

Dopplerometric Features of Blood Flow Changes in the Utero-Placental System in Women With Related Pregnancy Mission

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Abstract: This article discusses the problem of recurrent miscarriage, which is one of the urgent problems in the field of obstetrics and gynecology, and analyzes the problem of its prevention by identifying Doppler markers that predict this pathology in the early stages. To do this, we widely used ultrasound research methods and drew attention to their relationship with the level of disorders in the uteroplacental system.

Relevance. The great medical and social significance of the problem of placental insufficiency in primiparous re-pregnant women lies in the fact that the severe consequences it causes for the mother and child cannot always be prevented in the proper amount using only pharmacological therapy to prevent miscarriage [1,2,5]. That is why, considering the leading mechanisms of the pathogenesis of chronic placental insufficiency, it strongly emphasizes the need to find new medical technologies for the prevention of placental circulation disorders [3,6,7,9]. The antenatal therapeutic measures carried out at the present stage turn out to be ineffective, and often useless, due to their implementation only in the first trimester of pregnancy, against the background of placental insufficiency.

The study of risk factors in physiological pregnancy, their timely treatment and exclusion leads to the normal course of pregnancy [4,8,10]. It is known that the rheological properties of blood are manifested in its dynamics. The manifested hyperfibrinemia and a sharp increase in D-dimer in the blood leads to a deterioration in hemodynamic properties in the uterus-fetus-placenta system. At the same time, an increase in acute inflammation proteins leads to destructive consequences in the placenta and contributes to a change in the structure-functional properties of the placenta, which leads to a decrease in hormone production. To determine these data, we used Doppler ultrasound. The Doppler ultrasound method gives us information about changes in the uterus-placenta and placenta-fetus system, with the help of which complications can be predicted. It is known that, for dynamic observation in order to prevent complications, Doppler monitoring should be carried out. Dopplerometry performed at 4-11 weeks indicates the processes of implantation and the development of the chorion, at 20-24 weeks of pregnancy it shows the state of blood flow in the uterus-placenta and fetus-placenta system, in addition, it can be used to predict possible complications from the mother and fetus, which manifests itself in the form of structural and functional changes in the placenta. Doppler ultrasound at 30-34 weeks provides information about possible premature birth and fetal development. That is why we decided to make a step-by-step study of Doppler indicators depending on the weeks of gestation.

Key words: primiparous re-pregnant, placental insufficiency, therapy, dopplerometry.

Materials and research methods. In order to carry out the tasks set before us in the research, 116 women of reproductive age who had normal miscarriage in their anamnesis were involved. The first group consisted of 30 women whose previous pregnancies were physiological (group I), the next group included 40 women with AAA 4-9 weeks of pregnancy who had observed miscarriage, and the third group included 46 pregnant women of 9-14 weeks of gestation (III- group) entered. Patients included in the study were examined and treated at women's clinics and RShTYoIM BF.

The main criteria for grouping: women with a history of two or more miscarriages before the 14th week of pregnancy, without genetic anomalies or antiphospholipid syndrome (AFS) in the fetus,

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pregnant women without genital infection or endocrine system pathology were included. Informed consent for the study was obtained from all women included in the groups. With the help of questionnaires developed for all women in the study group, the results of which their anamnesis was fully studied were developed mathematically and statistically. Blood coagulation analysis, determination of D-dimer, determination of lipid content, morphological analysis of the placenta and UTT examination were performed in patients. Statistical analysis was carried out using Student's method, Fisher's method, X^2 (Pearson) method, StatGraf and Microsoft Excel software.

Results of the study and their discussion. The primary study is carried out at 4-11 weeks of gestation, because it is in this week of gestation that some complications are possible. At the same time, we studied the blood flow in the right and left uterine arteries. The conducted research showed that hemodynamics changes more in the right uterine artery. See table 1.

Table 1 Doppler parameters of the uterine artery in the first trimester of pregnancy at 4-11 weeks, M±m

Groups	a.uterina dextra			a.uterina dextra		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,70±0,12	0,65±0,03	5,48±0,29	1,78±0,12	0,65±0,03	5,67±0,29
2-nd group n= 40	1,07±0,04 ^a	0,71±0,02	5,22±0,09	1,12±0,04 ^a	0,67±0,01	5,31±0,10
3-rd group n= 46	1,10±0,04 ^a	0,68±0,01	5,11±0,07	1,34±0,06 ^a	0,68±0,01	5,43±0,09

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy ($P < 0.05$); b - reliability of comparative indicators between treated and untreated patients ($P < 0.05$); a significant difference in indicators between the 2nd and 3rd groups ($P < 0.05$).

