UNIT – III 11

1. **Chick Embryology:** (Extra-embryonic membranes) -

Structure and functions of- Amnion; Chorion; Yolk sac; Allantois

2. **Plancentation in mammals:** Classification on the basis of- Origin; Histology; Distribution of villi, Functions of Placenta.

Development of Chick

Chick belongs to the class of Aves. In chick the sexes are separate. There is sexual dimorphism. The male bird is the cock. It has a pair of testes. The female bird is the hen and it has only one ovary located on the left side. The hen is oviparous and it lays eggs. Fertilization is internal and it occurs during copulation which is called cloacal kiss in birds.

Chick Embryology: (Extra-embryonic membranes)

The embryos are covered and protected by a set of membranes called foetal membranes. These membranes are developed from the tissue lying outside the embryo. Hence they are also called extra-embryonic membranes.

The main functions of the foetal membranes are to provide protection, nutrition, respiration and excretion to the embryo. All the foetal membranes disappear before or immediately after hatching.

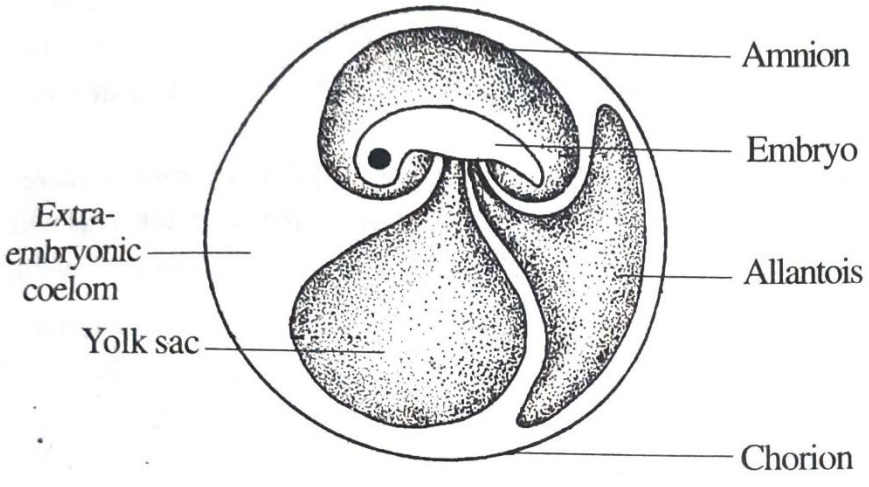


Fig. An embryo to show the foetal membranes.

There are mainly four types of foetal membranes. They are

1. Amnion 2. Chorion 3. Yolk sac 4. Allantois

1.Amnion

1. Amnion is a foetal membrane or extra-embryonic membrane.
2. The animals developing an amnion are called amniota. Eg. Reptiles, birds and mammals.
3. The animals which do not develop an amnion are called anamniota. Eg. Fishes, amphibians, etc.
4. It surrounds the embryo.
5. It is made up of two layers, namely an outer somatic mesoderm and inner ectoderm.
6. It encloses a cavity called amniotic cavity. It is filled with a fluid called amniotic fluid.
7. The amnion is connected to the embryo on the ventral side by a stalk called somatic umbilicus. Amnion develops from somatopleure.
8. During development, the somatopleure develops certain foldings called amniotic folds.
9. The amniotic folds develop into amnion.
10. Amnion ruptures at the time of hatching.

Amnion does the following functions:

a) The amniotic fluid provides a liquid medium for the embryo. It is called the artificial swimming pool of the embryo.

b) The amniotic fluid functions as a shock absorber.

c) It prevents the adhesion of the embryo to the shell.

d) It helps in respiration.

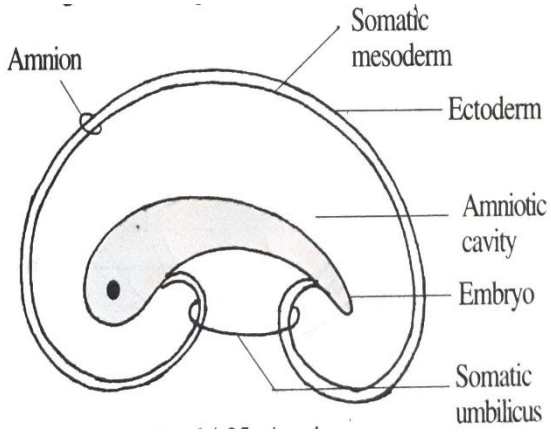


Fig. Amnion.

