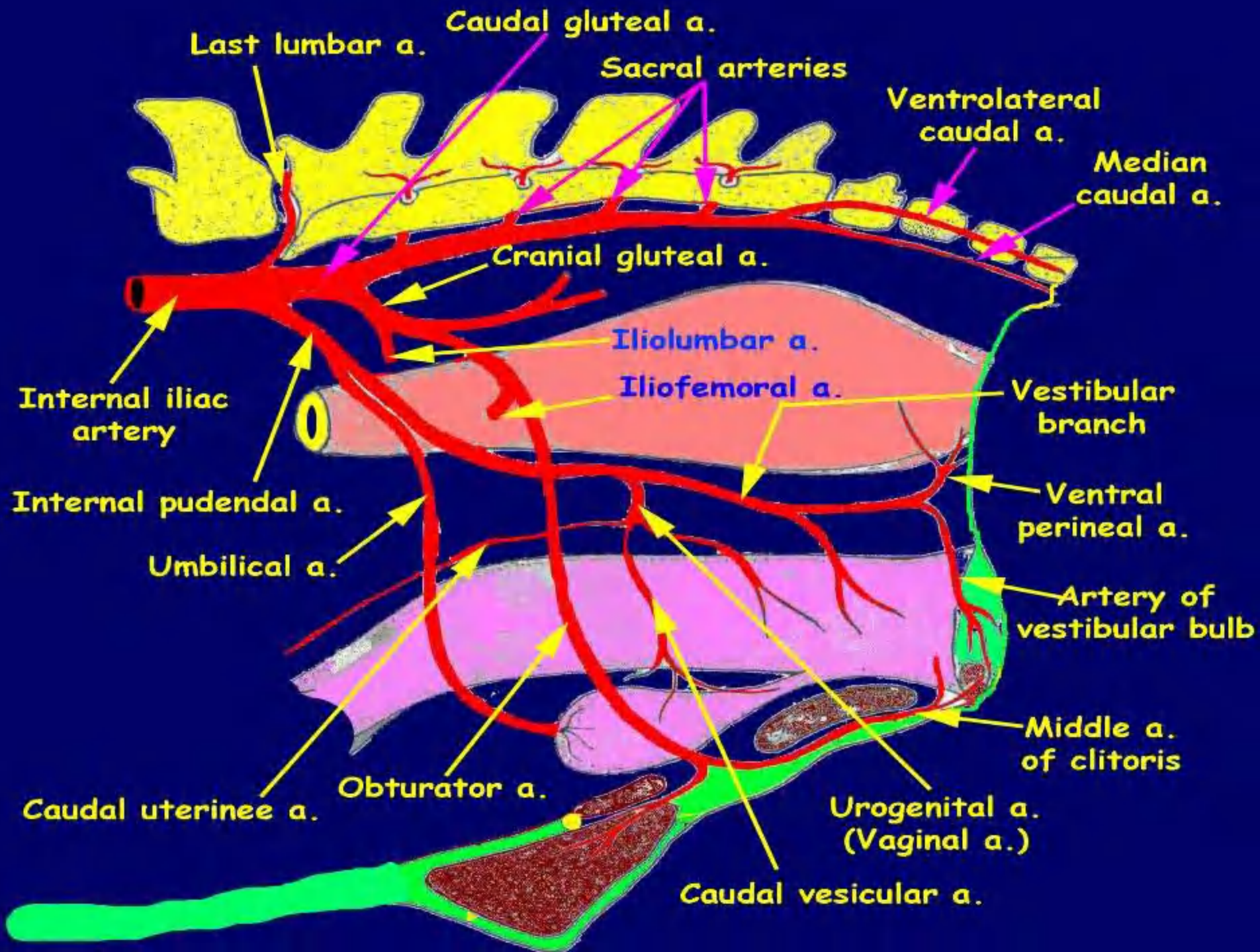


**Internal iliac artery**

**in mare**









