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Early Signs Of Latent Iron Deficiency During Pregnancy

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Abstract: Latent endothelial dysfunction is a condition in which the endothelial cells lining the vascular wall function inefficiently, which can lead to various pathophysiological disorders in the body. This condition is a significant predictor of anaemia. This study examines the clinical and laboratory aspects of anaemia for the purpose of prevention and treatment in women during pregnancy. Regular medical examinations and blood tests conducted for the early detection of anaemia, especially in the early stages of pregnancy, can ensure timely diagnosis and correction of this condition.

Keywords: Pregnancy, anaemia, latent endothelial dysfunction, endothelin-1, Willebrand factor, thrombomodulin.

Introduction: Anaemia remains one of the most common pathologies among women of reproductive age and pregnant women, representing a significant medical, social and clinical problem in modern healthcare. According to the World Health Organisation, anaemia is diagnosed in 30–50% of pregnant women worldwide, and in countries with developing healthcare systems, its prevalence reaches 60% or more. Despite existing prevention and treatment programmes, the incidence of anaemia and related complications remains consistently high [1,4,7].

In recent years, increasing attention has been paid to the role of endothelial dysfunction as a universal pathogenetic mechanism underlying a wide range of somatic and obstetric diseases. The endothelium is a key regulator of vascular tone, haemostasis, microcirculation, and tissue metabolism. Impaired endothelial function in the early, subclinical stages leads to an imbalance of vasoactive, procoagulant, and anti-inflammatory factors, creating conditions for the development of chronic tissue hypoxia [6].

Latent endothelial dysfunction, which has no pronounced clinical manifestations, is currently considered an early predictor of many pathological conditions. At the same time, its role in the formation and progression of anaemia remains insufficiently studied [2,3].

Available scientific data indicate that endothelial dysfunction can contribute to microcirculation disorders, reduced oxygen and iron delivery to tissues, activation of inflammatory reactions, and changes in erythropoiesis regulation, which creates conditions for the development of anaemic syndrome.[5, 10]

Most existing studies are devoted to the study of endothelial dysfunction as a consequence of anaemia or as a component of already established cardiovascular and obstetric complications. At the

same time, the question of whether latent endothelial dysfunction can be a primary pathogenetic link and an early prognostic marker for the development of anaemia remains open and has been largely overlooked in the available literature. [9]

This problem is particularly relevant in the context of preventive and personalised medicine, which focuses on identifying preclinical stages of diseases and forming high-risk groups. Early detection of latent endothelial dysfunction as a predictor of anaemia will justify new approaches to screening, prevention and individualisation of treatment measures, which is important for obstetrics, therapy and related clinical disciplines.[8]

Thus, research aimed at studying latent endothelial dysfunction as a predictor of anaemia, its clinical, pathogenetic and prognostic aspects, is relevant, scientifically sound and of high practical importance for modern medicine.

Objective. To investigate latent endothelial dysfunction as a predictor of anaemia in pregnant women and to determine the clinical aspects of this condition.

Research objectives.

1. Conduct a clinical study to identify signs of latent endothelial dysfunction and compare its indicators in pregnant women with and without anaemia.

2. Investigate possible markers of latent endothelial dysfunction that may serve as predictors of anaemia development in pregnant women.

METHODS

A prospective cohort study was conducted. The study included 112 pregnant women in their first trimester of pregnancy.

Inclusion criteria: pregnant women aged 18 to 40 years, consent to participate in the study, presence of iron deficiency anaemia.

Exclusion criteria: chronic diseases affecting vascular function, history of infectious diseases, megaloblastic anaemia, use of drugs affecting endothelial function (anticoagulants).

The following tests were performed as part of this examination: complete blood count and biochemical analysis, coagulogram, urinalysis, as well as blood type and Rh factor determination.

Haemoglobin levels and other clinical parameters (haematocrit, iron levels, ferritin) were assessed, C-reactive protein (CRP) levels were studied, and markers of endothelial dysfunction were determined for the diagnosis and monitoring of pregnant women.

RESULTS

The study was conducted at the Department of Obstetrics and Gynaecology No. 1 named after Academician Zakirov I.Z. of the Medical Faculty of Samara State Medical University. We observed 112 pregnant women in their first trimester, who were divided into two groups for the purposes of the study: the main group consisted of 78 pregnant women with a latent form (with an average haemoglobin level of 10.5 g/dl), and the control group consisted of 34 women (average haemoglobin level of 12.5 g/dl) with physiological pregnancies.

Before the start of the study, all patients gave their informed voluntary consent to be examined.

