

PLACENTA & FETAL CIRCULATION

Reproductive block

Objectives :

Unknown ..

Resources :

- ✓ 435 embryology (males & females) lectures.
- ✓ BRS embryology Book.
- ✓ The Developing Human Clinically Oriented Embryology book.

Color Index:

- ✓ EXTRA
- ✓ Important
- ✓ Day, Week, Month

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Placenta: المشيمة [video](#) \ [video](#)

It is a Fetomaternal structure يعني تكونت من الأم والجنين

Formed by the beginning of the **4th month**. قبل كذا كان يؤدي وظيفتها الكوريس ليوتيم

بس لو ما تكونت البلاسنتا بيحصل إجهاض مو معناته لو ماتكونت يستمر الكوريس ليوتيم لا بس يظهر بالبداية ويعطي البلاسنتا وقت للتكون

It is the primary site for exchange of gases and nutrients between the mother and the fetus.

Formation of Placenta forms at the site of implantation

Fetal Part

- Villous Chorion:

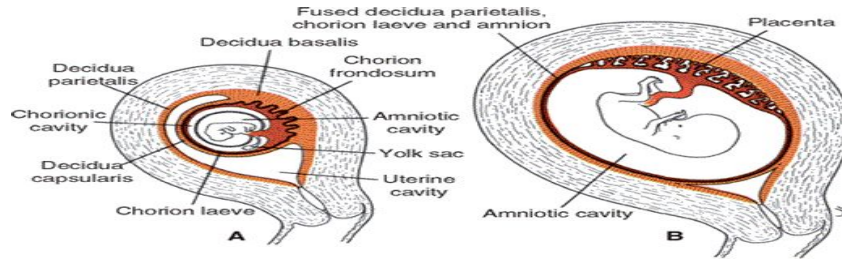
It is the bushy area at the embryonic pole

Its villi are more in number, enlarged and branch profusely

Maternal Part

- **Decidua Basalis:** part of the decidua deep to the conceptus. conceptus = Zygote

- **Decidua Gravid Endometrium:** it is the functional layer of the endometrium during pregnancy which is shed after parturition.



Full Term Placenta just before birth

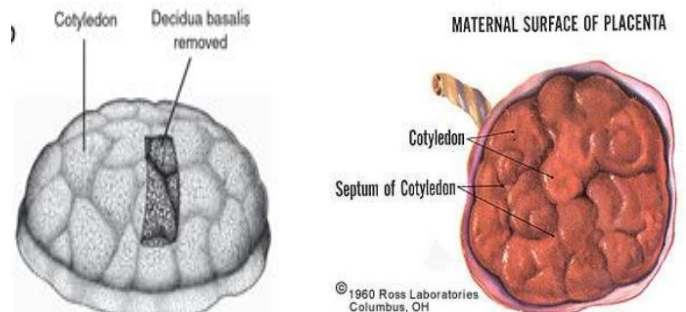
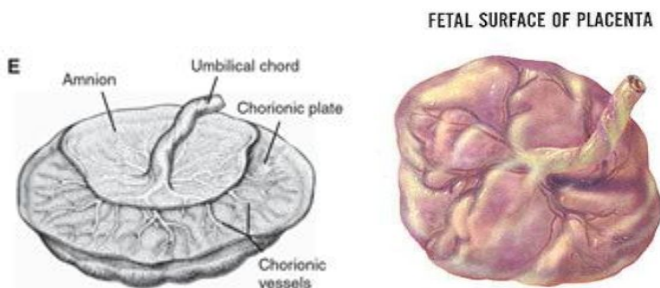
Discoid in shape. Weighs (500 – 600)g. عشان كذا الأم أول ما تولد تفقد نصف كيلو بسببها هذا غير فقدانها لوزن البيبي وكمية السوائل
:Has two surfaces

Fetal Surface

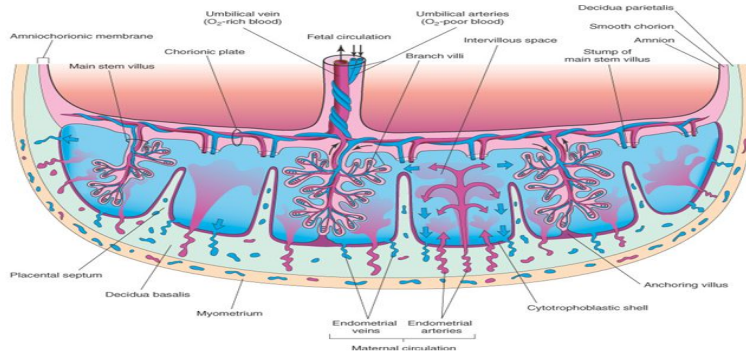
1. **Smooth** because it is covered with the **amnion**.
2. The **umbilical cord** is attached to its **center**.
3. The **chorionic vessels** are **radiating** from the umbilical cord