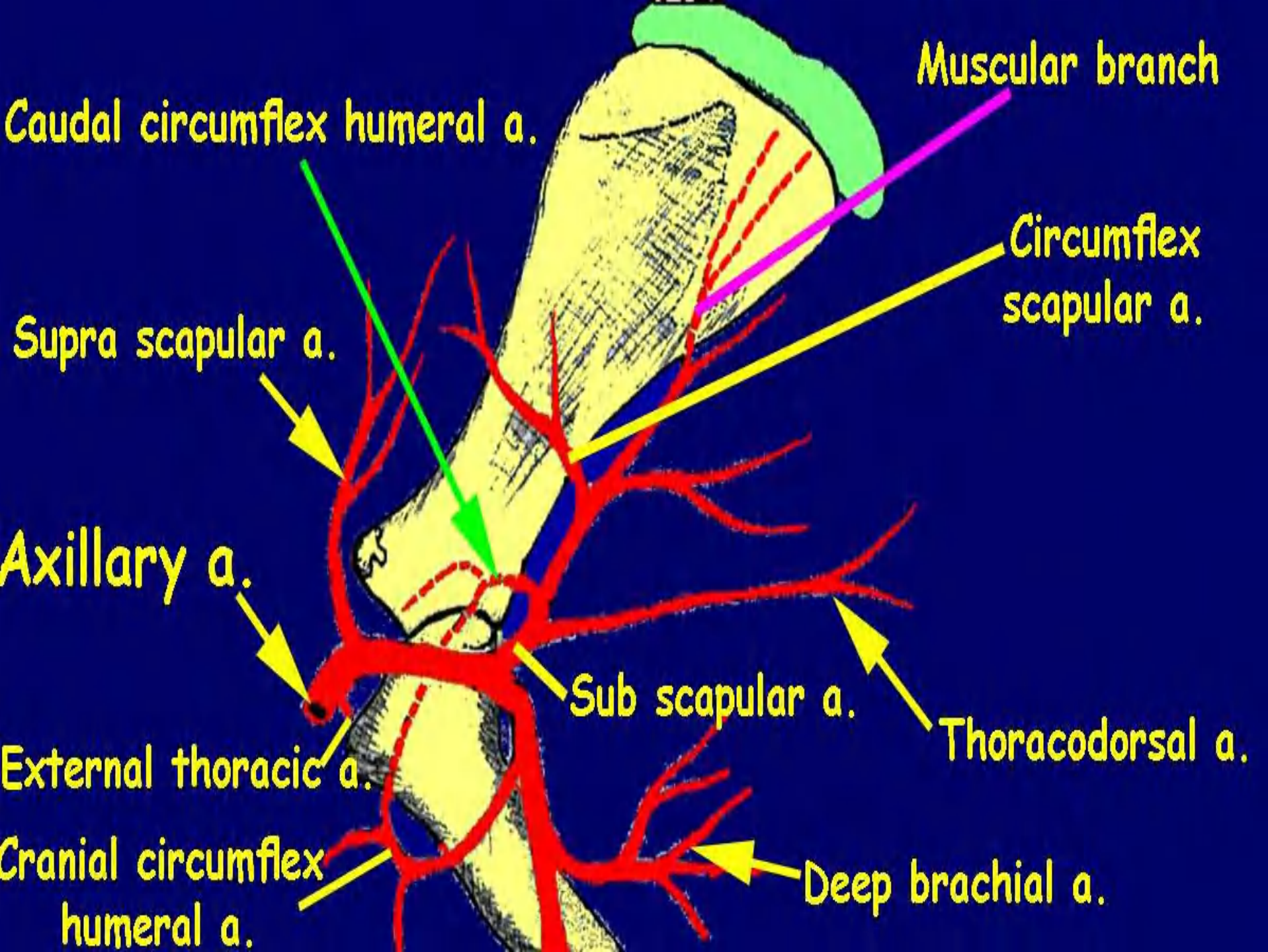
# **Arterial blood supply of the thoracic limb**