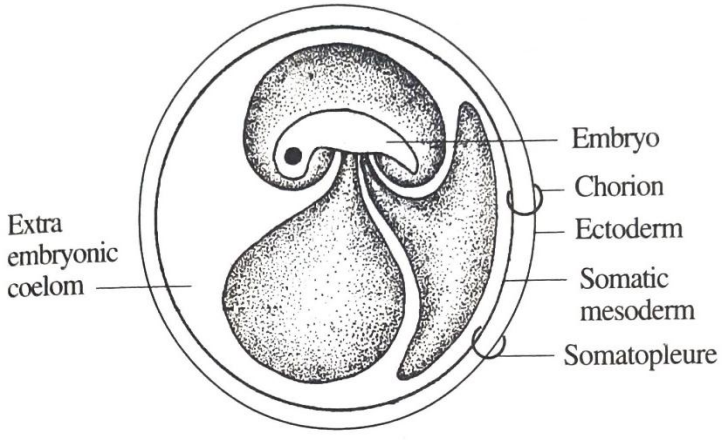


Fig. Chorion.

2.Chorion

1. Chorion is a foetal membrane or extra-embryonic membrane.
2. It is also called serosa.
3. It surrounds the entire embryo and lies outside. It lies close to the shell.
4. It is made up of two layers, namely an outer ectoderm and inner somatic mesoderm.
5. The cavity enclosed by the chorion is called extra-embryonic coelom.
6. The chorion develops from somatopleure containing an outer ectoderm and inner somatic mesoderm.
7. Chorion ruptures at the time of hatching.
8. Chorion does two functions, namely respiration and protection.

3.Yolk Sac

1. Yolk sac is a foetal membrane or extra-embryonic membrane.
2. Yolk sac encloses the yolk.
3. It is made up of an inner endoderm and outer splanchnic mesoderm. It develops from splanchnopleure.
4. It is attached to the midgut by a narrow stalk called yolk stalk.
5. It opens into the midgut by an yolk duct.
6. The endoderm of yolk sac has many finger-like folds called yolk sac septa.
7. The yolk sac septa increase the area of absorption of yolk,
8. The yolk sac is supplied by a pair of vitelline arteries.
9. A pair of vitelline veins collect the blood from the yolk sac.
10. The yolk sac gradually decreases in size as the yolk is consumed.
11. The yolk sac provides nutrition for the embryo.

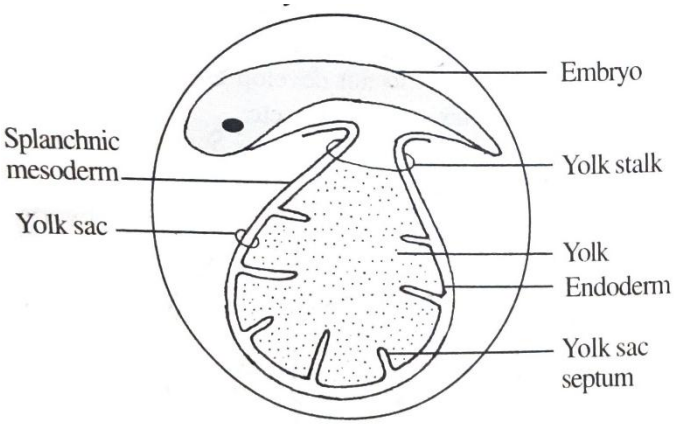


Fig. Yolk Sac

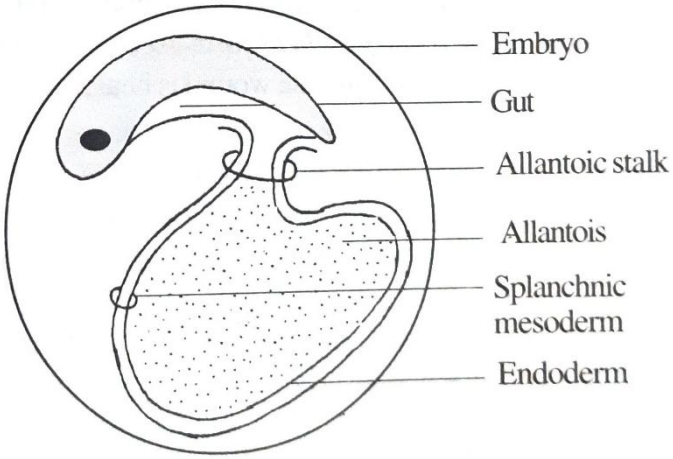


Fig. Allantois.

