

Fetal circulation



Objectives



- No objectives were found in male and female slides -

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[Ninja Nerd's helpful Explanation](#)



[Video Board](#) , [Notes](#)



[Osmosis video](#)

[Editing File](#)

Color index :

Main text (black)

Female Slides (Pink)

Male Slides (Blue)

Important (Red)

Dr's note (Green)

Extra Info (Grey)



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Fetal Circulation

male slides

The lungs are nonfunctional during prenatal life. Therefore, the fetal cardiovascular system is structurally designed so that **blood is oxygenated in the placenta** and most of it bypasses the fetal lungs. The modifications that establish the postnatal circulatory pattern are not abrupt but extend into infancy

Fetal Cardiovascular system is designed to:

1. Serve prenatal needs.
2. Permit modifications at birth, to establish the neonatal circulatory pattern.

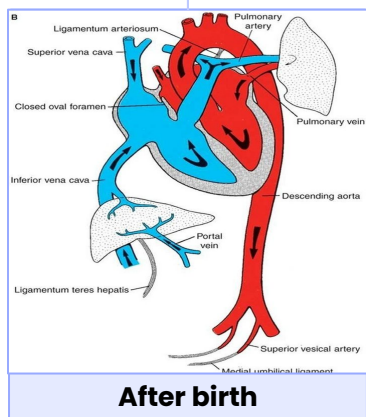
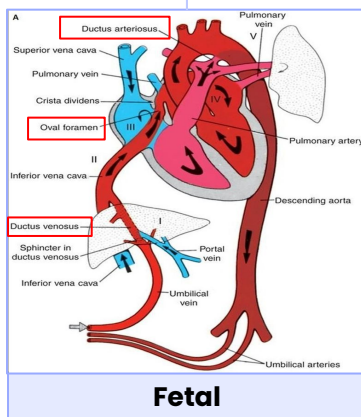
Most important vascular structures in transitional circulation are:

IMPORTANT

Important to know where is each place



Arrows showing the direction of blood flow



Fetal Circulation Before birth

Note, oxygenated blood mixes with deoxygenated blood in:

- I. The liver,
- II. The inferior vena cava,
- III. The right atrium
- IV. The left atrium, and
- V. At the entrance of the ductus arteriosus into the descending aorta.

Details in the next slides

Blood from the placenta (80% saturated with O₂)

Thru umbilical vein
Although it's a vein it contains oxygenated blood

Return to fetus

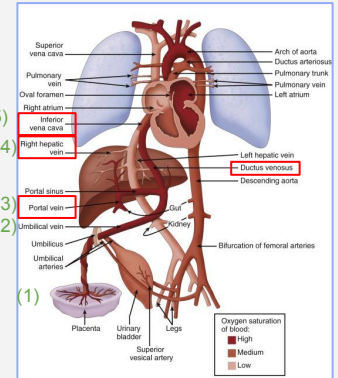


Fetal Circulation Before birth

1

At liver

- Oxygenated blood from the placenta(1) comes through umbilical vein(2) towards the liver, and then the umbilical vein dumps the blood into the portal vein(3) which go in the liver, so the blood become deoxygenated, and goes to IVC(5) through the hepatic vein.(4) see picture.
- But Most of the blood enter the ductus venosus [DV] (bypass the liver) and flows directly to IVC(half - in KLM embryo)** KLM is an embryology textbook.
- IVC *(بمعنى ان الدم المؤكسد الي جاي من المشيمة ما يحتاج يدخل الكبد, ويروح مباشرة لل IVC ويصير mixing ما بين الدم المؤكسد الي من المشيمة والدم الغير مؤكسد الي من ال IVC الي جاي من الاطراف السفلية.)*
- A smaller amount enters the liver sinusoids and MIXES with blood from portal circulation (GIT)



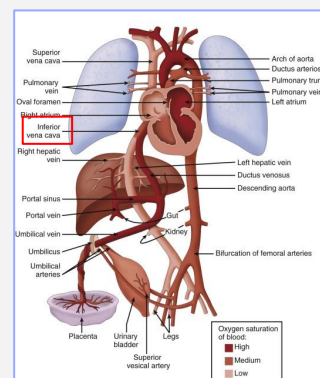
Is there a sphincter mechanism in DV ?

