Review article

Placental morphology and anemic pregnancy: morphology of Placenta significantly changes in anemic pregnancy

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Abstract :
Placenta is the vital organ for the maintenance of a normal pregnancy. Fetal growth and well-being depend on the functional and structural component of the placenta because Placenta is the home for this spirit! soul for nine months. Anaemia in pregnancy is common and one of the risk factor in pregnancy . Foetal hypoxaemia develops consequent to maternal anaemia and stimulates placental growth. In anaemia, significant changes are occurring in gross morphological structure of the placenta. The ability of the fetus to grow and prosper in uterus is presumed to be a function of the placental surface area available for the exchange of respiratory gases and nutrients. So, ultimately anaemia has a great impact on health of fetus as well as mother.

By the application of proper knowledge about morphological changes of placenta in anaemic pregnancy, both the maternal and fetal well being can be maintained.

Keywords : maternal anaemia, gross morphology of placenta,.

Introduction

Pregnancy is a healthy and welcoming process and children are God's blessing to a couple as well as to that family. Bangladesh is a developing country. Anaemia is one of the most common risk factors in the area of obstetrics and perinatal medicine. Anaemia in pregnancy is associated with an increased incidence of both maternal and fetal morbidity and mortality 87% of women have nutritional anaemia in pregnancy due to iron deficiency Maternal mortality due to anaemia in Bangladesh was 4% in1991[1]

Most of the female in child bearing age have mild to moderate degree of anaemia due to nutritional deficiency According to WHO, a level of Haemoglobin below 11 gm/dl during pregnancy is an indication of anaemia. But in South Asia, anaemia is diagnosed when the lowest antenatal haemoglobin is <lOg/d[2]. Placenta is an organ that is essential to the survival of the fetus of the mammals. Placental hypertrophy associated with maternal anaemia, which is probably a compensatory physiological response to ensure adequate oxygen supply to the fetus[3] Maternal anaemia causes the development of a big placenta[4].

It undergoes continuously throughout gestation a morphological changes such as in weight, structure, shape, and function in order to support prenatal life[6]. Babies born with a disproportionately large placenta are at greater rick for hypertension in later life[5]. Examination of the placenta can yield information that may be important in the immediate and later management of mother and infants. A one minute examination of the placenta performed in the delivery room provides information that may be important to the case of both mother and infant.

Anatomical and physiological background of placenta :

Placenta [plusen´tu] Pronunciation Key or **afterbirth**, organ that develops in the uterus during pregnancy. Placenta may be defined as any intimate apposition or fusion of fetal organs to maternal tissues for the purpose of physiological exchange[5]. It is an unique characteristic

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of the higher (orplacental) mammals.

The human placenta is a discoid, deciduate, haemochorial chorioallantoic placenta (DeCherney 2003) due to maternal blood comes into direct contract with the foetal trophoblast.

Placenta at term, an average volume of some 500 ml (range 200 - 950 ml), average weight about 500g (range 200-800 g), average diameter 18.5 cm (range 15.0-20.0 cm), average thickness 2.3cm (range 1.0-4.0 cm) and an average surface area of about 300 cm^2. Thickest at its centre (the original embryonic pole) it rapidly diminishes in thickness towards its periphery where it continues as the chorion leave[6].

Macroscopically, its foetal or inner surface, covered by amnion, is smooth, shiny and transparent and the mottled appearance of the subjacent chorion. The umbilical cord is attached near the center of the foetal surface, and branches of the umbilical vessels radiate out under the amnion from this point, the veins being deeper and larger than the arteries. Variations in this arrangement are possible - sometimes the umbilical cord is attached to the edge of the placenta or even to the membranes beyond the margin of the Placenta - but these differences appear to have little effect on normal function. Maternal surface is rough and spongy. Maternal blood gives it a dull red color (Dutta, 2003). The maternal surface is finely granular and mapped into some 15-30 lobes by series of fissures or grooves. The lobes are often somewhat loosely termed cotyledons and the grooves correspond to the bases of incomplete placental septa. The Maternal portion of the placenta amounts to less than one fifth of the total placenta. Only the decidua basalis and the blood in the intervillous space are of maternal origin[7].