4.Allantois

1. Allantois is a foetal membrane or extra-embryonic membrane.
2. It is made up of an inner endoderm and outer splanchnic mesoderm.
3. It develops from splanchnopleure.
4. It is attached to the hindgut by a narrow stalk called allantoic stalk.
5. Allantois is supplied by a pair of allantoic arteries and a single allantoic vein.
6. As development advances, allantois increases in volume.
7. In later stage, splanchnic mesoderm of allantois and somatic mesoderm of chorion fuse together to form a chorioallantoic membrane.
8. Allantois ruptures at the time of hatching.
9. Allantois does the following functions:
   a) It is excretory in function. It collects the excretory products from the embryo.
   b) It helps in respiration.
   c) It absorbs calcium from the shell. This helps the rupture of the shell at the time of hatching.

Placenta in Mammals

The term placenta is derived from a Greek word meaning flat cake. It is defined as a special kind of tissue connection between the mother and the foetus, formed by the inner lining of uterus and the foetal membranes for the purpose of physiological exchange of materials. Placenta is found in mammals. It develops in internal development. The embryo develops inside the uterus of the mother. The embryo makes contact with the uterine wall by a special kind of tissue called placenta. It is formed by the contributions of embryonic and maternal tissues. The process of development of placenta is called placentation.

Characteristics of Placenta

1. Placenta is a special kind of tissue connection between the mother and foetus.
2. It is formed by the fusion of uterine tissues and foetal membranes.
3. It serves mainly for the transport of nutrients and oxygen from the mother to the foetus.
4. It forms a placental barrier and prevents the direct mixing of foetal and maternal blood cells.

Classification of Placenta Based on the Type of Foetal Membranes Involved:

The embryonic tissues which are involved in the formation of placenta are the foetal membranes. Of the four membranes (amnion, chorion, yolk sac and allantois), the amnion does not participate in the formation of placenta. Chorion, yolk sac and allantois play important roles. The placenta is classified into two types based on the type of foetal membranes involved. They are the yolk sac placenta and the chorio-allantoic placenta.

1. Yolk Sac Placenta

Yolk sac placenta is formed by yolk sac and chorion. It is also called chorio-vitelline placenta or yolk sac placenta. It is a primitive type of placenta developed by a few primitive marsupials like Didelphis virginiana (opossum), Dasyurus (marsupial cat), etc.

The chorion develops small wrinkles and corrugations on its outer surface where it comes in contact with the uterine wall. These wrinkles hold the blastocyst to the uterine wall and thus reduce the possibility of its premature exit. In addition, the uterine milk,

secreted by the uterine glands, is freely absorbed by the chorion and is transported to the embryo through the vitelline circulation.

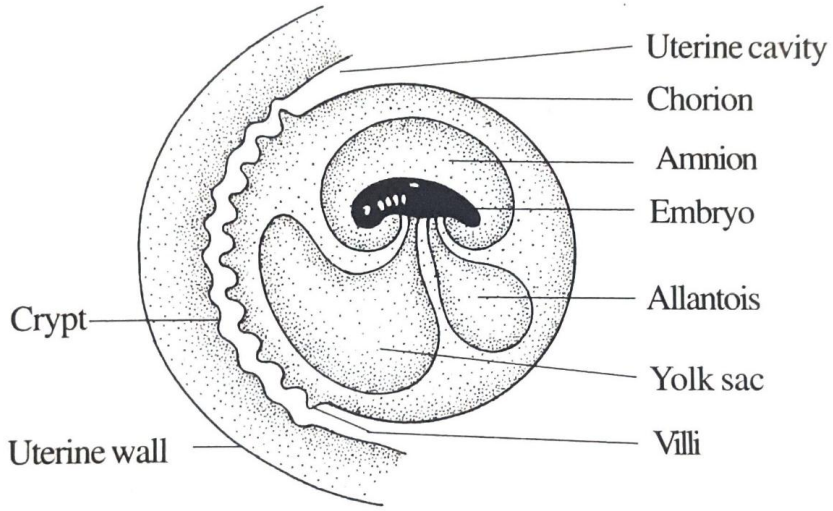


Fig.: Yolk sac placenta.