- YES, MORE **physiological** than anatomical.
- **Close to the entrance of the umbilical vein.**
- Regulates flow of umbilical blood thru the liver sinusoids.
- Closes during uterine contraction (venous return too high) **to prevent the overloading of the heart.**

2

At inferior vena cava

- A **short** course
- Mixing** of placental blood (oxygenated) with deoxygenated blood from Lower Limbs (LL), abdomen & pelvis.





Fetal Circulation Before birth

3

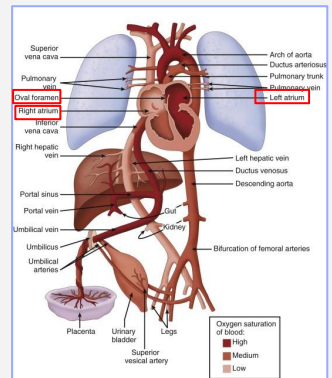
At RA, LA, LV

Right Atrium (RA) :

- The blood that was mixed in the IVC is Guided towards the **foramen ovale** { by the valve of IVC }
- Most of the blood passes **directly to the left atrium** (why? Because the left atrium has less pressure than the right atrium , high pressure -> low pressure)
- Small amount fails and remain in the RA this blood will go to the **pulmonary artery** and then its shunted to the aorta (details in Step number 5) (bcz of the **crista dividens** --- lower edge of septum secundum)
- Another mixing – with deoxygenated blood thru SVC (blood from the upper body comes through the SVC and enters the RA and then mixes with the blood that was coming from the IVC

Left Atrium (LA) :

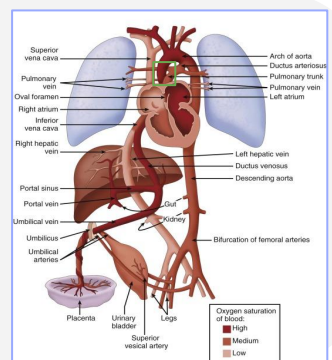
- Another mixing – with small amount desaturated blood returning from LUNGS
- Left Ventricle: -**



4

Ascending aorta

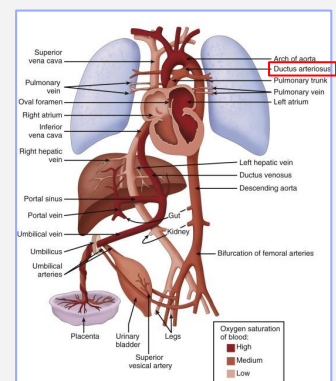
- Organ supplied with **Well-Oxygenated blood**: Heart and brain (Head, Neck & Upper Limb) – coronary and carotid arteries are the first branches of the AA.
- The aorta sends blood through its various branches.