Placental circulation

Placental circulation consists of independent circulation of blood in two systems :

- Utero-placental circulation
- Feto-placental circulation

Uteroplacental Circulation

(Maternal circulation):

It concerns with the circulation of maternal blood through the intervillous space. A villi system and 150 ml lying in the intervillous space. As the intervillous blood flow at term is estimated to be 500-600 ml per minute, the blood in the intervillous space is completely replaced about 3 to 4 times per minute. The villi depend on the maternal blood for their nutrition, thus it is possible for the chorionic villi to survive for a varying period even after the fetus is dead. The pressure within the intervillous space is about 10 to 15 mm Hg during uterine relaxation and 30-50 mm Hg during uterine contraction. In contrast, the fetal capillary pressure in the villi is 20-40 mm Hg[8].

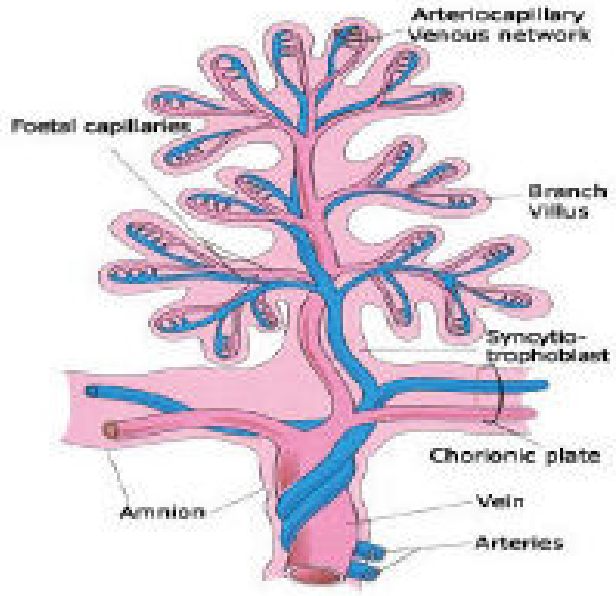

Fig-1 : Foetal Circulation through placenta (from Collins, 2005)

Feto-placental circulation

The two umbilical arteries carry the impure blood from the fetus. They enter the chorionic plate underneath the amnion, each supplying one half of the Placenta. The arteries break up into small branches, which enter the stems of the chorionic villi. Each in turn divides into primary, secondary and tertiary vessels of the corresponding villi. The blood flows into the corresponding venous channels either through the terminal capillary networks or through the shunts (Fig. 01). Maternal and fetal blood streams flow side by side, but in opposite direction. This counter current flow facilities maternal exchange between the mother and fetus. The villus capillary pressure varies from 20-40 mm Hg. The fetal blood flow through the placenta is about 400 ml per minute. This is mainly facilitated by the pumping action of the fetal heart[8].

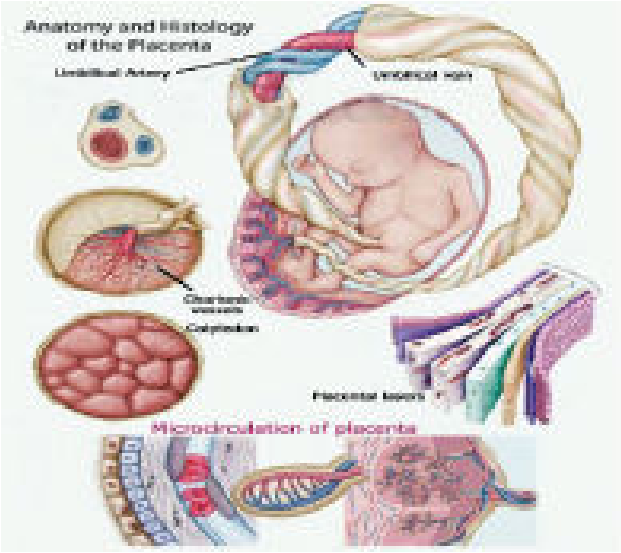

Fig-2 : Showing the gross morphology and histology of placenta (from science-art.com)

Structure of the placenta

Placental tissues are arranged as chorionic plate, basal plate and, between the two villus stem, their branches and the intervillous space.