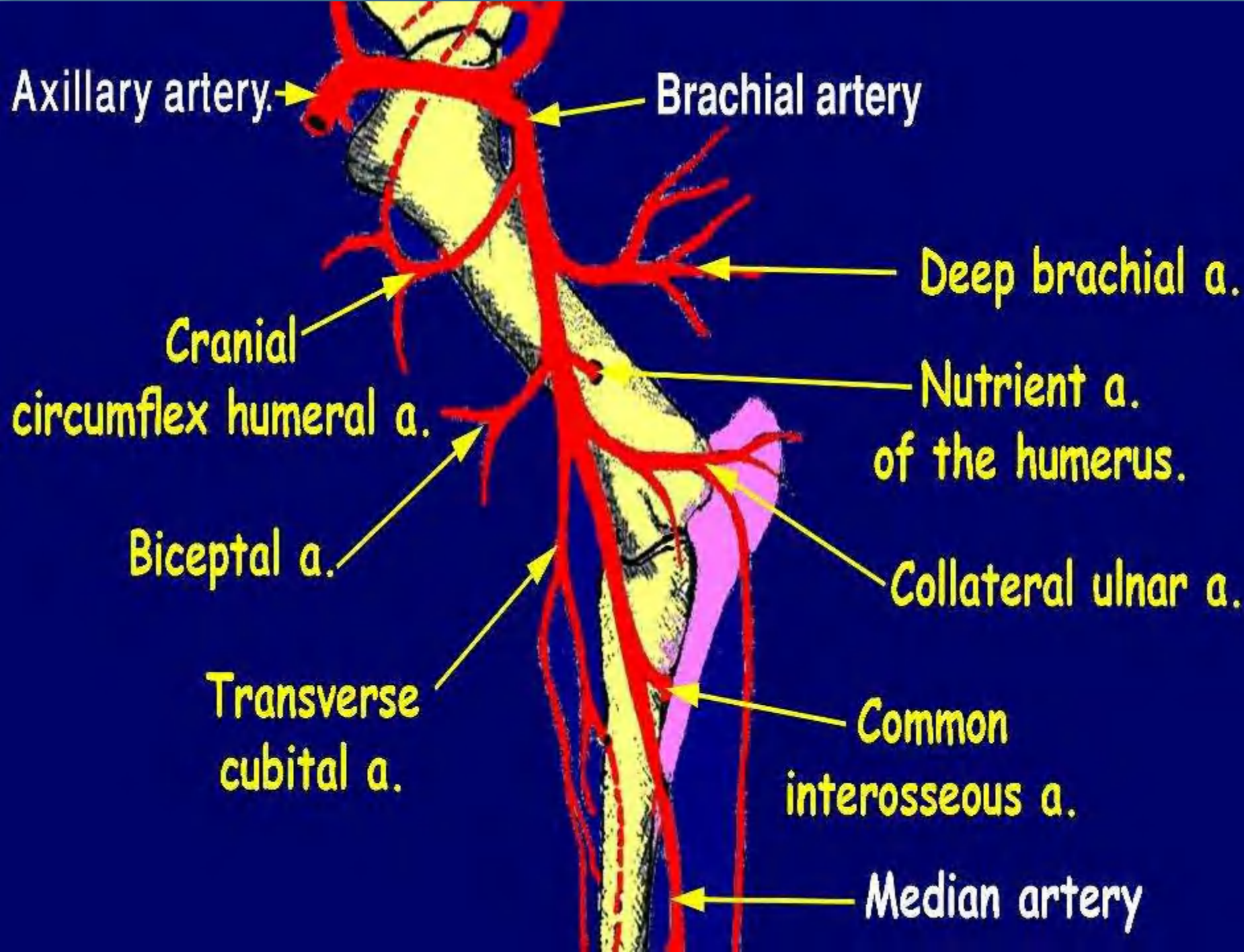


**Axillary artery**

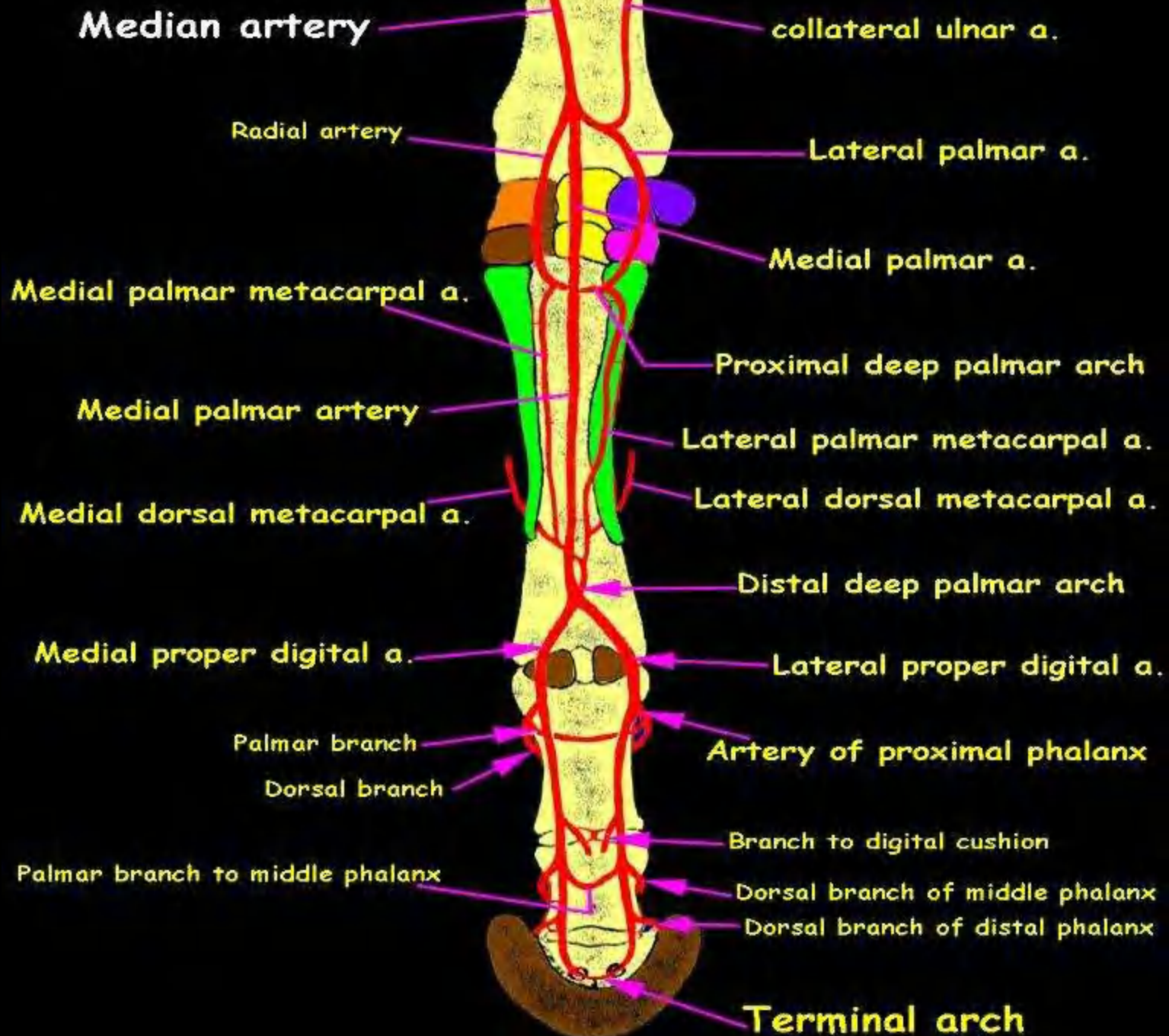
