Chapter 4

The Placenta

Originating from the trophoblastic layer of the fertilised ovum, the placenta links closely with the mother's circulation to carry out functions that the fetus is unable to perform for itself during intrauterine life. The survival of the fetus depends upon the placenta's integrity and efficiency.

Development

Initially, the ovum appears to be covered with a fine, downy hair, which consists of the projections from the trophoblastic layer. These proliferate and branch from about 3 weeks after fertilisation, forming the *chorionic villi*. The villi become most profuse in the area where the blood supply is richest — that is, in the basal decidua.

- This part of the trophoblast is known as the *chorion frondosum* and it will eventually develop into the placenta.
- The villi under the capsular decidua, being less well nourished, gradually degenerate and form the *chorion laeve*, which is the origin of the chorionic membrane.

The villi erode the walls of maternal blood vessels as they penetrate the decidua, opening them up to form a lake of maternal blood in which they float. The maternal blood circulates slowly, enabling the villi to absorb food and oxygen and excrete waste. Each chorionic villus is a branching structure arising from one stem (Fig. 4.1). The placenta is completely formed and functioning from 10 weeks after fertilisation.

Circulation through the placenta

- Fetal blood, low in oxygen, is pumped by the fetal heart towards the placenta along the umbilical arteries and transported along their branches to the capillaries of the chorionic villi.
- Having yielded up carbon dioxide and absorbed oxygen, the blood is returned to the fetus via the umbilical vein.
- The maternal blood is delivered to the placental bed in the decidua by spiral arteries and flows into the blood spaces surrounding the villi. It is thought that the direction of flow is similar to a fountain; the blood passes upwards and bathes the villus as it circulates around it and drains back into a branch of the uterine vein.

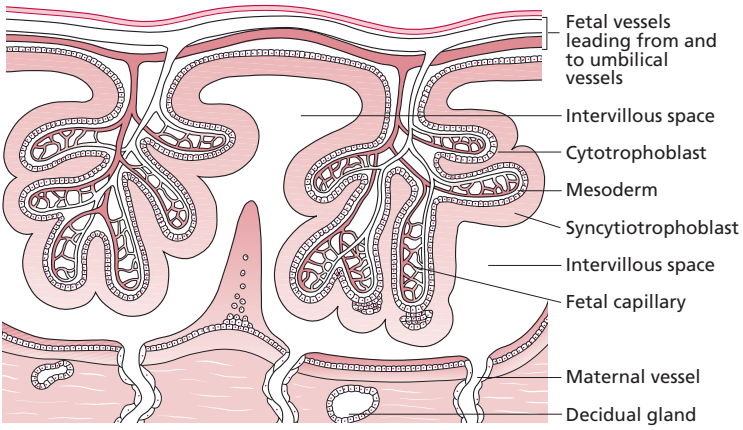

Fig. 4.1: Chorionic villi.

It is impossible for the maternal and fetal circulations to mix unless any villi are damaged.

The Mature Placenta

Functions

The 'Green B' mnemonic (Box 4.1) can be helpful.

Appearance of the placenta at term

The placenta is a round, flat mass about 20 cm in diameter and 2.5 cm thick at its centre.

- *The maternal surface*. Maternal blood gives this surface a dark red colour and part of the basal decidua will have been separated with it. The surface is arranged in about 20 lobes, which are separated by sulci. The lobes are made up of lobules, each of which contains a single villus with its branches.

Box 4.1 Functions of the mature placenta

- Glycogen storage plus iron and fat-soluble vitamins
- Respiration
- Excretion
- Endocrine:

  Human chorionic gonadotrophin (HCG) — is produced by the cytotrophoblastic layer of the chorionic villi

  Oestrogens — as the activity of the corpus luteum declines, the placenta takes over the production of oestrogens

  Progesterone — is made in the syncytial layer of the placenta

  Human placental lactogen (HPL) — has a role in glucose metabolism in pregnancy
- Nutrition
- Barrier to some but not all infections.

