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Morphological Examination of the Placenta in Multiple Pregnancies Depending on the Type of Placentation

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Abstract. The morphology of the placenta is very important in both singleton and multiple pregnancies. Determination of chorionicity, amniogenicity and identification of placental anomalies are key issues for the adequate management of multiple pregnancies. Placentas in dichorionic pregnancies were characterized by a higher incidence of maternal vascular lesions, whereas in monochorionic twins, the incidence of fetal vascular malperfusion and anomaly of umbilical cord attachment is high. Our analysis showed the percentage of occurrence of membrane attachment in monochorionic twins was 20.6%, and in dichorionic twins it was 10.2%. This results in unequal distribution of placental territory, which in turn can cause fetal growth discordance. Examination of the placenta after delivery can help evaluate the presence of placental and umbilical cord abnormalities, as well as provide with an information about chorion and imagination potential disease mechanisms affecting twin pregnancies.

Keywords: Dichorionic, monochorionic, pathology of the placenta and umbilical cord, twin pregnancy

Introduction.

Multiple pregnancies are under a risk structural abnormalities of the placenta. Some placental and umbilical cord abnormalities which can be founded in multiple pregnancies are nonspecific and may be found in singleton pregnancies. Other anomalies are unique for multiple pregnancy and are mainly related to the type of placentation [1,2]. Early diagnosis is important when managing a twin pregnancy. Determination of chorionicity, amniogenicity and identification of placental anomalies are key issues for the management of multiple pregnancies [3,4].

Multiple pregnancies are associated with a higher incidence of perinatal risks for both mother and fetus compared with singleton pregnancies. Often complications are associated with damage to the placenta or umbilical cord. However, placental pathology and umbilical cord insertion pathology are more common after ART than in spontaneous pregnancies, suggesting that the incidence of placental and umbilical cord abnormalities may be influenced by method of conception [5,6,7]. Abnormalities in the development, position, and vasculature of the placenta and umbilical cord can significantly influence perinatal morbidity and mortality. To better understand the pathogenesis, it is important to confirm the prenatal diagnosis by detailed histopathological examination of the placenta at birth. Early determination of chorionicity and amniogenicity is necessary to optimize treatment tactics for multiple pregnancies. Recently, there have been increasing attempts to standardize the approach to examining the placenta and classifying lesions in multiple pregnancies [8,9].

The aim of our study is to make a morphometric, morphological assessment of the monochorionic and dichorionic placenta.

Materials and methods of study.

The examination of the placenta included inspection, weighing, measurement of length, width and thickness. During the examination, attention was paid to the shape of the placenta, the relationship of the placental discs (common placenta, united placenta, separate placentas) and the color of the fetal and maternal surfaces. Also examined pathological changes in the fetal and maternal surface (petrification, fibrous degeneration, fatty degeneration, white infarctions, the presence of detachment areas, tumors), on the number of membranes. Planimetric studies were carried out - weight, width, length and thickness of the placentas. There was estimated attachment place of the umbrical cord.

The umbilical cord insertion site was divided into three groups: marginal (edge), valementos cord insertion (VCI), and normal. Placentas were divided based on the presence of an abnormal umbilical cord attachment (marginal or valementos).

Histopathological examination of the placenta was carried out according to a standard protocol. Placentas from the dichorionic diamniotic (DCDA) group were analyzed separately (2 placentas from each pregnancy). Placental lesions were classified according to criteria adopted by the Society of Pathologists. From each placenta, 6 tissue samples were placed in paraffin blocks for microscopic evaluation.

Results

After spontaneous or operative delivery, we examined monochorionic and dichorionic types of placenta to confirm the type of chorionicity, amnioticity and to identify pathology of the placenta and umbilical cord. Two groups were formed depending on the type of placentation: 1 group with dichorionic diamniotic (DCDA) type of placentation, 2 group with monochorionic diamniotic (MCDA) type of placentation.

We were interested in the question of whether there is a difference in the weight of the placentas. It turned out that the average weight of monochorionic (MC) placentas is 680±30, dichorionic (DC) 710±20 ($P>0.05$). The average weight of placentas during multiple pregnancy did not depend on their structure and the number of membranes.

After birth, the placenta was assessed taking into account the type of chorionicity and marginal, tunicated and normal umbilical cord attachment was identified. The incidence of abnormal cord insertion was higher in monochorionic versus dichorionic multiple pregnancies. Marginal umbilical cord attachment was recorded in 31.5% with MC and 35.7% with DC placenta, while velamentous cord attachment was observed in 21.1% and 10.7%, respectively (Table 1).