**Brachial artery**

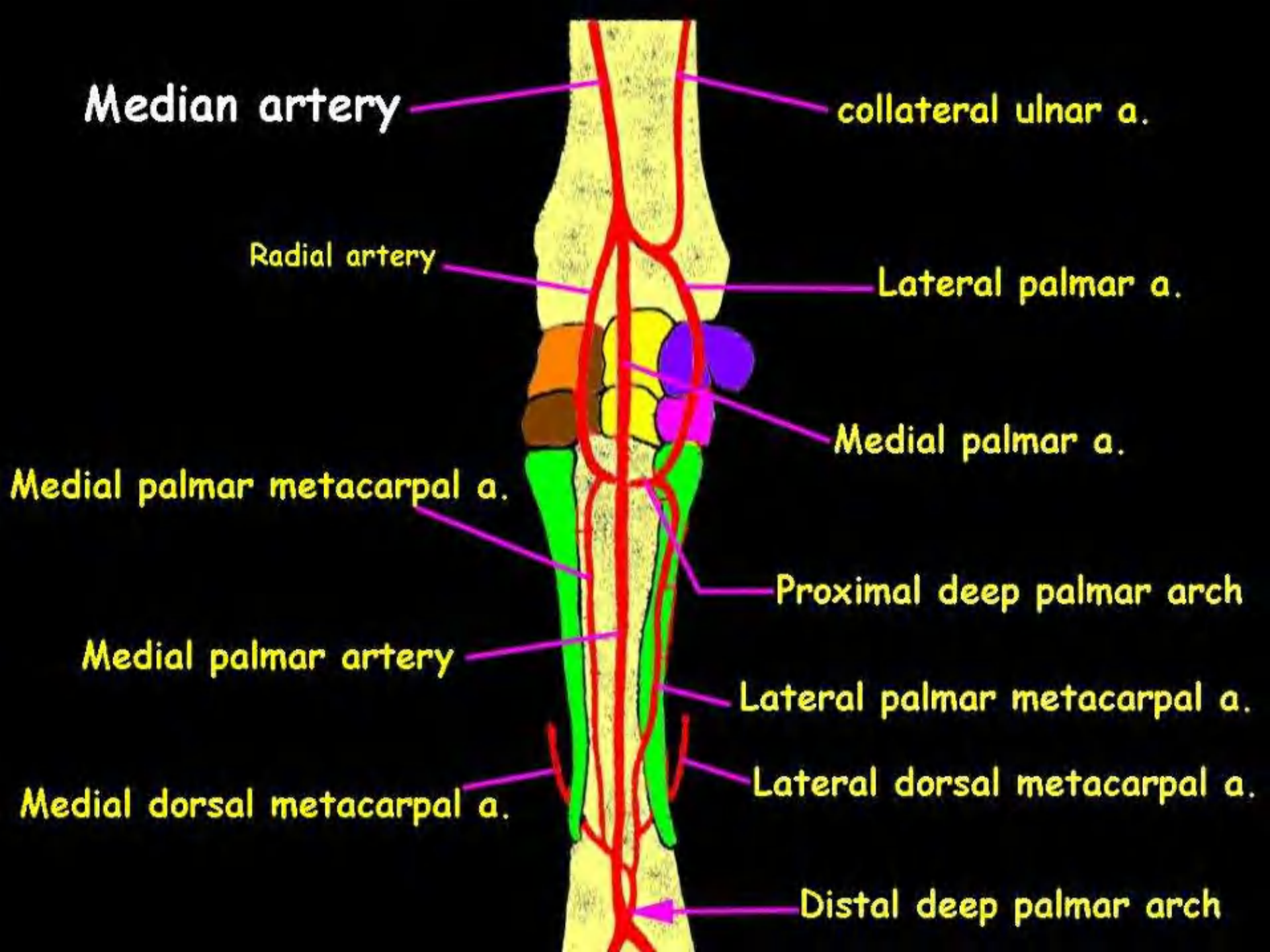