Maternal Surface

Rough. Formed of (15 – 20) irregular convex areas (**Cotyledons**) ارتفاع which are separated by grooves (**placental septa**). يفصلون الارتفاعات عن بعض
Each cotyledon is covered by a thin layer of **decidua basalis**. يغطون الارتفاعات.



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بهذه الجزئية غيرنا استدلالات الالوان الاحمر دم مؤكسج و الازرق دم غير مؤكسج واللي تحته خط المهم

- Structure of a **Cotyledon**: consists of **two or more stem villi** with their many branch villi. It receives (80-100) **maternal spiral arteries** that enter the intervillous spaces at regular intervals

- **Intervillous Space**: large **blood filled spaces** which are freely communicating. They **receive spiral arteries** from the lacunae in the **syncytiotrophoblast**. The spaces are drained through **endometrial veins**. Both arteries and veins pass through pores in the **cytotrophoblastic shell**.

الكوتيليدون مثل ما قلنا قبل إنها ارتفاع، يعني زي الجبل داخله 2 أو أكثر من معبر للبلود فزلز نسيمهم ستيم فيلاي ، كل ستيم فيلاي بيدخل ويتفرع يصير اسم التفرعات فيلاي و بيدخل في تجوفهم الامبلايكل بلود فزلز من الجنين، فقدر نقسم الفيلاي لـ3 مراحل أول ما صار لها تفرع تكون برايمري بعدين يزيد التفرع تصير سكندري بعدين يدخل فيها الامبلايكل فزلز تصير تيرشري، طيب الحين هذه الفيلاي، راح يكون فيه بينهم مسافات نسيمها انتر فليس سبيس بتستقبل 100 سبايرل ارتري جاي من اندومتريم الأم، مسمينه بالصورة اندومتريال ارتري، يعطي الجنين الغازات والمواد المغذية اللازمة ويرجع على هيئة اندومتريال فين

Placental Circulation يُفضل تدون بدورة الأم

2-Fetal Placental Circulation

Two Umbilical Arteries:

Carry **poorly oxygenated** blood from the fetus to the placenta.

within the branch chorionic villi, they form:

Arterio-capillary venous network:

It brings the fetal blood extremely close to the maternal blood.

The well oxygenated fetal blood in the capillaries passes into veins accompanying the

chorionic arteries.

At the umbilical cord, they form the

One Umbilical Vein.

1- Maternal Placental Circulation

80 –100 **spiral endometrial arteries** discharge into the intervillous space. The blood is propelled in **jet like fountains** by the **maternal blood pressure**.

The pressure of this entering blood is higher than that in the intervillous space.

It forms a roof of the space. As the pressure dissipates, the blood flows slowly around the branch villi.

Exchange of metabolites and gases with the fetal blood. As the pressure decreases, the blood flows back from the **chorionic plate** and enter the **endometrial veins** to the maternal circulation.

قلنا فوق إن الفيلاي يحتوي على الامبلايكل فزلز، وبما إنها فزلز يعني ارتري وكابلري وفين، طيب خلونا نعرف الأحداث بالترتيب: بالبداية الفيلاي بيدخلها **2 امبلايكل ارتريز** من الجنين يحتوي على **دم غير مؤكسج**، بيتحول الارتري الى كابلري عشان تحدث عملية تبادل الغازات، بياخذها من دم الام الي جاي من السبايرل ارتري وصب في الانتر فليس سبيس، وبعد ما تنتهي عملية تبادل الغازات الكابلري بيجتمع مع الكوريونك ارتري ويصيرون **1** فين نسيمه **امبلايكل فين** وهنا بيحتوي على **دم مؤكسج**.