Table 1.

Macroscopic examination of placentas of multiple pregnancies

Features of the placenta	1 group (n=28)	2 group (n=19)	P
Mass	710±20gr	680±30gr	>0,05
Diameter	23±1sm	20±1sm	<0,05
Placenta-fetal ratio (PFR)	0,14±0,005	0,17±0,005	<0,05
Examinations of the umbilical system			
Length	67±1,2sm	65±1,3sm	>0,05
Attachment place			
Central	15 (53,6±9,6%)	9 (47,3±11,8%)	>0,05
Marginal	10 (35,7±9,2%)	6 (31,5±10,9%)	>0,05
Valementos cord insertion	3 (10,7±5,9%)	4 (21,1±9,6%)	>0,05
Pathological focus: false and true nodes	4 (14,3±6,7%)	3 (15,8±8,6%)	>0,05
Pathological focus: varicose	5 (17,8±7,4%)	5 (26,3±10,4%)	>0,05
Examination of fetal membranes: color and transparency			
Serous-pink color	10 (35,7±9,2%)	7 (36,8±11,4%)	>0,05
Green-brown	9 (32,1±9,0%)	4 (21,1±9,6%)	>0,05
Semi transparent	5 (17,9±7,4%)	5 (26,3±10,4%)	>0,05
Opaque, cloudy (varenogo vida)	4 (14,3±6,7%)	6 (15,8±8,6%)	>0,05
Villus part inspection			
Pathological focus: hemorrhages	8 (28,6±8,7%)	8 (42,1±11,6%)	>0,05
Pathological focus: calcinates	9 (32,1±9,0%)	4 (21,1±9,6%)	>0,05
Pathological focus: defects	5 (17,9±7,4%)	3 (15,8±8,6%)	>0,05

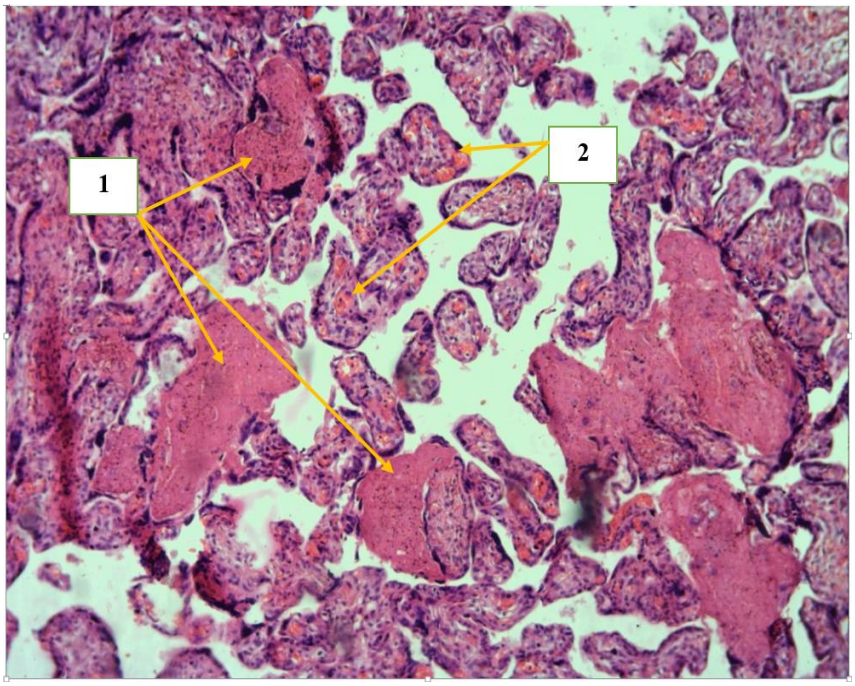
Retroplacental hemorrhages (28.5% versus 10.5%) and concomitant maternal vascular lesions (39.3% versus 21.1%) were more common in the placentas of the DC group compared to the MC group. On the other hand, fetal vascular lesions were more common in placentas from the MC group compared with the DC group (26.3% and 17.8%, respectively). The incidence of inflammatory lesions did not differ between groups.

Macroscopic examination of the placenta and umbilical system revealed more visible changes than the placentas of the control group. However, histological examination of the fetal membranes showed that the comparison group showed clear signs of an inflammatory nature, such as greenish-brown, boiled and dull. In addition, the presence of hemorrhages, calcifications and defects in the villi of the placenta was seen.

