Practical 14: Fetal Membranes and Placenta

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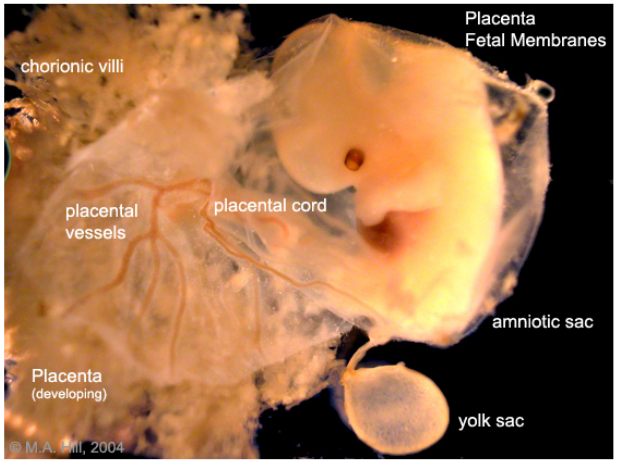
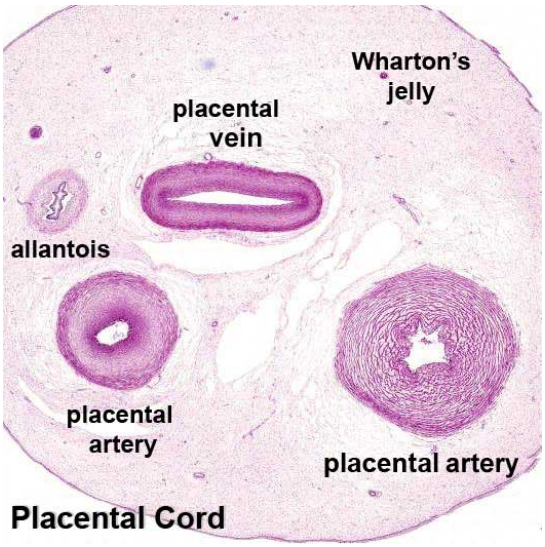
Gametes	Fertilization	Blastocyst	Implantation	Embryo	Fetus
Menstrual Cycle			**Placenta and Fetal Membranes**		



Human Embryo (week 7) placenta and fetal membranes.



Placental cord (term) cross-section.

Aim:

To understand the development, anatomy and histology of the placenta and the fetal membranes.

Key Concepts:

Implantation, uterine changes (endometrium to decidua), early placentation (cytotrophoblast and syncitiotrophoblast cells), villi development, placental cord, placental function, placental membranes, abnormalities.

Key Reading:

1. Schoenwolf, G.C., Bleyl, S.B., Brauer, P.R. and Francis-West, P.H. (2009). ***Larsen's Human Embryology*** (4th ed.). New York; Edinburgh: Churchill Livingstone.
2. Moore, K.L. & Persuad, T.V.N. (2008). ***The Developing Human: clinically oriented embryology*** (8th ed.). Philadelphia: Saunders.

Online Resource:

Online resource for this section is

- **UNSW Embryology** (http://php.med.unsw.edu.au/embryology)
- http://php.med.unsw.edu.au/embryology/index.php?title=BGDA_Practical_-_Placenta_and_Fetal_Membranes
- http://php.med.unsw.edu.au/embryology/index.php?title=Placenta_Development

Introduction

The placenta (Greek, *plakuos* = flat cake) named on the basis of this organs appearance. The placenta a mateno-fetal organ which begins developing at implantation of the blastocyst and is delivered with the fetus at birth. Only recently have we begun to understand the many different functions this organ carries out in addition to its role in embryonic nutrition. The parts of the conceptus that did not contribute to the embryo now develop and differentiate in parallel to form the embryonic placenta and the fetal membranes. Remember that the placenta has a dual origin from both fetal and maternal contributions and that overall placental structure varies between species.

Clinically, the placenta is first observed by ultrasound and both the site of formation and its development are critical to fetal development. The placenta and the fluid within the fetal membranes, are an important diagnostic tool for the genetic status of the fetus. At birth, in recent years, the cells derived from the placental cord are now an important source of “cord stem cells”. These will eventually have many clinical therapeutic applications.

This class will cover normal placenta and membrane development and will also discuss functions and abnormalities associated with this “system”. The practical will work through a number of on-line resources and histology images as well as displayed fixed specimens and models. Use the online list of terms (bottom of each page) and glossary (linked alphabetically) to define any new terms in the practical class.

Placenta Structure

Dimensions

- At birth - discoid up to 20cm diameter and 3 cm thick (at term) and weighs 500 - 600 gm.
- Variety of shapes - accessory placenta, bidiscoid, diffuse, horseshoe.
- Considered to have 2 surfaces, a maternal and embryonic surface, both delivered at parturition, retention may cause uterine haemorrhage.

Fetal Surface

- Placental (umbilical) cord attachment - cord 1-2 cm diameter, 30-90cm long.
- Surface covered with amniotic membrane and attached to chorionic plate.
- Placental (umbilical) vessels branch into chorionic vessels that anastomose.

Maternal Surface

- Cotyledons - form cobblestone appearance, originally placental septa formed grooves.
- Placental septum - depressed linear region separating cotyledons.
- Surface covered with maternal decidua basalis.

Implantation and Early Placentation

- Review the content from Practical 7 (Implantation to 8 weeks) and embryonic circulation.
- Identify the early interaction between embryonic and uterine tissues (cytotrophoblast and syncitiotrophoblast cells, extra-embronic mesoderm).
- Identify the early extra-embryonic membranes (yolk sac, amnion and the chorion).
- Identify the changes in membrane size and structure during the first trimester.