كيف تنتقل الغازات من الأم إلى الجنين؟ بتتحرك من الضغط العالي(دم الأم) إلى الضغط المنخفض(دم الجنين) طيب ومين الي بيعلي ضغط الأم؟ وجود جزئات الاوكسجين، بالتالي لو الأم كان عندها انيميا وقل الاوكسجين وانخفض ضغطها ما راح يحصل فيه تبادل غازات طريقة ضخ الارتري في السبيس بتكون زي النافورة كل ما زاد ضغط الأم بيضخ وإذا قل الضغط بيقل بمعني إن الضخ مستمر بيعتمد على الضغط

Placental Membrane: حاجز بين المترنل والفيثال بلود

It is a composite thin membrane of extra fetal tissues which separates the fetal and maternal bloods.

Up to **20 weeks**, it is composed of **4 layers**: (pic B)

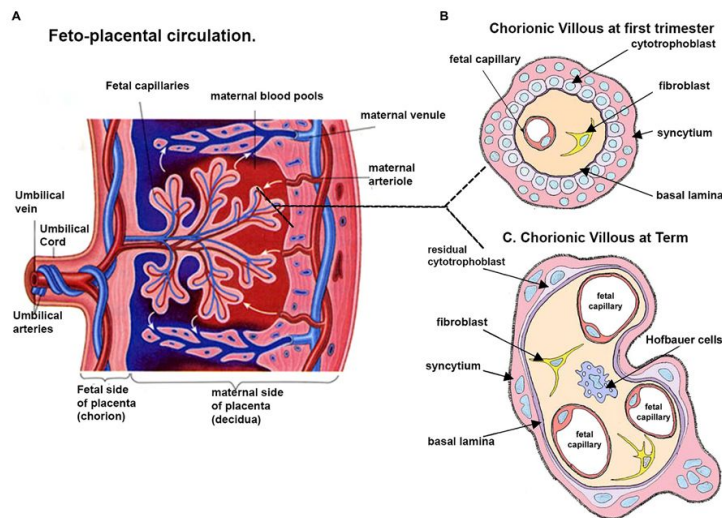
1. **Syncytiotrophoblast**. most outer
2. **Cytotrophoblast**.
3. **Connective tissue of the villus**.
4. **Endothelium of fetal capillaries**.

At full term it becomes thinner and composed of **3 layers only**: (pic C)

الجنين كبر فيحتاج رابد ترانسفيوشن فبيتلخص من واحد من الليرز الأربعة وهو ال سايتوتروفوبلاست

1. **Syncytiotrophoblast**.
2. **Connective tissue**.
3. **Endothelium of the capillaries**.

At some sites, the syncytio comes in direct contact with the endothelium of the capillaries and forms **Vasculo-Syncytial** placental membrane.



FUNCTIONS OF THE PLACENT

1-Metabolic

- Synthesis of: Glycogen, Cholesterol and Fatty Acids. المشيمة هي بنفسها تصنعهم ما تعتمد على الام.
- They supply the fetus with nutrients and energy.

2-Transportation

Gases

- Exchange of O₂, CO₂ and CO is through simple diffusion.
- The fetus extracts (20 –30) ml of O₂/minute from the maternal blood. فاذا صار للام هيبوكسيا راح يصير للجنين

Nutrients & Electrolytes:

- Water, Amino acids, Carbohydrates, Vitamins and Free Fatty Acids are rapidly transferred to the fetus.

Maternal Antibodies	-Maternal immunoglobulin G gives the fetus passive immunity to some infectious diseases (measles, small box) and not to others (chicken box). لهذا بعد الولادة ما يعطى الطفل تطعيمات الحصبة الا بعد 3-4 شهور, لان الانتي باديبز الي اخذها من الام بدت تروح
Drugs & Drug metabolites	-They cross the placenta by simple diffusion. -They can affect the fetus directly or indirectly by interfering with placental metabolism.
Hormones	-Protein hormones do not reach the embryo in sufficient amounts. some of these hormones (Thyroxine & Testosterone which may cause masculinization of a female fetus) <u>can cross</u> the placental membrane.
Waste products	-Urea and uric acid pass through the placental membrane by simple diffusion.
3-Endocrine Synthesis	
Progesterone	Maintains pregnancy if the corpus luteum is not functioning well. اذا ما فيه. بروجسترون ما بيكمل الحمل ويتجهض الأم
Estrogen	Stimulates uterine growth and development of the mammary glands. for lactation
hCS or Hpl hCS=Human Chorionic Somatomammotropic. Hpl=Human Placental lactogen.	-A growth hormone that gives the fetus the priority on maternal blood glucose. Hpl : playing a role in gestational diabetes. -It promotes breast development for milk production.
hCG	Maintains the corpus luteum and used as indicator of pregnancy . يظهر بدري. بالحمل