2. Chorio-allantoic Placenta

Chorio-allantoic placenta is formed of chorion and allantois. The allantois is so large that it comes in contact with the chorion. allantois and chorion fuse together to form a membrane called chorio-allantoic membrane. This membrane is well vascularized by the allantoic arteries and veins. It develops on the outer surface branched or unbranched finger-like outgrowths called villi.

The uterine wall develops depressions called crypts. The villi dip into the crypts. This facilitates the absorption of nutrients from the maternal side. This type of placenta is found in all eutherian mammals and in some marsupials. Eg. Man, cow, dog, etc.

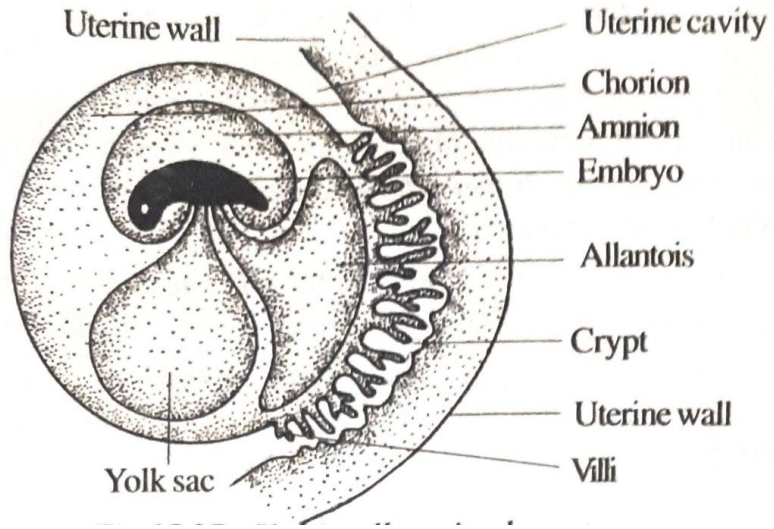


Fig.: Chorio-allantoic placenta.

Classification of Placenta Based on the Distribution of Villi

The chorio-allantoic placenta, is classified into six types based on the distribution of villi on the surface of chorion. They are as follows:

1. Diffuse Placenta

In diffuse placenta, the villi are uniformly distributed throughout the surface of the blastocyst. Diffuse placenta is a chorio-allantoic placenta. The uterus has crypts. The villi fit into the crypts. It is found in pig, horse, etc.

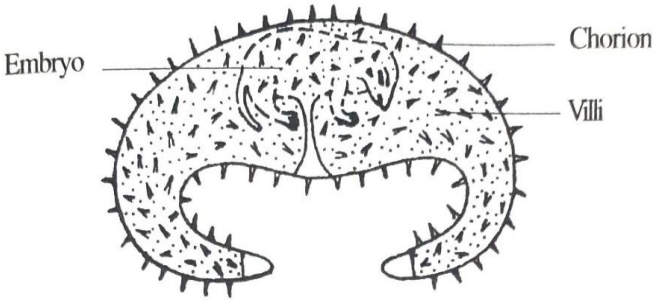


Fig.: Diffuse placenta-Pig.

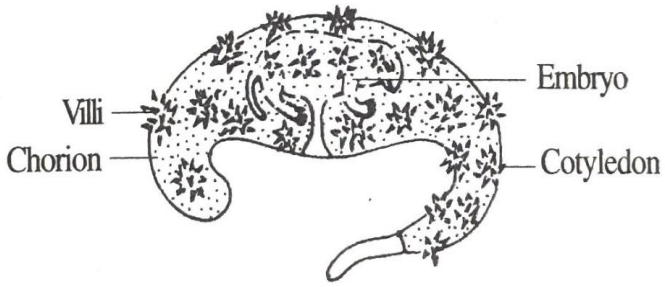


Fig.: Cotyledonary placenta-Sheep.

2. Cotyledonary Placenta

In cotyledonary placenta, the villi are arranged in groups on the surface of the embryo; the intervening regions are smooth. Each group of villi is said to be a cotyledon. The uterine wall is provided with thickened sockets called caruncles. Each caruncle is made up of a group of crypts. Each villus of the cotyledon fits into a corresponding crypt in the caruncle. It is a chorio-allantoic placenta. Eg. Sheep, cow and deer.

3. Intermediate Placenta

The blastocyst is provided with both villi and cotyledons. The villi are distributed in between the cotyledons. Eg. Camel and giraffe.