5

Another shunt and Mixing -
Ductus Arteriosus

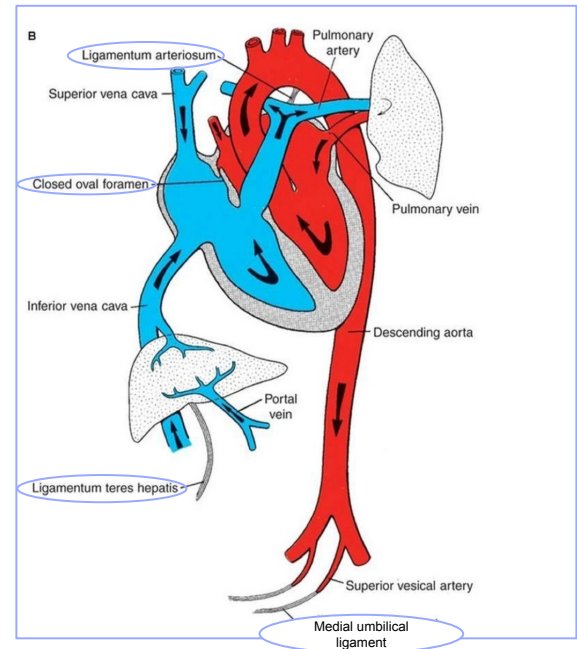
- blood from RV will go to the pulmonary artery and then the ductus arteriosus simply shunts blood from the high pressure pulmonary artery to the lower pressure aorta .
 - **Right Atrium (desaturated blood thru SVC) → to Right Ventricle → to pulmonary trunk thru; High resistance in pulmonary vessels.**
 - Causes most of the blood to **pass directly to Descending Aorta via Ductus arteriosus.**
 - Last mixing with blood from proximal aorta.
- Finally blood flows toward the fetal body and placenta thru two umbilical arteries (O2 saturation is approx. 58%).





Circulatory changes after birth

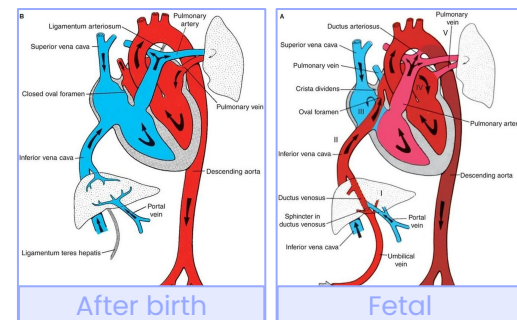
- During prenatal life, the placental circulation provides the fetus with its oxygen, but after birth the **lungs** take on gas exchange.
- In the circulatory system, the following changes take place at birth and in the first postnatal months:
1. the ductus arteriosus closes.
 2. the oval foramen closes.
 3. the umbilical vein and ductus venosus close and remain as the ligamentum teres hepatis and ligamentum venosum.
 4. the **umbilical arteries** form the medial umbilical ligaments.



Changes in the vascular system at birth are caused by:

1 **cessation of placental blood flow.**

2 **the beginning of respiration.**



Since the ductus arteriosus closes by muscular contraction of its wall, the amount of blood flowing through the lung vessels increases rapidly.

This, in turn, raises pressure in the left atrium. Simultaneously, pressure in the right atrium decreases as a result of interruption of placental blood flow.

The septum primum is then opposed to the septum secundum, and functionally, the oval foramen closes.



Circulatory changes after birth



	Functional closure	Anatomical closure	Remnant
Ductus Arteriosus	Almost immediately after birth— and within days	1-3 months	Ligamentum arteriosus
Umbilical Arteries	Few minutes after birth	2-3 months	- Distal part → Medial umbilical ligament - Proximal part → Superior vesical arteries
Umbilical Veins	Shortly after Umbilical Arteries		Ligamentum teres hepatis
Ductus Venosus	Shortly after Umbilical Arteries		Ligamentum venosum
Foramen Ovale	First few breaths	KLM: 3rd month Langman's: 1 year	Fossa ovalis, In 20% Probe patent foramen ovale

Anomaly

Patent Ductus Arteriosus (PDA)	- common anomaly - 2-3 times more in females	Possible Causes: - Maternal rubella infection in early pregnancy - Premature and born at high altitude
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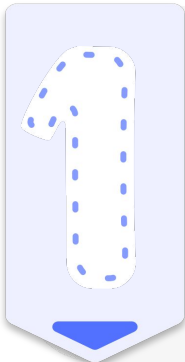
Circulatory changes after birth