Drugs that can cross the placental membrane:

- Fetal drug addiction can be due to some drugs as Heroin, Nicotine and Alcohol. (the baby after birth will have withdrawal symptoms)
- All sedatives and analgesics can affect the fetus to some degree.
- Drugs used for management of labor can cause respiratory distress to the newborn. عشان كذا
بوقت الولادة نعطي الأم جرعة قليلة من المخدر وبعد ما يطلع الطفل نزيد الجرعة عشان الخياطة وغيره

Mechanism of transportation in boys slides only

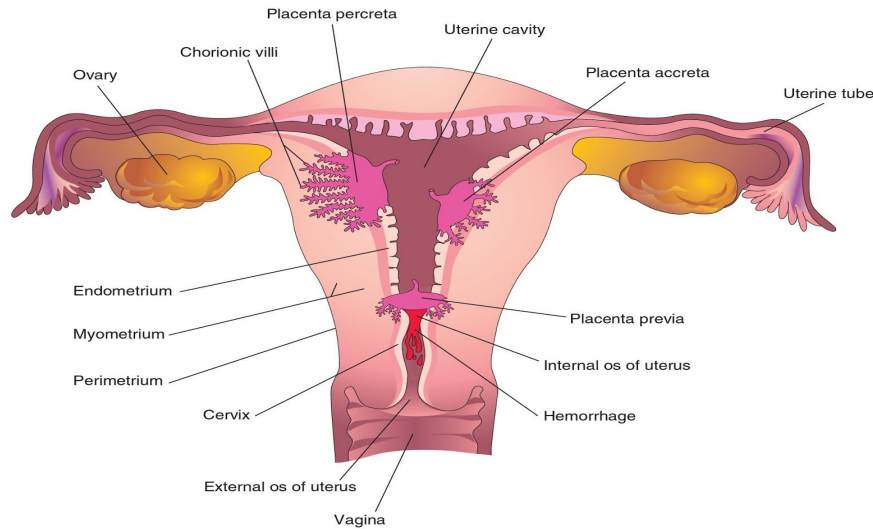
the transportation through the placental membrane is by one of the following mechanism:

- **Simple (passive) diffusion**
Depends on difference in pressure. من الاعلى الى الاقل
- **Active transport**
Requires energy.
- **Facilitated transport**
Through electrical discharge.
- **Pinocytosis**
The material engulfer is a small sample of extracellular fluid.

Anomalies of Placenta:

depends on structure (Placenta Accreta) or position (Placenta Percreta & Previa)

Placenta Accreta	Placenta Percreta	Placenta Previa
<p>Abnormal Absence of chorionic villi with partial or complete absence of the <i>decidua basalis</i>. ما يكمل الحمل</p>	<p>بدال ما تكونت بالاندوميترיום تكونت بالمايومتريوم (العضله) Chorionic villi penetrate the myometrium to the perimetrium. The most common presenting sign of these two anomalies is trimester bleeding. ما يكمل الحمل</p>	<p>The blastocyst is implanted close to or overlying the internal uterine os. It is associated with late pregnancy bleeding. Delivery is through Cesarean section. ليه تولد قيصري؟ لان هنا المشيمة بتطلع قبل الطفل وقت الولادة فاذا طلعت قبله كيف بيتنفس بتسبب له اختناق فالحل الامثل القيصري</p>



Fate of Placenta: بعد ربع الى ثلث ساعة من الولادة تبدأ الانقباضات مره ثانيه

The strong uterine contractions that continue after birth compress uterine blood vessels to limit bleeding and cause the placenta to detach from the uterine wall (within 15 minutes after birth of the infant). دور الطبيب يتأكد أن المشيمة نزلت كامله, لان اذا بقي قطعه ما نزلت بيصير نزيف للأم.

Fetal Cardiovascular system is designed:

1-To serve prenatal needs.

2-To permit modifications at birth, which establish the neonatal circulation.

Important structures in transitional circulation

Ductus venosus

Ductus arteriosus

Foramen ovale

Blood reaches and leaves fetus through the umbilical cord.

Umbilical cord contains **two arteries** and **one vein**.

Highly oxygenated blood passes from placenta to the umbilical vein.

Half of this blood reaches IVC through **Ductus venosus**.