4. Zonary Placenta

In zonary placenta, the villi are arranged in one or more circles around the blastocyst. Eg. Elephant, dog, cat, etc. In dog, there is a single girdle of villi. In racoon, the single girdle is incomplete. In for, there are two circles of villi. It is a chorio-allantoic placenta.

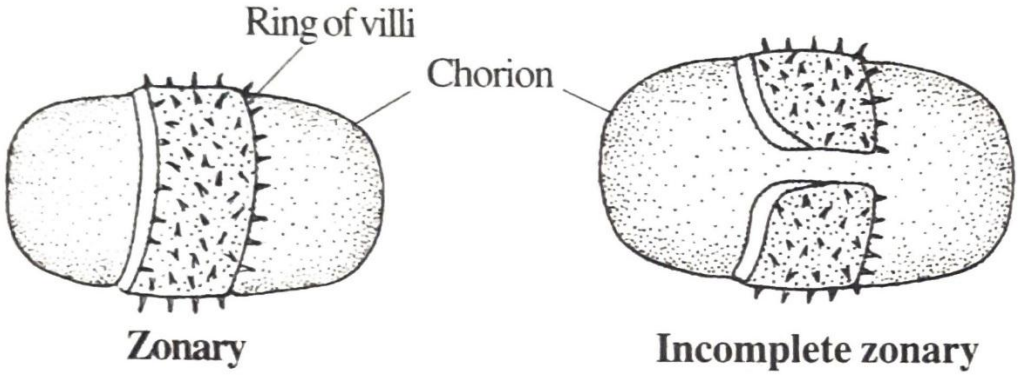


Fig.:Zonary placenta.

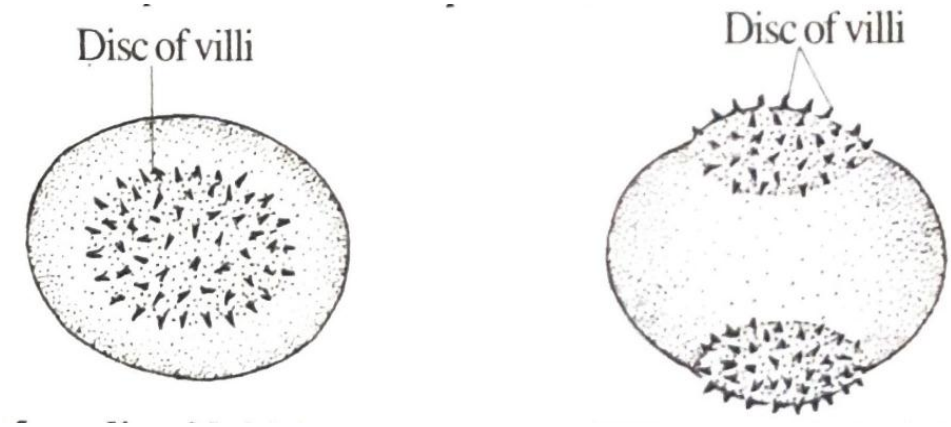
5. Discoidal Placenta

In this type of placenta, the villi are arranged in one or more disc-shaped areas. Eg. Rat, rabbit, etc.

6. Metadiscoidal Placenta

In metadiscoidal placenta, the villi are at first uniformly distributed throughout the entire surface of chorion. But later they are restricted to one or more disc-shaped areas on the ventral side. This type of discoidal placenta is said to be metadiscoidal placenta. Metadiscoidal placenta occurs in primates.

Man has a single disc of villi and it is called monodiscoidal placenta. Monkey has two discs of villi and the placenta is called bidiscoidal.



Monodiscoidal-Man *Bidiscoidal-Monkey*

Fig.: Metadiscoidal placenta.

Classification of Placenta Based on the Type of Tissues Involved (Histology)

Based on the nature of tissue layers involved in the placenta (histology), the placenta is classified into five types. They are:

1. Epitheliochorial placenta 2. Syndesmochorial placenta 3. Endotheliochorial placenta 4. Haemochorial placenta 5. Haemoendothelial placenta

1. Epitheliochorial Placenta

In epitheliochorial placenta, the uterine epithelium of the mother makes contact with the chorion of the embryo and hence the name. It is the simplest type of placenta. The villi of the chorion dip into the crypts of the uterine wall. It is a chorio-allantoic placenta.