In all groups, we observed a statistically significant change in the PI index. In addition, in the 2nd and 3rd groups, we observed a statistically significant decrease by 1.54 and 1.59 times. These changes occur according to pregnancy. This means that if, in a prospective analysis of women who were observed and took treatment, it was reduced by 1.45 and 1.56 times, in women who did not receive treatment from early gestation, by 1.67 and 1.68 times, in the group who had a miscarriage reduced by 1.83 and 1.77 times. Other indicators (RI and SDO) did not change statistically significantly. Changes similar to this occur in the left uterine artery and are manifested in the form of clear changes in the PI index, which are declining.

The second series of works was devoted to the prediction of pregnancy complications in the perinatal period based on the study of the echocardiography of the ovum in the first trimester of gestation. Because in the early stages, the embryo is only one of the components of the complex "chorion, manion, yolk sac and umbilical cord".

Upon admission to the hospital, all patients underwent an ultrasound examination of the pelvic organs to determine the gestational age and the state of the embryo. 15.3% of those examined with scanty bloody discharge from the genital tract in the second group and 7.8% in the third group were diagnosed with retrochorial, parietal hematoma up to 16 ml.

Occurring early hemodynamic changes in the early period of pregnancy lead to hypoxia in the tissues. We did the next Doppler at 11-14 weeks. (See Table 2.)

Table 2 Doppler parameters of the uterine artery in the first trimester of pregnancy at 11-14 weeks, M±m

Groups	a.uterina dextra			a.uterina dextra		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,96±0,05	0,76±0,01	5,32±0,05	1,99±0,04	0,75±0,01	5,29±0,04
2-nd group n= 40	1,33±0,07 ^a	0,71±0,01	5,10±0,05	1,42±0,06 ^{a,b}	0,73±0,01	5,10±0,06
3-rd group n= 46	1,23±0,06 ^a	0,74±0,01	5,14±0,03	1,09±0,04 ^a	0,77±0,01	4,96±0,05

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy ($P < 0.05$); b - reliability of comparative indicators between treated and untreated patients ($P < 0.05$); a significant difference in indicators between the 2nd and 3rd groups ($P < 0.05$).



If in the 1st group all indicators in the right and left uterine arteries increase, then in women who have a risk of miscarriage, there is some lag behind the normative indicators. The PI index in the 2nd and 3rd groups was reduced by 1.59 and 1.47 times. This means that in women with physiological pregnancy in the uterine arteries there is an increase in hemodynamic parameters, and in women with a risk of miscarriage there is some lag. This, in our opinion, means a change in the uteroplacental pool, the intima of blood vessels and dysfunctional changes in the endothelium, which leads to the risk of developing thrombosis of the placental vessels.

Subsequent Doppler ultrasound is performed at 20-23 weeks of pregnancy, because with the development of pregnancy, blood circulation develops in the uterus-placenta system. At the same time, we performed dopplerometry of the uterine arteries but also studied the parameters of blood flow in the placenta-fetus system. During the study, we determined that women of the 2nd and 3rd groups have a statistically significant decrease in PI by 1.25 and 1.44 times compared to the first group. In a prospective analysis of the indicators of the 2nd group, a decrease in two indicators was determined, in women belonging to the 3rd group, this indicator was statistically significantly lower by 2.23 and 1.45 times. A similar change occurs in the left uterine artery. The obtained results of women with the threat of miscarriage in the early period of gestation in the uterine arteries in which hemodynamic changes are observed, which, aggravated over time, lead to feto-placental insufficiency. (See table 3.)