لانها بين تو فين نطلق عليها دكتور فينوزيز

The other half pass through **liver sinusoids** and then to IVC.

كانتا نقول الانفيريور فينا كيفا يستقبل الدم مرتين طيب ليه المره الاولى ما دخل الكبد؟ عشان يكون اسرع ركزوا هنا ان الانفيريور فينا كيفا دم مؤكسج

Blood of the IVC reaches the right atrium, then left atrium through the **Foramen Ovale**. **crista dividens** (Lower border of septum secundum) responsible for directing the blood to "left atrium"

Then to the left ventricle to the **ascending aorta** and to aortic arch to supply head and neck, brain, cardiac muscle and upper limbs.

دامه بيعطي للدماغ فلازم يكون دم مؤكسج بما فيه الكفاية

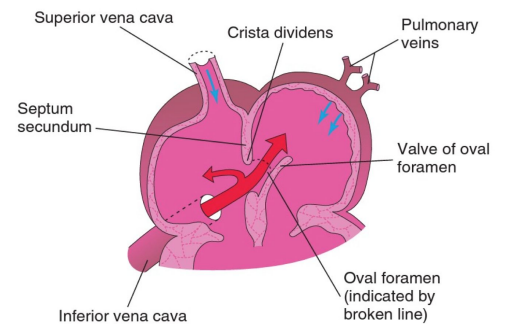
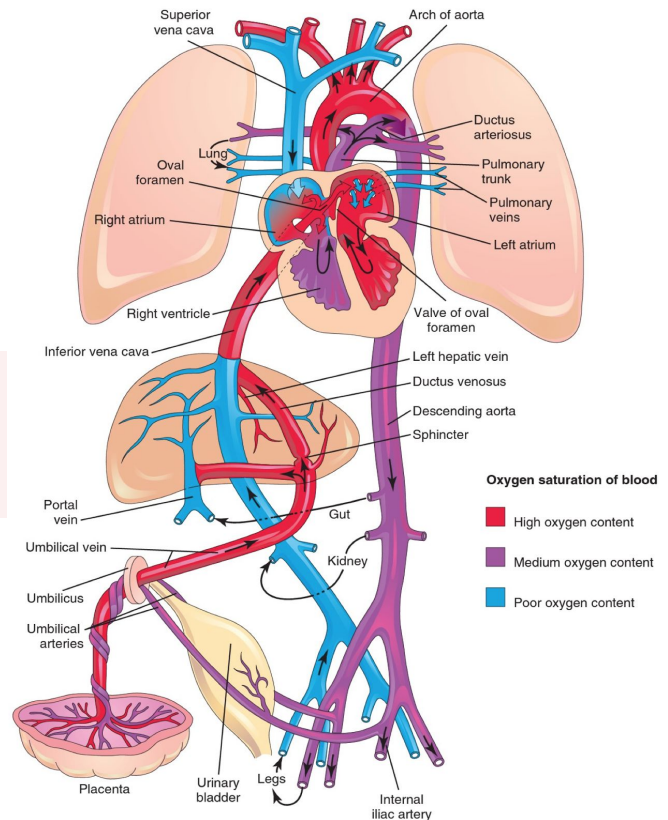
Small amount of highly oxygenated blood in right atrium mixes with venous blood of **SVC** passes to **right ventricle**.

لسوبيريور فينا كيفا بيكون دم غير مؤكسج لاحظوا الفرق بينه وبين الانفيريور

Then to pulmonary artery then to **Ductus Arteriosus** (between arch of aorta & L pulmonary artery) to the **Descending aorta** -> fetal body.

بين تو ارتري عشان كذا اسمه دكتور ارتريوزيز

Then back to placenta via the **umbilical arteries**.



It is believed that there is a valve in the liver at the entrance of the umbilical vein. This valve controls the amount of blood going to the liver sinusoids or the Ductus venosus.

1. <u>After ligation</u> ¹ of the umbilical cord:	2. <u>After Aeration of the lungs at birth</u> :
1. Sudden fall of blood pressure in the IVC and the right Atrium. 2. The valve (between IVC and umbilical vein) of the ductus venosus constricts.	1. Marked <u>increase</u> in the pulmonary <u>blood flow</u> . 2. Dramatic <u>fall</u> in pulmonary vascular <u>resistance</u> . 3. <u>Thinning</u> in the wall of the pulmonary arteries.