IMPORTANT

Event	How it happened	picture
<p>Closure of the umbilical arteries</p>	<ul style="list-style-type: none"> ➔ Accomplished by contraction of the smooth musculature in their walls, is probably caused by thermal and mechanical stimuli and a change in oxygen tension. ➔ Functionally, the arteries close a few minutes after birth, although the actual obliteration of the lumen by fibrous proliferation may take 2 to 3 months. ➔ Distal parts of the umbilical arteries form the medial umbilical ligaments, and the proximal portions remain open as the superior vesical arteries. 	
<p>Closure of the umbilical vein and ductus venosus</p>	<ul style="list-style-type: none"> ➔ Occurs shortly after that of the umbilical arteries. (ALLOWS the blood from the placenta may enter the newborn for some time after birth). ➔ After obliteration, the umbilical vein forms the ligamentum teres hepatitis in the lower margin of the falciform ligament. ➔ The ductus venosus, which courses from the ligamentum teres to the inferior vena cava, is also obliterated and forms the ligamentum venosum. 	
<p>Closure of the ductus arteriosus</p>	<ul style="list-style-type: none"> ➔ By contraction of its muscular wall occurs almost immediately after birth; it is mediated by bradykinin, a substance released from the lungs during initial inflation. placenta is separated after delivery, which leads to a fall in Prostaglandin levels which will contribute to the closure. ➔ Complete anatomical obliteration by proliferation of the intima is thought to take 1 to 3 months. In the adult, the obliterated ductus arteriosus forms the ligamentum arteriosum. 	
<p>Closure of the oval foramen</p>	<ul style="list-style-type: none"> ➔ By an increased pressure in the left atrium, combined with a decrease in pressure on the right side. ➔ The first breath presses the septum primum against the septum secundum, which causes the closure ➔ During the first days of life, however, this closure is reversible. Crying by the baby creates a shunt from right to left, which accounts for cyanotic periods in the newborn. ➔ Constant apposition gradually leads to fusion of the two septa in about 1 year. In 20% of individuals, however, perfect anatomical closure may never be obtained (probe patent foramen ovale). 	



MCQ



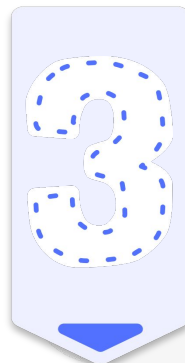
The proximal part of the umbilical artery forms which of the following structures ?

- A** Medial umbilical ligament
- B** Ligamentum teres
- C** Superior vesical artery
- D** Ligamentum venosum



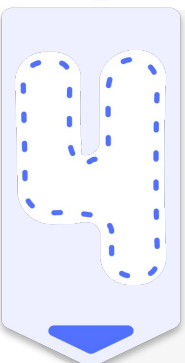
Which of the following contributes to the closure of oval foramen?

- A** Decrease pressure in the RA
- B** Increase pressure in the LA
- C** A+B
- D** Increase pressure in the RA



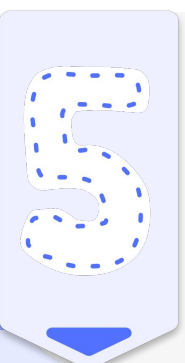
From where do the blood of the fetus come from?

- A** Placenta
- B** Ligamentum venosum
- C** The heart
- D** Ductus arteriosus



Closure of the ductus arteriosus mediated by which of the following?

- A** Relaxation of the muscular wall
- B** Drop of the pressure
- C** Elevation of pressure
- D** Bradykinin



Which of the following forms the Ligamentum teres after birth?

- A** Umbilical artery
- B** Ductus arteriosus
- C** Umbilical vein
- D** Ligamentum venosum

Embryology Team



Leader

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Leader

رهف الشويهي



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عبدالله الكودري



خالد العنزي



فراس مازن



زياد العتيبي



فيصل الشويعر



ريناد صالح الشهري



ريوف الأحمري



ريماس المحمود



شادن الهزاني



ريناد محمد الشهري



لمى العتيبي



ريم العمير

Special thanks and gratitude to the amazing Lama Alotaibi for this fabulous designing of the theme