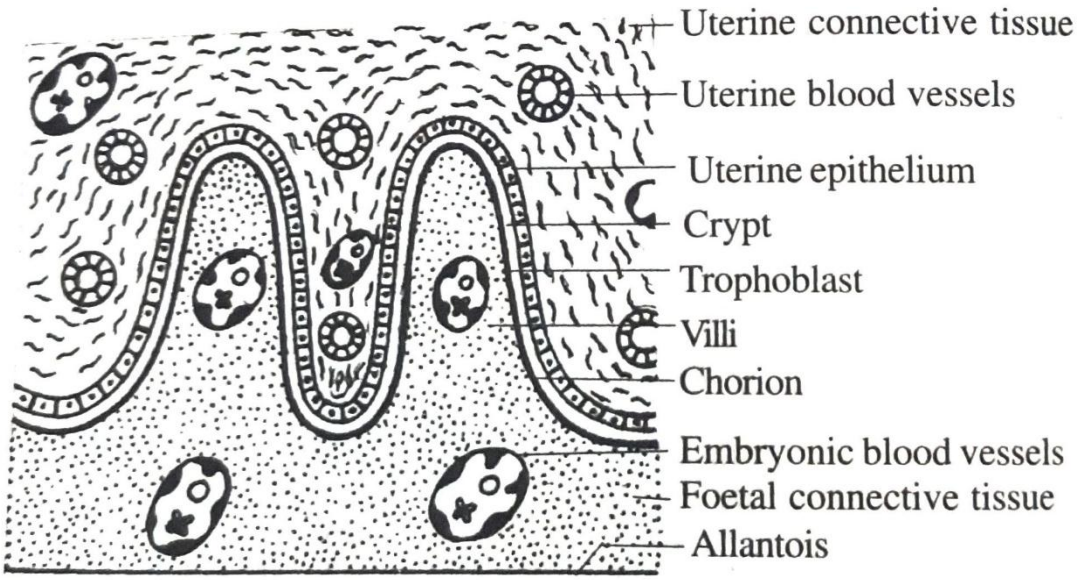


Fig.: Epitheliochorial placenta.

This type of placenta is provided with 6 types of tissues. They are named from the maternal blood as follows:

1. Maternal endothelium 2. Maternal connective tissue (syndesmos) 3. Maternal uterine epithelium 4. Chorion 5. Foetal connective tissue and 6. Foetal endothelium.

Thus the nutritive materials pass through the maternal endothelium → maternal connective tissue → uterine epithelium → chorion → foetal connective tissue → foetal endothelium to reach the foetal blood. Eg. Pig, horse, etc.

2. Syndesmochorial Placenta

In syndesmochorial placenta, the maternal connective tissue (syndesmos) makes contact with the chorion and hence the name. In this type of placenta, the uterine epithelium is

eroded. Thus the nutrients pass through maternal endothelium maternal con→ nective tissue → chorion → foetal connective tissue foetal endothelium.

The syndesmochorial placenta is found in sheep.