3. <u>Changes after birth</u> :
<p>1. Closure of foramen ovale: تفقل مره وحده ما تحتاج فترات عكس الدكت ارتيريوسيس</p> <p>A. Physiological closure ("concomitant of ligation" different in pressure, pressure drop in right atrium)</p> <p>B. Anatomical closure. "requires 3 months"</p> <p>2. Constriction of ductus arteriosus :</p> <p>A. By the end of the first 24 hours (1 day) 20% of the lumen of the ductus is closed.</p> <p>B. By the end of 48hours (2days) 82% is closed.</p> <p>C. By 96 hours (4days) 100% of the duct is closed.</p>

طبيب عشان يصير constriction of ductus arteriosus نحتاج مساعدة .. مين يساعدنا؟

● **Bradykinin:** the helper

- It is a substance released **from fetal lungs** during their initial inflation.
- This substance has a **contractile effect** on smooth muscles of the **ductus arteriosus**.
- The action of this substance appears to be **dependant on the high Oxygen saturation** of the aortic blood.
- طبب المساعدة حقتنا نفسها تحتاج بانزين عشان تشتغل الي هو الاكسجين لازم عندنا كمية مره كبيره منه والا ماراح تشتغل
- When oxygen tension reaches **50 mmHg** (لازم خمسين او اكثر) in the ductus arteriosus it causes constriction of its smooth muscles.
- During intrauterine fetal life the patency of ductus arteriosus (**before birth**) is **controlled by the low contents of oxygen** in the blood passing through it. So hypoxia "like having delivery in high altitude (alhadada or himalayadas.." and other ill-defined factors keep the ductus arteriosus patent. قبل الولادة حتى لو البراديكينين موجوده ماراح تسوي شغلها لان كمية الاكسجين قليله (مافي بانزين).

Adult derivatives of fetal vascular structures: important	
Umbilical vein	Ligamentum teres (in liver holds the antr abdominal wall to the liver)
Umbilical arteries	medial umbilical ligaments
Ductus venosus	Ligamentum venosum (back of the liver).
Ductus arteriosus	Ligamentum arteriosum (hold the pulmo artery w/ arch of aorta, posterior to it the left recurrent laryngeal nerve in the thorax)
Foramen ovale	fossa ovalis. it's Floor=septum primum it's Margin (Limbus of fossa ovalis)=(septum secundum)
remnant of the embryonic urachus .	median umbilical ligament.

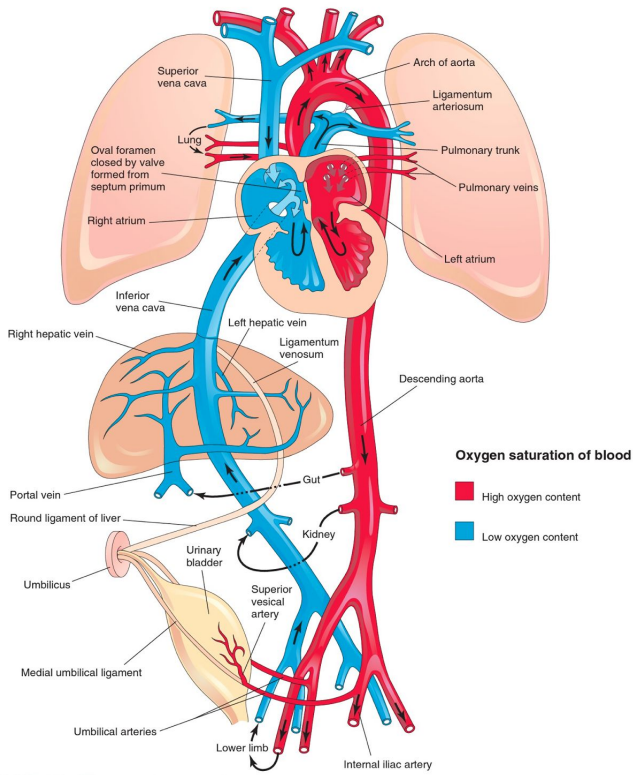
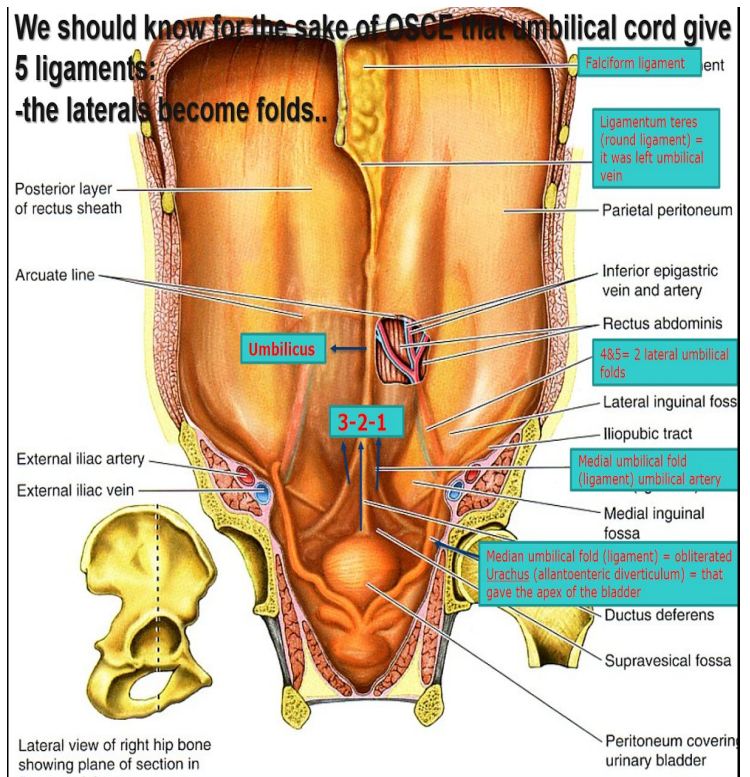