**Median artery**

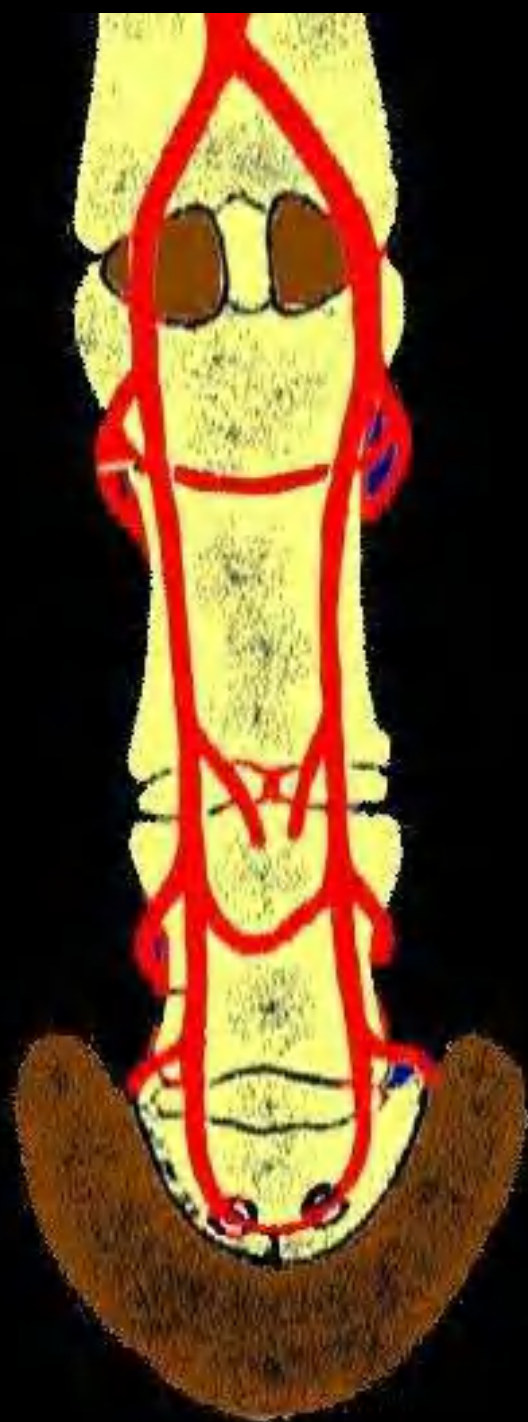




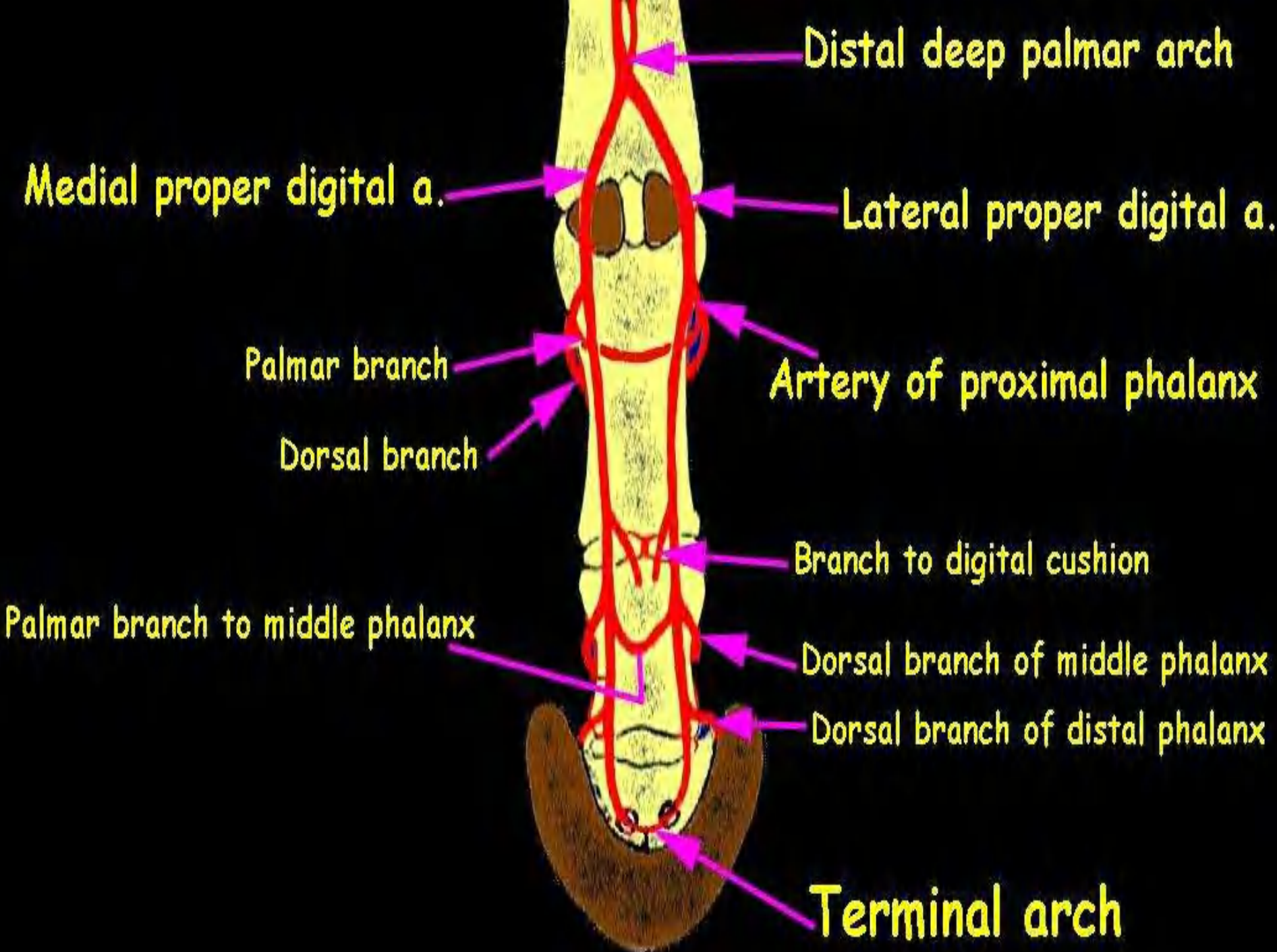