Table 3. Doppler parameters of the uterine artery in the second trimester of pregnancy at 20-23 weeks, M±m

Groups	Right uterus artery			Left uterus artery		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,74±0,04	0,61±0,01	1,88±0,02	1,74±0,03	0,62±0,01	1,91±0,01
2-nd group n= 40	1,21±0,07 ^a	0,50±0,02 ^a	1,84±0,01	1,19±0,07 ^a	0,58±0,02	1,88±0,01
3-rd group n= 46	1,39±0,07 ^a	0,53±0,02	1,85±0,01	1,27±0,07 ^a	0,55±0,02	1,89±0,02

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy ($P < 0.05$); b - reliability of comparative indicators between treated and untreated patients ($P < 0.05$); a significant difference in indicators between the 2nd and 3rd groups ($P < 0.05$).

At a period of 20-23 weeks in the umbilical artery in the Doppler study, a significant statistical decrease in the PI index in the second group by 1.23 times is determined (see Table 4.) ±m

Groups	Right uterus artery			Median artery of the fetal brain		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,44±0,05	0,74±0,01	4,09±0,04	2,13±0,03	0,81±0,004	3,93±0,02
2-nd group n= 40	0,97±0,06	0,74±0,01	4,00±0,10	2,09±0,03	0,82±0,01	3,90±0,02
3-rd group n= 46	1,17±0,05 ^a	0,75±0,01	4,01±0,06	2,04±0,03	0,81±0,002	3,90±0,02

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy ($P < 0.05$); b - reliability of comparative indicators between treated and untreated patients ($P < 0.05$); a significant difference in indicators between the 2nd and 3rd groups ($P < 0.05$).

In the 3rd group, these indicators were reduced by 1.48; 1.44 and 2.03 times. It should be noted that the umbilical artery resistance index did not differ from the normative indicators, the systolic-diastolic ratio was reduced. In the middle cerebral artery of the fetus, the blood flow did not change from the normative values, only the PI index remained reduced in DORS. This means that at this time hemodynamic disturbances occur not only in the uterine but also in the umbilical arteries, in our opinion this can lead to a lack of oxygen and food to the fetus, which contributes to the development of fetal lagging.

We conducted a further study at 24-29 weeks of pregnancy. In this period, some changes occur in the right and left uterine arteries: in the 2nd and 3rd groups, the PI index in the right uterine artery



significantly statistically decreased in relation to physiological parameters by 2.14 and 1.26 times (see table 5).

Table 5. Doppler parameters of the uterine artery in the period of 24-29 weeks, M±m

Groups	Right uterus artery			Median artery of the fetal brain		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,18±0,08	0,56±0,01	1,97±0,05	1,17±0,07	0,56±0,01	2,08±0,09
2-nd group n= 40	0,94±0,06	0,48±0,02	1,82±0,01	1,21±0,04	0,56±0,01	1,83±0,01
3-rd group n= 46	0,55±0,00 ^a	0,34±0,01 ^a	1,73±0,01	0,72±0,02 ^a	0,53±0,02	1,90±0,01

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy (P <0.05); b - reliability of comparative indicators between treated and untreated patients (P <0.05); a significant difference in indicators between the 2nd and 3rd groups (P <0.05).

The resistance index was reduced by 1.59 and 1.17 times. Especially these changes occur in the 3rd group. The systolic-diastolic ratio in the umbilical artery was higher than the standard values (in the 2nd and 3rd groups by 1.23 and 1.32 times), PI and RI indicators are gradually decreasing. (See table 6.)

Table 6. Doppler parameters of the fetoplacental artery at 24-29 weeks, M±m

Groups	Umbilical artery			Fetal aorta			Median artery of the fetal brain		
	PI	RI	SDO	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	0,98±0,02	0,70±0,01	2,96±0,16	2,08±0,03	0,83±0,005	6,50±0,06	1,94±0,06	0,77±0,01	3,08±0,07
2-nd group n= 40	0,80±0,03	0,73±0,01	3,91±0,08 ^a	2,00±0,03	0,86±0,01	6,18±0,10	1,83±0,02	0,75±0,01	3,73±0,05 ^a
3-rd group n= 46	0,93±0,04	0,60±0,003 ^a	3,63±0,05	1,97±0,03	0,83±0,003	5,75±0,10	1,99±0,05	0,74±0,003	3,53±0,05

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy (P <0.05); b - reliability of comparative indicators between treated and untreated patients (P <0.05); a significant difference in indicators between the 2nd and 3rd groups (P <0.05).