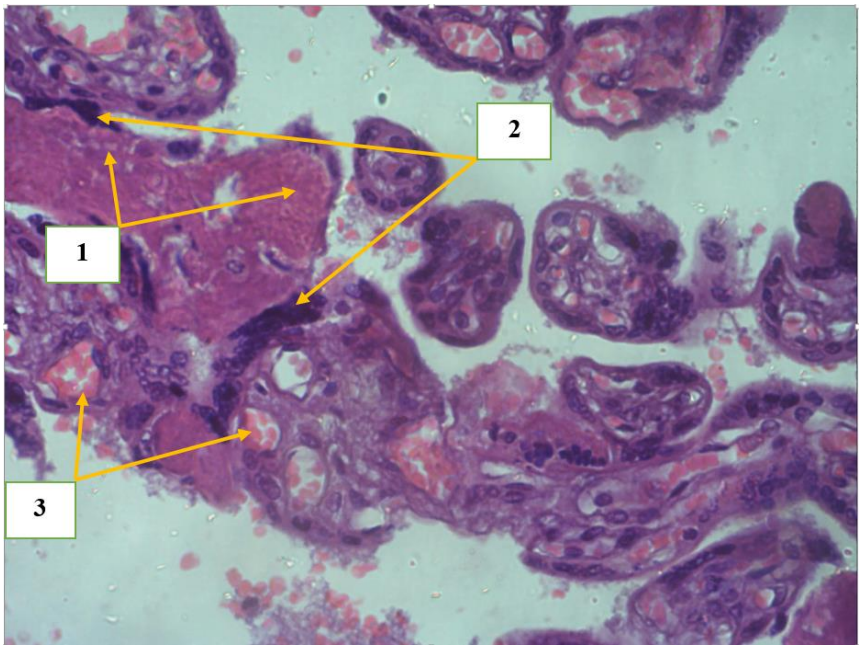
Structural and functional disorders of the placental microcirculation, which are the result of changes in the hemostasis system, later lead to impaired growth and development of the fetus

and lead to immunological mechanisms that damage the placental structures. In the study of the placenta, pathological foci were found in the monochorial placenta: chronic fullness in 42.1%, calcinations in 21.1%, fibrinoid foci and placental defect in 15.8%. In the bichorial type, chronic fullness was found in 28% cases, calcinations in 32.1%, and fibrinoid foci in 21.4%. Among the morphological changes, afunctional zones, fibrin and fibrinoid necrosis, hemorrhages, serous-basal deciduits, chorioamnionitis were noted in individual cases, mainly in the (multiple fetus) group. It is worth noting that the greatest changes in the placenta are characteristic of women with multiple pregnancies of the monochorial type. Hypercoagulation syndrome, which is common in this category of women, can lead to an increase in fibrin synthesis in the placenta and its premature aging, an increase in vascular resistance, and a violation of fetoplacental blood flow.

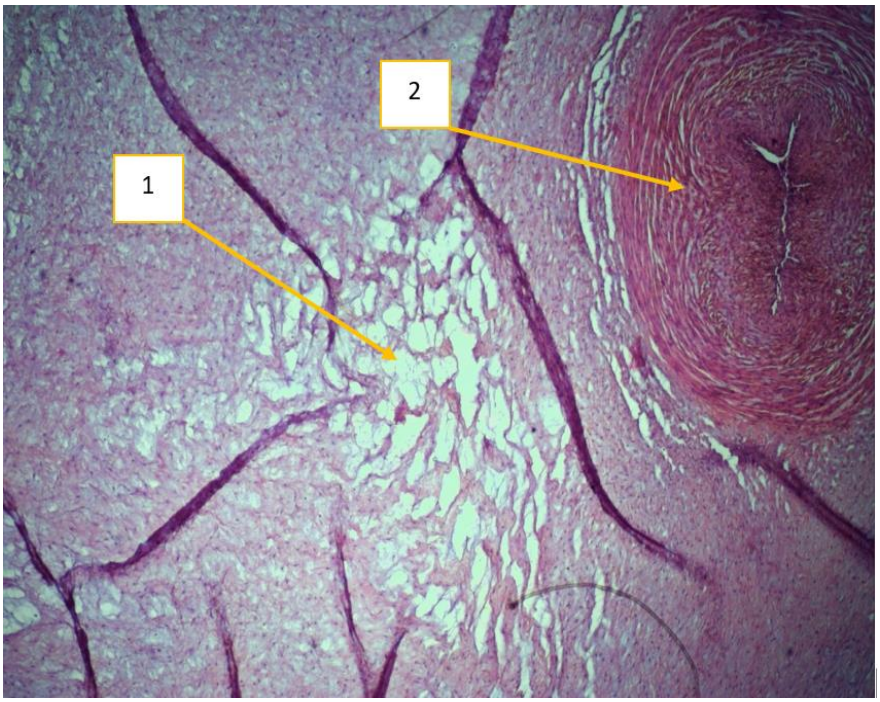
Calcifications and increased fibrin tissue were found in 23 (60%) of control group women's placentas. Interchorionic thrombi were found in all women with multiple pregnancies, and 80% of these thrombi were found in the maternal part of the placenta.



