

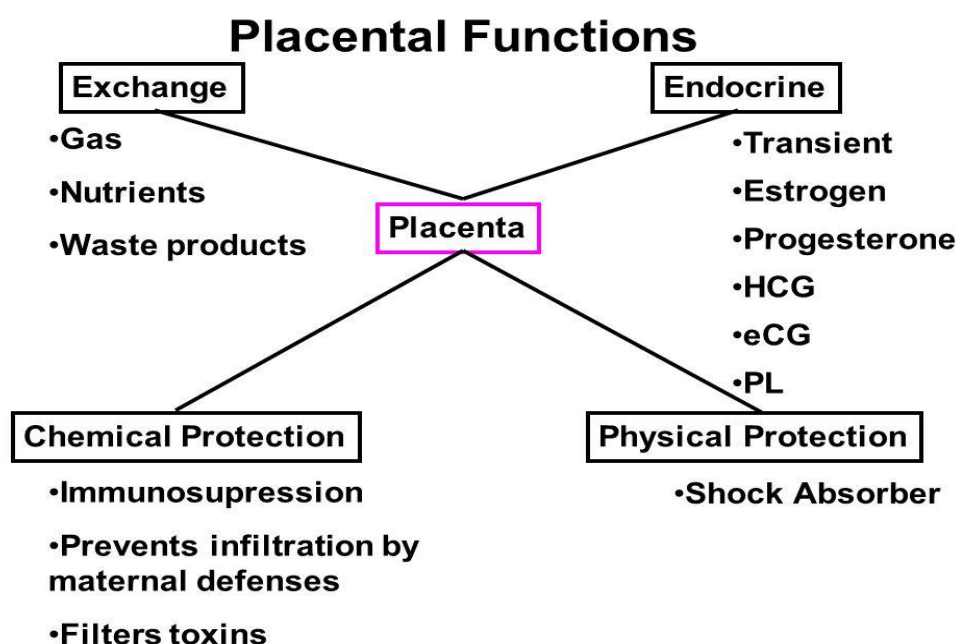
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Sub Topic	Development of Placenta
Content	Introduction Development Classification Placental function
Search KeyWords	Placenta, fetus, collustrum

Learning Outcomes

- Understanding about the Placenta
- Classification of Placenta
- Metabolic and Endocrine activity of Placenta

Introduction

The placentas of all eutherian (placental) mammals provide common structural and functional features, but there are striking differences among species in gross and microscopic structure of the placenta. Two characteristic are particularly divergent and form bases for classification of placental types- first gross shape of the placenta and the distribution of contact sites between membranes and endometrium. Second the number of layers of tissue between maternal and fetal vascular systems. The placenta is an organ that connects the developing fetus to the uterine wall. The placenta supplies the fetus with oxygen and food, and to allow fetal waste to be disposed via the mother blood supply. The word Placenta comes from the Latin for cake.



Development- The placenta begins to develop upon attachment (Livestock) or implantation (Human, dog, cat, rabbit) of the blastocyst into the maternal endometrium. The outer layer of the blastocyst becomes the trophoblast which forms the outer layer of the placenta. This outer layer is divided into two further layer: the underlying cytotrophoblast layer and the overlying syncytiotrophoblast layer. This syncytiotrophoblast is a multinucleate continuous cell layer which covers the surface of the placenta. It forms as a result of differentiation and fusion of the underlying cytotrophoblast cells, a process which continues throughout placental development. The syncytiotrophoblast thereby contributes to the barrier functions of the placenta. The placenta grows throughout pregnancy.

Classification Based on Placenta Shape and Contact Points-

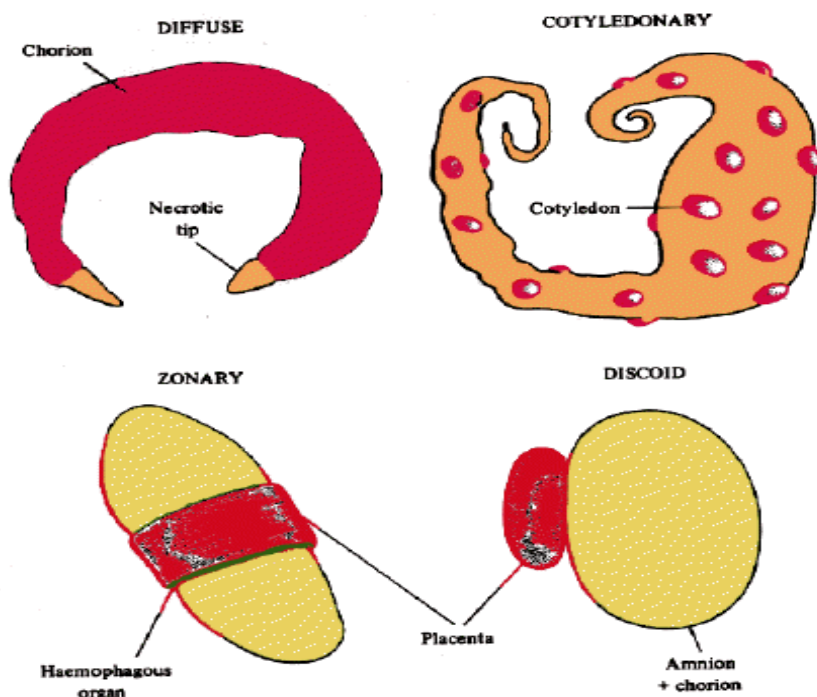
Examination of placentae from different species reveals striking differences in their shape and the area of contact between fetal and maternal tissue:

Diffuse- almost the entire surface of the allanto-chorion is involved in the formation of the placenta e.g. horses and pigs.