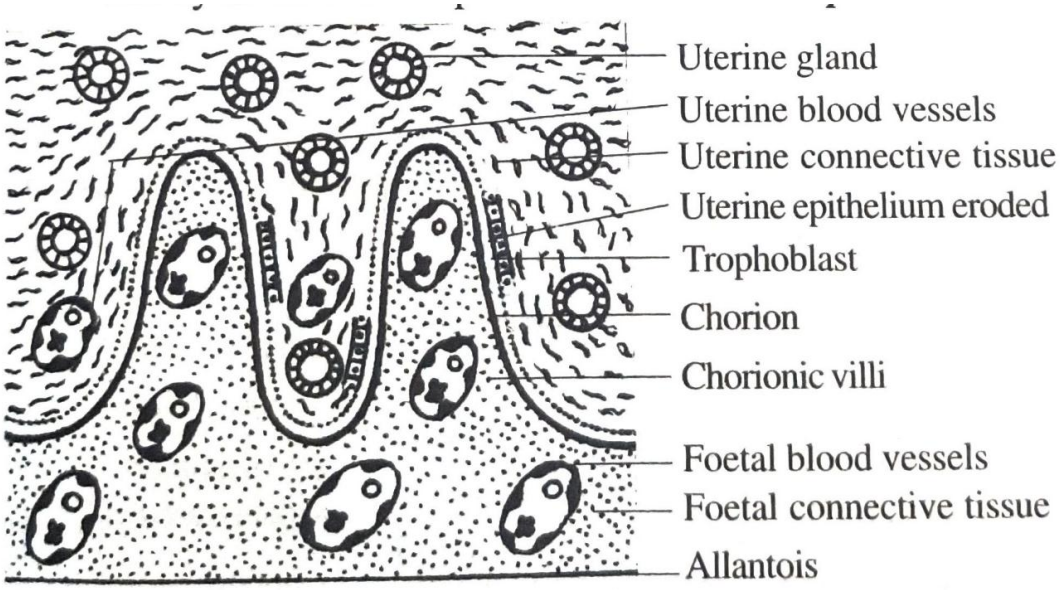


Fig: Syndesmochorial placenta (Sheep).

3. Endotheliochorial Placenta

In endotheliochorial placenta, the endothelium of the mother makes direct contact with the chorion and hence the name. The uterine epithelium and the maternal connective tissue are eroded.

The nutritive materials pass through the maternal endothelium → chorion + foetal connective tissue → foetal endothelium. This condition is found in dogs, cats, etc.

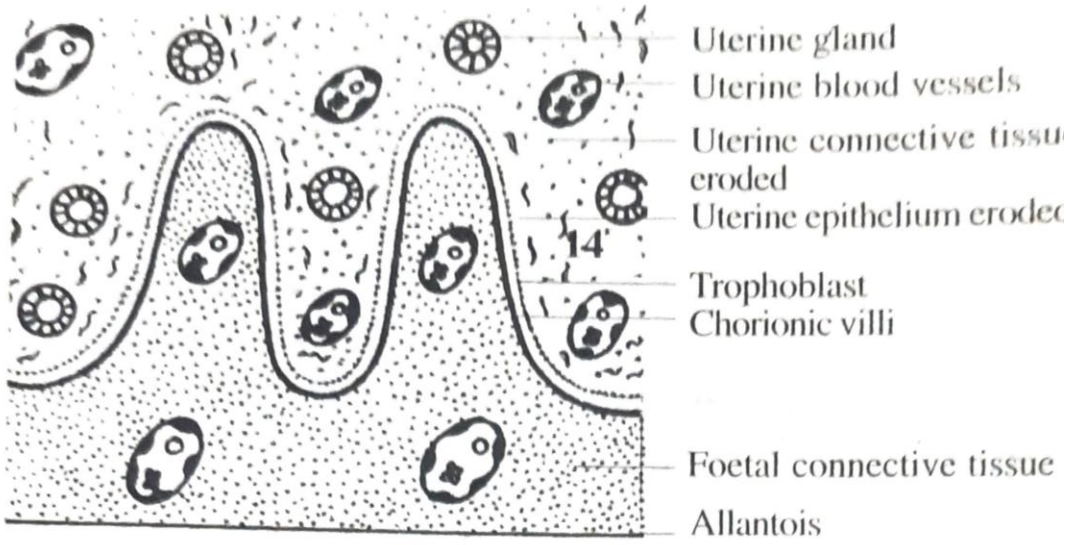


Fig.: Endotheliochorial placenta (Dog).

4. Haemochorial Placenta

In haemochorial placenta, the chorion of the embryo directly dip into the maternal blood sinuses and hence the name.

Here the uterine epithelium, maternal connective tissue and the maternal endothelium are eroded. Thus the chorionic villi directly dip into the maternal blood sinuses. This type of placenta is found in man, monkey, bats, etc.