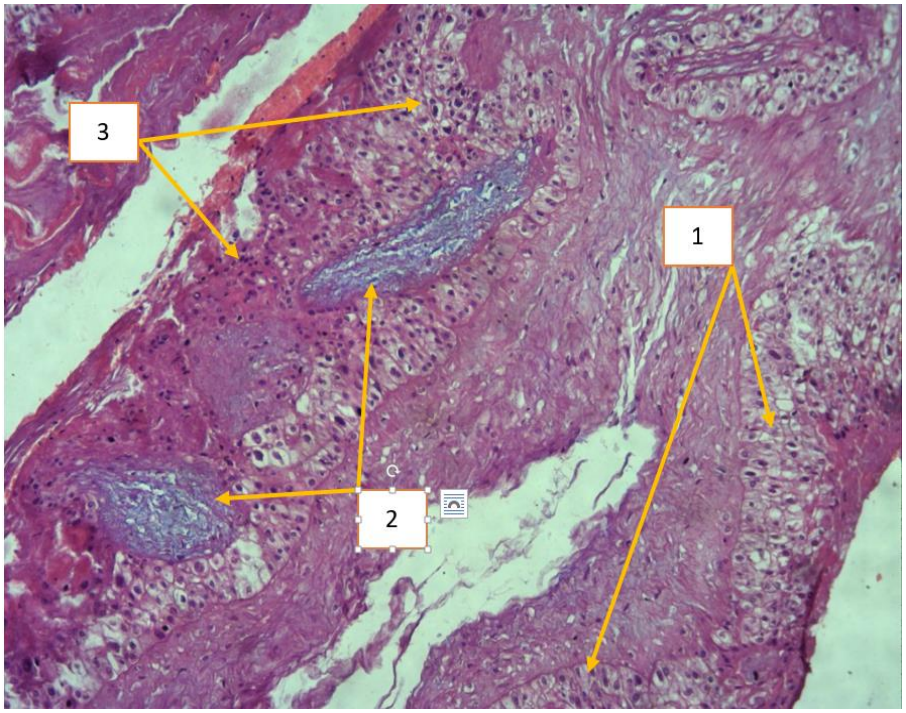
Picture 1. 32-33-week-old placental chorions, focal fibrioid and fibrinoid necrosis (1), an increase in the number of blood vessels in the stroma of some terminal vortices (2) are observed. Color - hematoxylin and eosin. The size is 10x10.



Picture 2. An increase in the number of blood vessels and fullness (3) in the stroma of vorsin chorions, fibrinoid necrosis (1), syncytiotrophoblast (2) and numerous terminal vorsins of the placenta of a 34-35 week pregnant woman are detected.
Color - hematoxylin and eosin. The size is 10x40.



Picture 3. A 35-36 week-old pregnant woman was diagnosed with placental umbilical system, swelling of the umbilical substance (1), umbilical arterial blood vessel spasm (2). Color - hematoxylin and eosin. Cat. 10x40.



Picture 4. A pregnant woman of 37-38 weeks was diagnosed with amniotic membrane, proliferative chorioamnionitis (1), focal fibrinoid (2) and inflammatory infiltrate (3). Color - hematoxylin and eosin. The size is 10x40.

Discussion.

Preterm birth is one of the most serious complications of multiple pregnancies and contributes to morbidity and mortality. In the absence of more specific complications in twins, evaluation of the placenta for these common complications is largely the same as in singletons [10,11].

It should be noted that one of the causes of perinatal complications is umbilical cord pathology. According to a number authors, the incidence of umbilical cord pathology ranges from 15 to 38%, and in 7.7-21.4% of cases it causes asphyxia of the newborn, in 1.7-4.3% - stillbirth, in 1.5- 1.6% - postnatal mortality [12,13]. According to a number of authors, valementos cord insertion attachment is observed in 2% of cases in singleton pregnancies, 7% in dichorionic and 12% in monochorionic twins [14,15, 16]. Our analysis showed the percentage of valementos attachment occurrence in monochorionic twins was 20.6%, and in dichorionic twins it was 10.2%.