FIGURE 13-47 Neonatal circulation. The adult derivatives of the fetal vessels and structures that become nonfunctional at birth are shown. The arrows indicate the course of the blood in the infant. The organs are not drawn to scale. After birth, the three shunts that shortcircuited the blood during fetal life cease to function, and the pulmonary and systemic circulations become separated.



Summary

Maternal & fetal circulation

ANOMALIES OF PLACENTA

1. Placenta Accreta	Abnormal A bsence of chorionic villi with partial or complete absence of the decidua basalis.
2. Placenta Percreta	Chorionic villi p enetrates the myometrium to the perimetrium. The most common presenting sign of these two anomalies is trimester bleeding.
3. Placenta Previa	The blastocyst is implanted close to or overlying the i nternal uterine os. It is associated with late pregnancy bleeding. Delivery is through C esarean section.

4th month	formation of placenta
until 20 w	placental membrane composed of 4 layers
at full term	placental membrane becomes thinner and composed of 3 or 2 layers only
after birth	<ul style="list-style-type: none"> - Closure of foramen ovale - Constriction of ductus arteriosus

Mcq's

1- During the later stages of pregnancy, maternal blood is separated from fetal blood by the

- A. syncytiotrophoblast only
- B. cytotrophoblast only
- C. syncytiotrophoblast and cytotrophoblast
- D. syncytiotrophoblast and fetal endothelium
- E. cytotrophoblast and fetal endothelium

2- The maternal and fetal components of the placenta are

- A. decidua basalis and secondary chorionic villi
- B. decidua capsularis and secondary chorionic villi
- C. decidua parietalis and tertiary chorionic villi
- D. decidua capsularis and villous chorion
- E. decidua basalis and villous chorion

3- The intervillous space of the placenta contains

- A. maternal blood
- B. fetal blood
- C. maternal and fetal blood
- D. amniotic fluid
- E. maternal blood and amniotic fluid

4- A 26-year-old pregnant woman experiences repeated episodes of bright red vaginal bleeding at week 28, week 32, and week 34 of pregnancy. The bleeding spontaneously subsided each time. Use of ultrasound shows that the placenta is located in the lower right portion of the uterus over the internal os. What is the diagnosis?

- A. Hydatidiform mole
- B. Vasa previa
- C. Placenta previa
- D. Placental abruption
- E. Premature rupture of the amniochorionic membrane

T or F

5- Blood of the SVC reaches the right atrium, then left atrium through the Foramen Ovale.

6- By the end of the first 24 hours after birth ductus arteriosus is closed completely.

7- The umbilical cord Contains one artery and two veins.

8- in Placenta Accreta Chorionic villi penetrate the myometrium to the perimetrium.

9- in Placenta Previa The blastocyst is implanted close to or overlying the external uterine os.

10 - Syncytiotrophoblast disappear after 20 week.

1	2	3	4	5	6	7	8	9	10
D	E	A	C	F	F	F	F	F	F