# Arterial blood supply of the manus (palmar view)



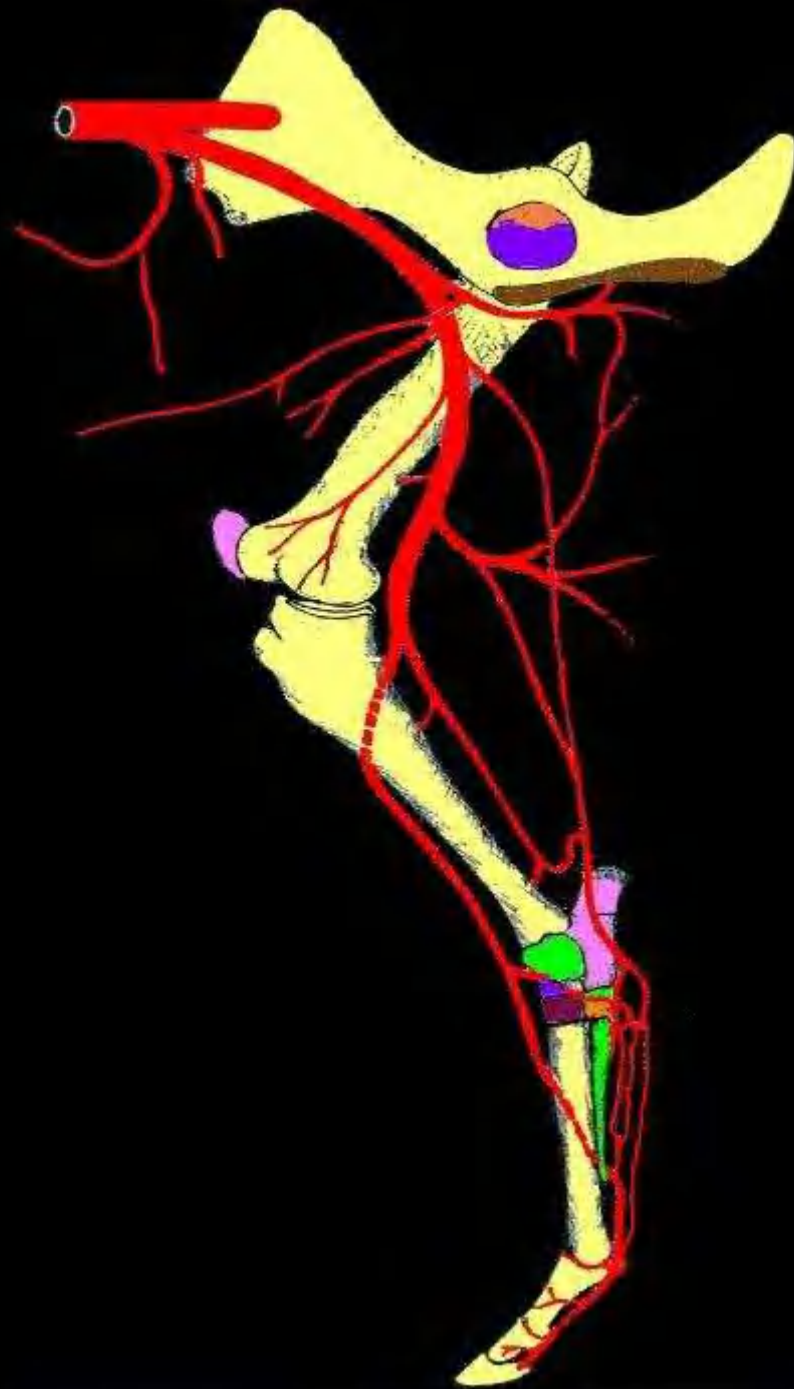