Abnormal umbilical cord attachment appears to be associated with impaired development and function of the placenta and thus affects fetal growth. One of the most common complications of multiple pregnancies is discordant fetal growth, associated with delayed development of one of the fetuses. Altered placental development with abnormal umbilical cord attachment may influence the relationship between birth weight and placental weight, but this remains to be confirmed. According to a number authors, a difference in the level of dissociation of more than 20% and 25% is a prognostic factor for perinatal complications with an increased risk of morbidity and mortality [16,17].

The percentage of premature births with varying degrees of discordance in fetal weight had significant differences in groups depending on the type of chorionicity and anomaly of umbilical cord attachment. With discordance >20 and ≤25% and with marginal umbilical cord attachment, the rate of preterm birth was 13.3% in the group with MC, and 11.2% in the group with type DC. And with a discordance of >25% where a valementos attachment of the umbilical cord was detected, the frequency of preterm birth was 16.7% and 8.9%, respectively, which proves the

connection between the degree of fetal discordance and anomalies of umbilical cord attachment and the percentage of preterm birth in the group with the MC type of placentation.

In case of multiple pregnancy, it is necessary to determine the territory of the placenta, since the volume of the placenta is a factor determining the growth of the fetus. Placentas can be divided along the equator of the vessels and weighed separately [18,19]. There are two systems in the placenta: maternal open (intervillous) and fetal closed (intravillous). Blood from these two systems circulates in close contact, being separated by the villous epithelium, villous stroma and endothelium of the villous capillaries. Thus, metabolic exchange takes place between the two systems. Placental vascularization is a necessary element for normal growth and development of the fetus, be it a single or multiple pregnancy. During a macroscopic examination placenta, areas of calcification, infarction, fibrinoid deposits, and vascularization were observed, as in a singleton pregnancy. In twins, areas of placental fusion were identified with the same changes which characterized the third trimester of pregnancy. Larger placental infarcts were associated with hypertensive disorders, fetal growth discordance, and FGR. Studies by a number of authors prove that with an increase in the area of infarctions/fibrin deposits/calcifications, decreased the density of blood vessels, the weight of the placenta, as well as the weight of the fetus, which suggests that these morphopathological changes may have clinical significance for fetuses in both singleton and in multiple pregnancies [20,21, 22].

And so, morphopathological changes (placental infarction, calcifications, fibrin deposits, thrombosis) detected during histapathological examination can affect the vascularization of the placenta, growth and development of the fetus. The presence of these changes leads to a decrease in the number of capillary vessels from the level of placental villi, and due to a decrease in vascularity, the weight of the placenta and, indirectly, the weight of the fetus decreases. In addition, fetal weight in twins depends on the type of chorionicity and complications of pregnancy.

Histopathological lesions of the placenta and neonatal outcome depend on the type of placentation. Placentas during pregnancy with twins DC were characterized by a higher incidence of maternal vascular damage. On the other hand, placentas obtained from MC twins were characterized by a higher incidence of fetal vascular malperfusion and abnormal umbilical cord insertion. Placental-maternal vascular lesions are primarily associated with pregnancies complicated by hypertensive disorders and preeclampsia, suggesting that abnormal placentation with subsequent disruption of the uteroplacental circulation leads to placental vasocular arteriopathy and other placental-maternal vascular malperfusion lesions. In our study, the observation of an increased incidence of maternal vascular lesions during pregnancy with DC twins compared with MC twins is new. Placental-fetal vasocular malperfusion lesions are known to be important factors in adverse pregnancy outcomes, such as fetal growth restriction, intraventricular hemorrhage, neonatal encephalopathy and cerebral palsy. It can be assumed that a higher unfavorable neonatal outcome observed in MC twins compared to DC twins, in the absence of vascular anastomoses, revealed malperfusion lesions of the fetal placenta.

Thus, the frequency of inflammatory processes did not differ between groups. However, the histological examination of maternal and fetal vessel damage revealed differences between monochorial and dichorionic twins during pregnancy. In DC, pregnancy with twins placenta was characterized by a high rate of maternal vascular damage. On the other hand, placentas obtained from MC twins were distinguished by a higher rate of fetal vascular malperfusion, injury, and abnormal location of the umbilical cord. According to these data, it was determined that the increase in adverse neonatal outcomes observed during pregnancy in MC twins is interrelated.

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