- *The fetal surface*. The amnion covering the fetal surface of the placenta gives it a white, shiny appearance. Branches of the umbilical vein and arteries are visible, spreading out from the insertion of the umbilical cord, which is normally in the centre. The amnion can be peeled off the surface, leaving the chorionic plate from which the placenta has developed and which is continuous with the chorion.
- *The fetal sac*. The fetal sac consists of a double membrane. The outer membrane is the chorion; this is a thick, opaque, friable membrane. The inner, smooth, tough, translucent membrane is the amnion, which contains the amniotic fluid.

Amniotic Fluid

Functions

These are listed in Box 4.2.

Volume

- The total amount of amniotic fluid increases throughout pregnancy until 38 weeks' gestation, when there is about 1 litre.

Box 4.2 Functions of the amniotic fluid

- Distends the amniotic sac and allows for the growth and movement of the fetus
- Equalises pressure and protects the fetus from jarring and injury
- Maintains a constant temperature for the fetus
- Provides small amounts of nutrients
- Protects the placenta and umbilical cord from the pressure of uterine contractions in labour, as long as the membranes remain intact, Also aids effacement of the cervix and dilatation of the uterine os, particularly where the presenting part is poorly applied

- It then diminishes slightly until term, when approximately 800 ml remains.
- If the total amount exceeds 1500 ml, the condition is known as *polyhydramnios*.
- If there is less than 300 ml, the term *oligohydramnios* is applied.

Constituents

Amniotic fluid is a clear, pale, straw-coloured fluid consisting of 99% water. The remaining 1% is dissolved solid matter, including food substances and waste products. In addition, the fetus sheds skin cells, vernix caseosa and lanugo into the fluid. Abnormal constituents of the liquor, such as meconium in the case of fetal distress, may give valuable diagnostic information about the condition of the fetus.

The Umbilical Cord

The umbilical cord extends from the fetus to the placenta and transmits the umbilical blood vessels: two arteries and one vein. These are enclosed and protected by *Wharton's jelly*. The whole cord is covered in a layer of amnion continuous with that covering the placenta. The length of the average cord is about 50 cm.

True knots should be noted on examination of the cord, but they must be distinguished from false knots, which are lumps of Wharton's jelly on the side of the cord and are not significant.

Anatomical Variations of the Placenta and the Cord

These are listed in Box 4.3. Except for the dangers noted, these varieties of conformation have no clinical significance.

See chapter 19 for inspection after birth.

Box 4.3 Anatomical variations of the placenta and the cord

Succenturiate lobe of placenta

- A small extra lobe is present, separate from the main placenta but joined to it by blood vessels that run through the membranes to reach it
- A hole in the membranes with vessels running to it is likely to indicate a retained lobe

Circumvallate placenta

- An opaque ring is seen on the fetal surface of the placenta
- It is formed by a doubling back of the chorion and amnion and may result in the membranes leaving the placenta nearer the centre instead of at the edge as is usual

Battledore insertion of the cord

- The cord is attached at the very edge of the placenta in the manner of a table-tennis bat

Velamentous insertion of the cord

- The cord is inserted into the membranes some distance from the edge of the placenta
- The umbilical vessels run through the membranes from the cord to the placenta
- If the placenta is normally situated, no harm will result to the fetus, but the cord is likely to become detached upon applying traction during active management of the third stage of labour
- If the placenta is low lying, the vessels may pass across the uterine os. The term applied to the vessels lying in this position is vasa praevia. In this case there is great danger to the fetus when the membranes rupture and even more so during artificial rupture, as the vessels may be torn, leading to rapid exsanguination of the fetus

Bipartite placenta

- Two complete and separate parts are present, each with a cord leaving it
- The bipartite cord joins a short distance from the two parts of the placenta

Tripartite placenta

- This is similar to bipartite, but with three distinct parts