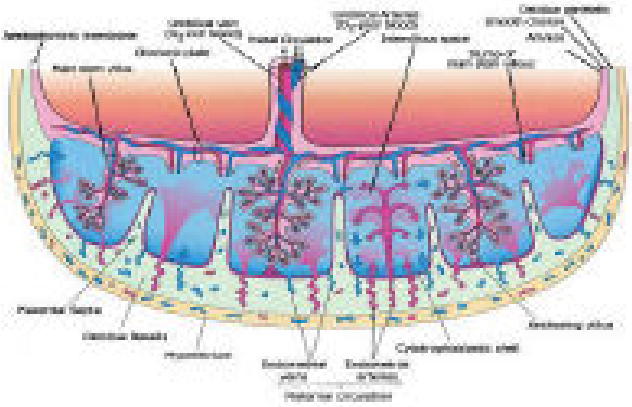

Fig-3 : Photograph of fine dissection of placenta showing the vascular pattern of chorionic vessels

Development of the placenta

The placenta has two parts, develop from two different individual. Chorionic frondosum froms fetal part and decidua basalis froms maternal part.

Placental barrier

In spite of close proximity, there is no mixing of the maternal and fetal blood. The two are separated by tissues called placental membrane or barrier. In early pregnancy, it consists of :

(1) syncytiotrophoblast

(2) cytotrophoblast

(3) basement membrane

(4) stromal tissue and

(5) endothelium of the fetal capillary wall with its basement membrane.

The endothelium is about 0.025 mm thick. Near term, there is attenuation of the syncytial layer.

Physiology of Placenta.

The placenta is attached to the uterus, and the fetus is connected to the placenta by the umbilical cord. The placenta draws nourishment and oxygen, which it supplies to the fetus, from the maternal circulation. In turn, the placenta receives the wastes of fetal metabolism and discharges them into the maternal circulation for disposal. It also acts as an endocrine gland, producing estrogen, progesterone, and gonadotrophin.

Shortly after delivery of the fetus the placenta is forced out by contractions of the uterus. Severe hemorrhage may occur if the placenta does not emerge in its entirety or if the uterus fails to contract properly.

It could be said that the placenta puts a little 'PEP' into the baby's life by being involved in production, exchanges, and protection[9].

Pathophysiology

The architecture of the placenta has been claimed to be changed in maternal diseases like anaemia[2,11,13,] hypertension,[12.13] & eclampsia[10]. Although to some extent these changes may be compensatory responses.

Role of Hb= O_2 transport from lungs to tissues, decrease, causes tissue hypoxia, responsibl e for all manifestations of anaemia [Dora Mbanya].

The placental weight higher in the iron deficiency group compared with control group.Thangaleeta, et al. in 1994 Teasdale, 1980 studied with 17 placentas between mid-gestation to term in only normal pregnancy. He observed that two stages are clearly discernible in the development of the human placenta. The first stage of growth, which terminates at approximately 36 weeks of gestation, is characterized by a progressive increase in parenchymal components. The second stage, which extends from around 35 weeks to term, is called the maturation stage because it is characterized by

substantial fetal growth but without any increase in placental functional tissues.

In 2006, Baumann et al. observed hypoxia in any condition such as anaemia causes reduced birth weight due to reduced blood flow and oxygen delivery. Placental weight was higher in anaemic group as compared to the controls[4]. They observed that there was a significant difference in both the placental weight and placental diameter among the different groups and grossly calcification were more in anaemic group.

Anaemia and pregnancy:

Anaemia is one of the most common risk factors in the area of obstetrics and perinatal medicine. Anaemia in pregnancy is associated with an increased incidence of both maternal and fetal morbidity and mortality[11].