Villi Development

The functional exchange unit of the placenta is the villus (Latin, "shaggy hair", plural, villi). Tertiary villi are the third stage of chorionic villi differentiation, where mesenchyme differentiates into blood vessels and cells, forms arterio-capillary network, fuse with placental vessels that developed in connecting stalk.

- Identify the specific steps in villi development (primary, secondary, tertiary)
- Observe the histology of villi development during the first trimester.
- Observe the histology of villi development at term.

Maternal Decidua

Decidualization is the process of endometrial stromal cells (fibroblast-like) changing in shape (polygonal cells) and function (protein expression and secretion). This process commences at the site of implantation and gradually spreads throughout the entire uterine lining.

- Identify the histological changes to the endometrium transforming into maternal decidua.
- Identify the different decidual regions (decidua basalis or decidua, decidua capsularis, decidua parietalis).
- Identify the changes in uterine vascularisation.

Placental Functions

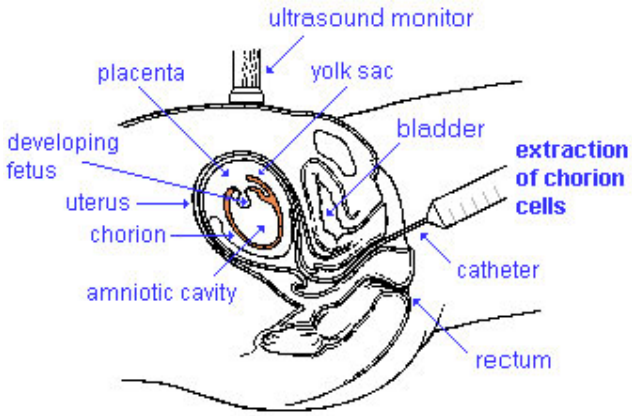
The placenta has functions in addition to the transport and exchange of nutrients and oxygen/carbon dioxide. These additional functions include metabolism (synthesizes glycogen, cholesterol, fatty acids) and endocrine (chorionic hormones and steroid metabolism). Trophoblast cells are the major source of placental hormones.

- Use the provided models and anatomical specimens to observe the features of placental growth.
- Observe the fixed anatomical specimen of the term placenta.
- Identify the maternal and fetal sides features and the placental cord.
- Identify changes in the placental cord structure that occur at birth (histology of the cord).

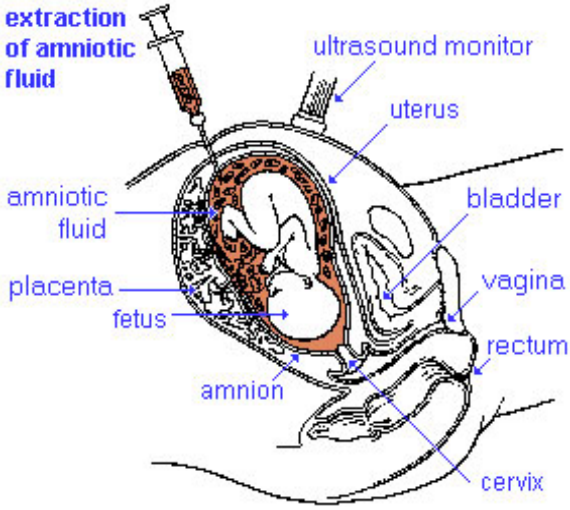
Diagnostic Techniques

Non-invasive and invasive techniques are used as tools mainly for prenatal genetic analysis. The non-invasive include **ultrasound,** for placenta position, structure and cord vessel number and blood flow. The invasive techniques include **chorionic villus sampling** (CVS), **amniocentesis** and **cord blood sampling**. Chorionic Villus Sampling test is done in the 10th to 12th week after the first day of the mother's last menstrual period (LMP). Amniocentesis is a prenatal diagnostic test carried out mainly between 14th to 18th week (GA) of pregnancy.

- Understand the diagnostic tools associated with the placenta and fetal membranes.
- Understand the purpose and risks associated with each placental or fetal membrane procedure.
- Understand the normal placental (umbilical) cord vessel structure (two placental arteries and one large placental vein).
- Consider the uses of cord blood cells (cord stem cells).



Chorionic villus sampling (CVS)



Amniocentesis

Abnormalities

Placental abnormalities can range from anatomical associated with degree or site of implantation, the structure (shape, twinning), to placental function, placento-maternal effects (pre-eclampsia, fetal erythroblastosis) and finally mechanical abnormalities associated with the placental (umbilical) cord.

- Identify the abnormalities of placenta location (tubal pregnancy, placenta previa, vasa previa).
- Identify the abnormalities of placenta implantation (accreta, increta, percreta).
- Identify the abnormalities of placenta formation (hydatidiform mole, diabetic placenta).
- Identify abnormalities associated with the placental cord (vessel number, length, knotting).

Notes

1. All events that occur in placental development cannot be covered in depth in today's class.
2. All practical material is available online and content is permanently available through the web, as are additional resources.
3. Some of the earlier events were introduced in early (Practical 3) and embryonic (Practical 7) practicals and will be revised only briefly.
4. There are many new terms introduced in the class. Either write down, or Cut n Paste into electronic documents, the terms and their definitions using the linked glossary (A-Z found at the bottom of each page) or the search window.
5. All timings are only approximate and refer to embryonic days from fertilization not clinical days from Last Menstrual Period (LMP).
6. Consider the other maternal changes (not covered in this class) that also occur during the entire pregnancy.