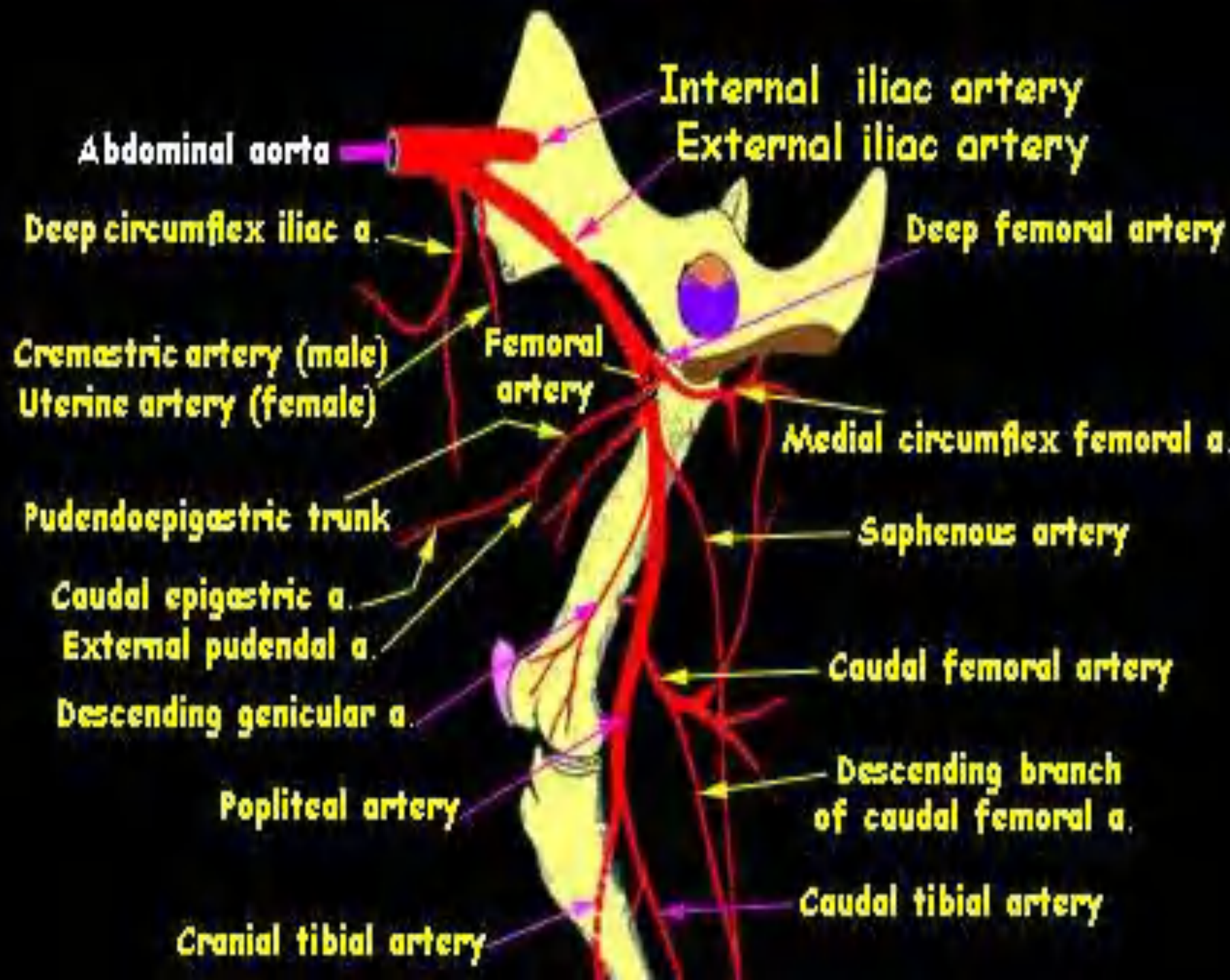


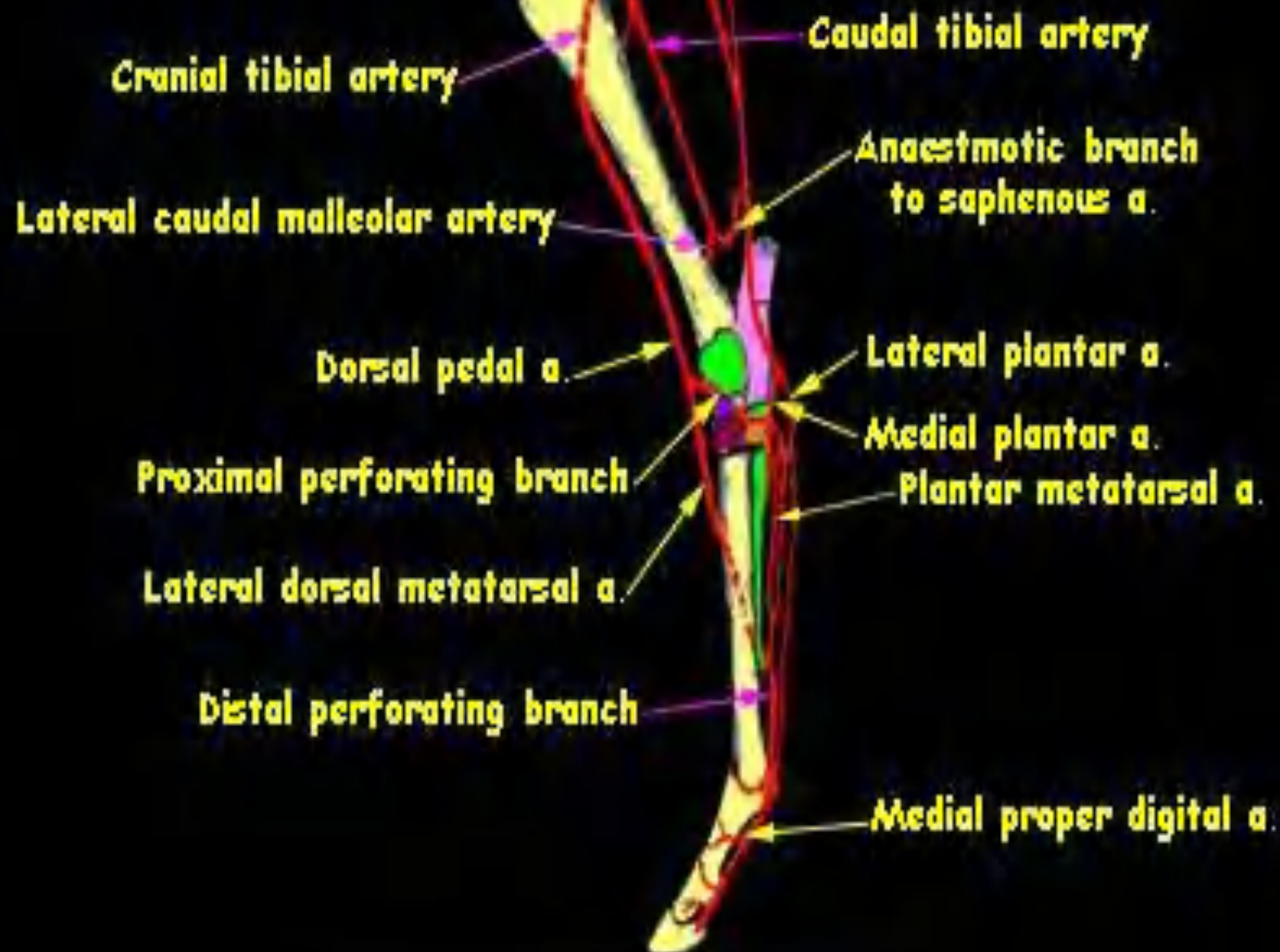




# Arterial blood supply of the pelvic limb







Arterial blood  
supply of the pes