About 87% of women have nutritional anaemia in pregnancy due to iron deficiency (ICMR Bull 2000). According to WHO, a level of Haemoglobin below 11 gm/dl during pregnancy is an indication of anaemia. But in South Asia, anaemia is diagnosed when the lowest antenatal haemoglobin is <10g/dl[14]

In Global Perspective iron deficiency is the most common nutrient deficiency in the world, and the most common cause of anaemia in pregnancy linked to reduced iron reserves, which may exist prior to conception. It is estimated that 60 million pregnant women worldwide are anaemic; of these, some 4 million live in industrialized countries. The prevalence of iron deficiency anaemia in pregnancy varies among countries[11]. A half of all pregnant women about 50% to 59% in Bangladesh are Anaemic[12]. In general, it is low during the first trimester and increases during the second trimester. About 50% of iron deficiency anaemia occurs after the 25th gestational week[8].

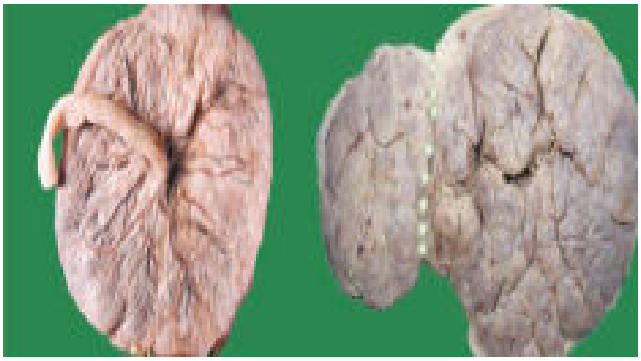

Fig-4 : Irregular type of placenta in anaemic group

Foetal iron metabolism is completely dependent on maternal iron delivery and iron transport from the mother to fetus across the placenta. Placental transferring receptors play a key role in binding circulating transferrin, which releases incorporated iron on the placental side[6]. Iron enhances placental superoxide dismutase activity, which scavenges superoxide radicals and protects the foetus from their deleterious effects.There is a U-shaped relationship between maternal haemoglobin and birth weight i.e. haemoglobin levels above 11.0 g/dL and below 9.0 g/dL show a 2-3 fold increase in the risk of delivering a low birth weight infant[8].

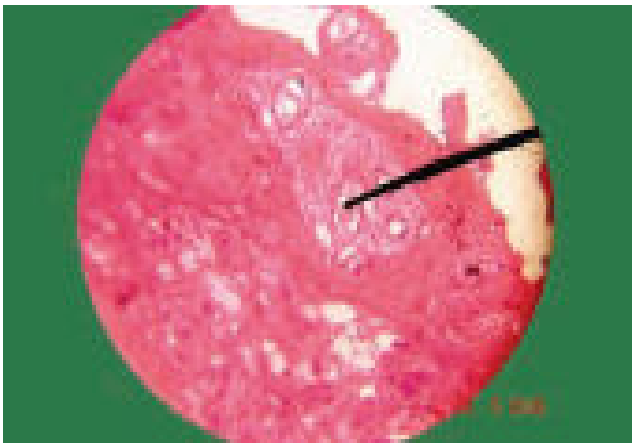

Fig-5 : Photomicrograph indicates Haemolysis of foetal capilliary of moderate anaemic group (x40 objective H & E stain)

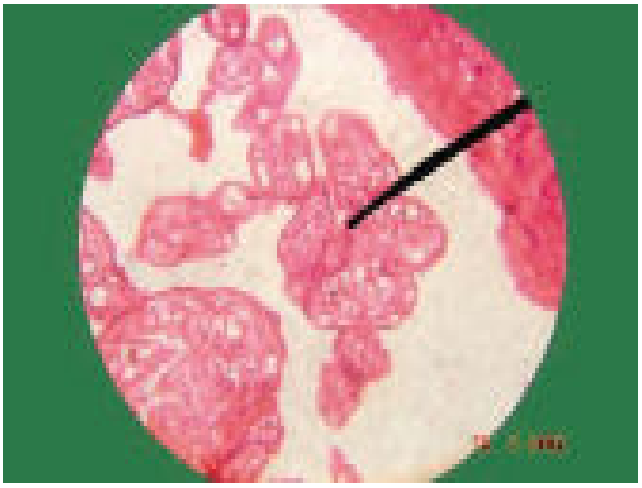

Fig-6 : Photomicrograph of placenta of moderate group of anaemia showing infraction marked by indicator (H & E x 40 objectives).