Cotyledonary- multiple, discrete areas of attachment called cotyledons are formed by interaction of patches of allanto-chorion with endometrium. The fetal portions of this type of placenta are called cotyledons, the maternal contact sides (caruncles), and the cotyledon-caruncle union a placentome. This type of placentation is found in ruminants.

Zonary- the placenta takes the form of a complete or incomplete band of tissue surrounding the fetus. e.g. dogs, cats, seals, bears etc.

Discoid- A single placenta is formed and is discoid in shape. Discoid placenta is seen in primates and rodents.

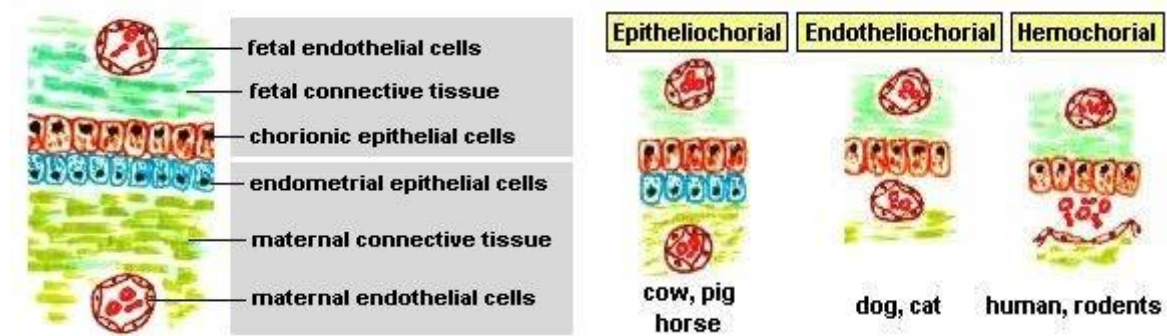


Classification Based on Layers between Fetal and Maternal Blood- Before formation of the placenta there are total of six layers of tissue separating maternal and fetal blood. There are three layers of fetal extra-embryonic membranes in the chorioallantoic placenta of all mammals, all of which are components of the mature placenta:

- Endothelial lining allantoic capillaries
- Connective tissue in the form of chorioallantoic mesoderm
- Chorionic epithelium, the outer most layer of fetal membranes derived from trophoblast

There are also three layers on the maternal side, but the number of these layers which are retained- that is not destroyed in the process of placentation, varies greatly among species. The three maternal layers in a placenta are-

- Endothelium lining endometrial blood vessels
- Connective tissue of the endometrium
- Endometrial epithelial cells

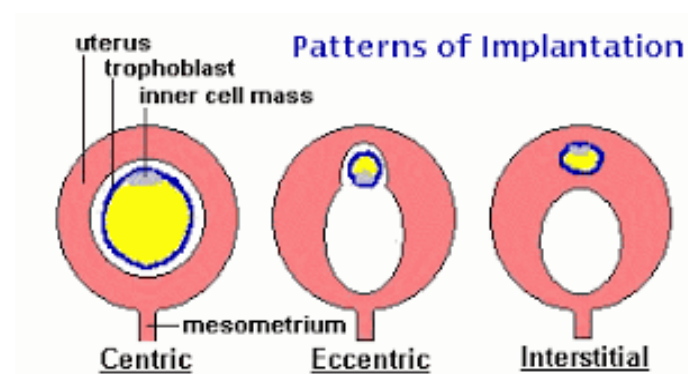


Types of Placenta	Examples
Diffuse - Epitheliochorial	Horses and pigs
Cotyledonary - Epitheliochorial	Ruminants (cattle, sheep, goats, deer)
Zonary - Endotheliochorial	Carnivores (dog, cat, ferret)
Discoid - Hemochorial	Humans, apes, monkeys and rodents

Umbilical cord-

- Encloses allantoic vessels
- Vascular link between mother and fetus: Arteries- deoxygenated blood from fetus to placenta and Veins- oxygenated blood from placental to fetus.

Attachment & Implantation (Intra-uterine)-



Cetral or Centric- Lower primates, e.g. rabbit embryo attached to the surface of uterine lining and projects freely into uterine. It is also known as superficial implantation.

Concentric or Eccentric- Embryo embedded in a groove or pocket e.g. mouse, rat, squirrel etc.

Interstitial- The blastocyst or embryo actually burrows into uterine tissue to become completely surrounded by it e.g. Man, apes etc.

Placental Circulation of Blood-

Deoxygenated fetal blood passes through umbilical arteries to the placenta. At the junction of umbilical cord and placenta the umbilical arteries branch radially to form chorionic arteries. Chorionic arteries also branch before they enter into villi. In the villi, they form an extensive arteriocardillary venous system, bringing the fetal blood extremely close to the maternal blood (do not mix).

Placental Substrate exchange-

Simple diffusion, facilitated diffusion, active transport, endocytosis, pinocytosis.

Glucose (primary energy source) converted to fructose. Amino acids converted into proteins by fetus. Limited transport of lipids by fetus. Antibodies do not cross placenta in livestock species newborns get antibodies through **colustrum**. Vitamins and minerals transferred across placenta.

The placenta and fetus may regard as a foreign allograft inside the mother, and thus must evade from attack by the mothers immune system. The mechanism are-

- a. It secretes **Neurokinin B** containing **phosphocholine** molecules.
- b. Also there is presence of small lymphocytic suppressor cells in the fetus that inhibit maternal **cytotoxic T cells** by inhibiting the response to **interleukin2**.

References-

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William K. Purves; Gordon H. Orians; H. Craig Heller (2003). *Life: The Science of Biology*.

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