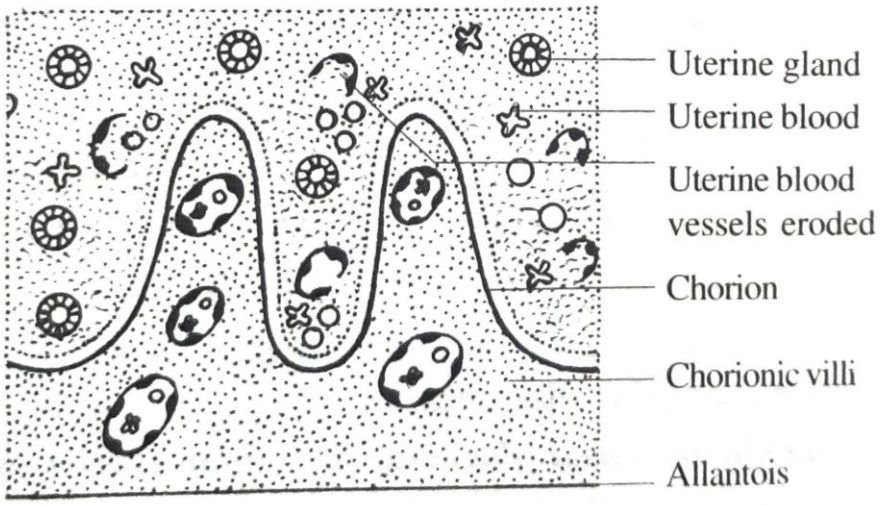


Fig.: Haemochorial placenta (Man).

5. Haemoendothelial Placenta

In haemoendothelial placenta, the foetal blood vessels dip into maternal blood pools. The uterine epithelium, the maternal connective tissue, the maternal endothelium and the chorion are eroded. The maternal blood has only one barrier, the foetal endothelium to reach the embryo. Eg. Rabbit, rat, etc.

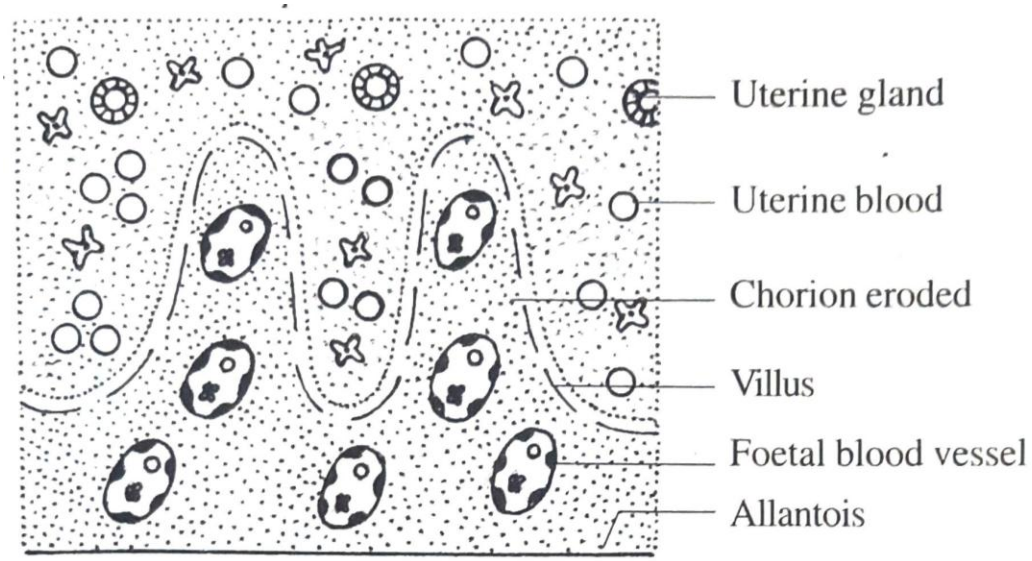


Fig.: Haemoendothelial placenta (Rabbit).

Functions of the Placenta

Placenta performs the following functions:

1. **Nutrition:** Placenta transports nutrients through blood from the mother to the embryo.
2. **Respiration:** Placenta permits the transport of O, from the mother to the embryo and CO, from the embryo to the mother through blood.
3. **Excretion:** The nitrogenous waste products of the embryo diffuse into the maternal blood through the placenta.
4. **Anchorage:** The anchoring villi attach the embryo to the uterine wall.
5. **Immunity:** The antibodies developed in the blood of mother against certain diseases like diphtheria, measles, smallpox, etc. are passed from the mother into the embryo and the embryo develops passive immunity.
6. **Storage:** Placenta stores substances like fat, glycogen, iron, etc.
7. **Endocrine Function:** Placenta functions as an endocrine gland. It secretes hormones like oestrogen, progesterone, follicle stimulating hormone, luteinizing hormone and relaxin.
8. **Protection:** Placenta functions as a barrier for the transport of certain pathogens from the mother to the foetus. However bacteria and viruses do pass through the placenta.
9. **Transport of Drugs:** The drugs consumed by the mother are transported through the placenta. Sometimes they are harmful to the embryo.
10. **Source of Nourishment:** The placenta and after birth tissue (decidua) form a source of food for some mammals such as rabbit. The mother eats the placenta and after birth tissue immediately after birth.