Similar changes occur in the fetal aorta and fetal middle cerebral artery, but they were not statistically significant. This means that as the gestational age increases, changes occur not only in the uterine arteries, but also, in a certain sense, in the umbilical and fetal arteries.

A follow-up study was performed at 30-33 weeks of gestation. In this pattern, changes occur in the right and left uterine arteries: in the 2nd and 3rd groups, the PI index in the right uterine artery significantly statistically decreased in relation to physiological parameters by 1.34 and 1.38 times (see Table 7.).

Table 7. Doppler parameters of the uterine artery at 30-33 weeks, M±m

Groups	Right uterus artery			Left uterus artery		
	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	1,41±0,04	0,62±0,01	1,86±0,01	1,40±0,03	0,61±0,01	1,86±0,01
2-nd group n= 40	1,02±0,05	0,52±0,02	1,75±0,02	1,06±0,07 ^a	0,56±0,01	1,60±0,07
3-rd group n= 46	1,05±0,06 ^{aa}	0,55±0,01 ^a	1,74±0,01	1,09±0,05 ^a	0,57±0,01	1,74±0,02

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy (P <0.05); b - reliability of comparative indicators between treated and untreated patients (P <0.05); a significant difference in indicators between the 2nd and 3rd groups (P <0.05).

Decrease in the right uterine artery of these indicators was noted reduced by 1.13 and 1.19 times. These changes were especially pronounced in the group with FGR: the PI and resistance index were reduced in 2.82 and 2.71; the resistance index in the 3rd group was 1.88 lower. Changes similar to these occur in the left uterine artery. See table 8.



Table 8. Doppler parameters of the fetoplacental artery at 30-33 weeks, M±m

Groups	Umbilical artery			Fetal aorta			Median artery of the fetal brain		
	PI	RI	SDO	PI	RI	SDO	PI	RI	SDO
1-st group, n=30	0,87± 0,07	0,72± 0,01	3,22± 0,13	1,97± 0,03	0,83± 0,004	6,53± 0,06	2,12± 0,03	0,73± 0,01	3,18± 0,03
2-nd group n= 40	0,81± 0,04	0,67± 0,02	3,04± 0,10	1,92± 0,02	0,84± 0,01	6,36± 0,08	1,93± 0,03	0,74± 0,01	3,33± 0,03
3-rd group n= 46	0,92± 0,03	0,69± 0,01	2,78± 0,04 ^a	1,90± 0,02	0,84± 0,002	6,34± 0,06	1,96± 0,04	0,73± 0,01	3,36± 0,04

Note: a - the reliability of the studied parameters in patients with physiological and pathological pregnancy ($P < 0.05$); b - reliability of comparative indicators between treated and untreated patients ($P < 0.05$); a significant difference in indicators between the 2nd and 3rd groups ($P < 0.05$).

In the umbilical artery during these periods in the 2nd and 3rd groups, the systolic-diastolic ratio was reduced, the PI index also decreased. Especially these changes were obvious in the 3rd group. There were no hemodynamic changes in the fetal aorta. In the fetal middle cerebral artery, PI remains low. In the 3rd group of women, this indicator decreased by 1.29 times and was statistically significantly reduced, while in the 2nd group of pregnant women there were no statistically significant changes.

This means that in the third trimester of pregnancy, hemodynamic changes in the uterine arteries persist. Relative changes occur in the umbilical and fetal arteries in women of the examined groups. In women with dysfunction of the feto-placental system, changes occur in the uterine arteries, then in the umbilical and fetal arteries. This, in our opinion, means that there are structural and functional changes in the feto-placental system that lead to premature birth. Reliably based on the analyzes, we assert that 11.9% of pregnant women had preterm birth. The therapeutic and preventive measures taken did not allow correcting hemodynamic changes in the uterus-placenta-fetus system.

Conclusion. Based on the above, the following conclusions can be drawn:

1. Hemodynamic changes that have occurred in the right uterine artery at 4-11 weeks of gestation may cause a risk of recurrent miscarriage. If the fetus is preserved in women of this period, the risk of hemodynamic changes in subsequent gestational periods increases.
2. In the second trimester of pregnancy in the uterine, fetal and middle cerebral arteries, the hemodynamic changes that occurred are especially pronounced in the group of women who are registered for pregnancy at later gestation periods and who do not receive timely treatment aimed at preventing primary placental insufficiency.

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