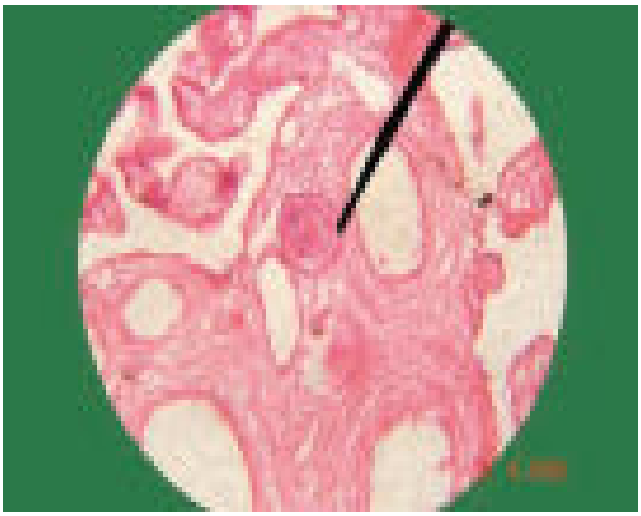

Fig-7 : Photomicrograph of placenta showing the intervillous thrombus (marked by indicator) H & E x 40 objective

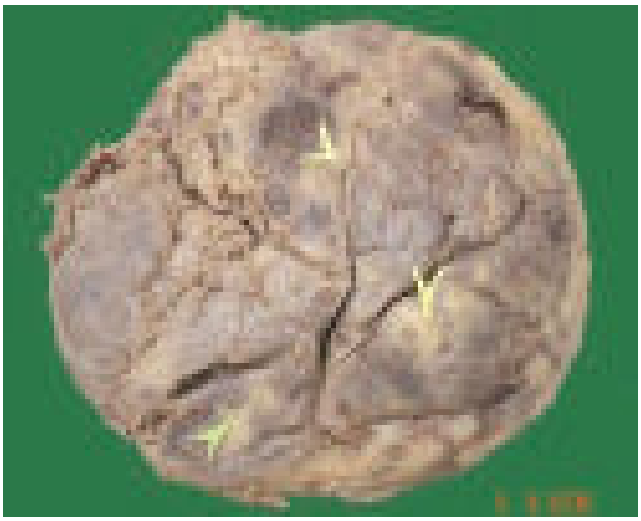

Fig-8 : Photograph of placenta showing diffused infarction on maternal surface marked by Arrow Sign

Placental hypertrophy associated with maternal anaemia, which is probably a compensatory physiological response to ensure adequate oxygen supply to the fetus[2]. Thagaleeta et al. observed a significant difference in diameter among different groups[13]. The highest diameter was 18.80 cm in moderate anaemia Placental weight & thickness has been taken as an indicator of placental function1. Increases in placental weight in case of maternal anaemia have therefore frequently been interpreted as evidence of compensatory hypertrophy for reduced oxygen supply. Braumafln 1993 observed that in hypoxic condition like anaemia, thickened placenta causes reduced birth weight due to blood flow and oxygen supply is happened in oedematous thickened placenta[11].

Placental weight has been taken as an indicator of placental function. Increases in placental weight in case of maternal anaemia have therefore frequently been interpreted as evidence of compensatory hypertrophy for reduced oxygen supply.

Some studies[4,5,13] observed that the maternal anaemia was associated with placental hypertrophy. Lao and Wong[3] observed that placental weight was higher in anaemic group.

Conclusion

It should be emphasized that the placenta is a tool that is easily and non-invasibly available for gross morphological and histological study. These characteristics of the organ are unique and the future researcher may make the best used of it for identifying how much changes occur in syncytial knot, vasculosyncytial membrane of placenta in anaemic mothers. Immunocyto chemistry against transferring receptor using a monoclonal anti-body may be performed in a paraffin-embedded block section for determining the functional condition of the peripheral villi. Again, using the perfused placenta cotyledon preparation may be done to understand the controlling factor of vascular tone in foeto placental circulation in hypoaxic condition. Grossly placental chorionic plate growth may be measured using computerized imaging technique.

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