Collecting anamnestic information is a key stage in the process of medical examination and diagnosis, as it provides a complete picture of the patient's health. This process included not only recording complaints, but also a detailed study of hereditary and family history, which is an important aspect for identifying possible genetic predispositions to various diseases. We have established that age and the presence of concomitant diseases are significant predictors of the development of both endothelial dysfunction and anaemia in pregnant women, and therefore special attention was paid to the characteristics of the course of this pregnancy. This comprehensive approach contributed to a more accurate diagnosis and the development of an individualised treatment plan for the patient.

Upon admission to the maternity hospital, all women underwent clinical and laboratory examinations, which is an important step in assessing the health status of patients and ensuring a high level of medical care.

Our research showed that the patients' ages ranged from 18 to 38 years, with an average age of 27.5±5.1 years in the main group and 24.6±4.8 years in the control group.

A study of pregnancy complications found that they occur in more than half of all clinical cases. Analysis of the course of the first trimester did not reveal any statistically significant differences in the frequency of complications in both groups.

The analysis showed that in terms of social status, housewives predominated in the main group (73%), employed women accounted for 16.7%, students - 10.3%, while in the control group - housewives - 73.6%, employed - 17.6%, students - 8.8%, i.e. we did not observe any significant differences in the social aspect in both groups.

By place of residence, 51.3% of pregnant women in the main group were women from rural areas, 48.7% were urban women, while in the control group there were no

patients from other areas, 56% were urban women, and 44% were from rural areas.

There were 20 primiparas (25.6%) in the main group and 15 (44.1%) in the control group, while 58 (74.4%) women in the main group and 19 (55.9%) women in the control group had had previous births.

Laboratory tests were performed in the clinical laboratory of the Samara State Medical University multidisciplinary clinic. The results of the study showed that pregnant women, depending on the degree of anaemia, exhibit pronounced changes in haemostasis and endothelial function indicators.

In grade I anaemia, the haemoglobin level was 90.6 ± 9.3 g/l, the platelet count was 204.5 ± 9.3 $\times 10^9$/l, and the endothelial cell content was 3.0 ± 0.25 $\times 10^4$/l. Platelet function was characterised by a predominance of hypoaggregation (65.0%), with a smaller proportion of isoaggregation (11.3%) and hyperaggregation (23.7%).

In grade II anaemia, a further decrease in haemoglobin to 76.2 ± 2.3 g/L was observed. The platelet count decreased to 184.2 ± 6.7 $\times 10^9$/L, and the endothelial cell level increased to 7.7 ± 0.8 $\times 10^4$/L. The structure of platelet functional activity continued to be dominated by hypoaggregation (61.8%), with an increase in the proportion of hyperaggregation (26.5%) and minimal values of isoaggregation (7.4%).

The most pronounced changes were recorded in grade III anaemia. The haemoglobin level decreased to 62.2 ± 1.8 g/L, the platelet count decreased to 178.4 ± 6.2 $\times 10^9$/L, while the endothelial cell content reached 10.6 ± 1.1 $\times 10^4$/L. The functional state of platelets was characterised by a sharp predominance of hypoaggregation (73.3%), with minimal values of isoaggregation (10.0%) and hyperaggregation (16.7%).

Thus, pregnant women with increasing anaemia show:

1. a progressive decrease in haemoglobin and platelet counts;

2. an increase in endothelial cell content, reflecting increased endothelial dysfunction;

3. a predominance of platelet hypocoagulation, most pronounced in grade III anaemia.

It was found that 50 women (45%) of the participants had signs of latent endothelial dysfunction, which is confirmed by the fact that women with latent endothelial dysfunction had a haemoglobin level 1.5 g/dl lower than that of pregnant women in the control group ($p < 0.01$). This indicates a significant correlation between the state of the endothelium and the development of anaemia.

It was found that C-reactive protein (CRP) levels were significantly higher in pregnant women with latent endothelial dysfunction ($p < 0.05$). This indicates the presence of inflammatory processes that can exacerbate both endothelial function and anaemia. The results of the study emphasise the importance of understanding the pathogenetic mechanisms linking endothelial dysfunction with the development of anaemia in pregnant women.

Based on the data obtained, we have proposed recommendations for regular monitoring of the condition of the endothelium in pregnant women at risk of developing anaemia, including the use of markers of inflammation and oxidative stress for early diagnosis and prevention.

Thus, our research shows that a comprehensive approach to monitoring and treating patients with latent endothelial dysfunction can significantly improve pregnancy outcomes and the health of both mother and child.

CONCLUSIONS

1. Anaemia in pregnant women is a common problem that can negatively affect the health of both mother and child.

2. Timely detection, prevention, and treatment of anaemia through proper nutrition and supplementation can significantly reduce risks and improve pregnancy outcomes.

3. Regular monitoring of haemoglobin levels, as well as the importance of an individualised approach to therapy, can contribute to more effective control of anaemia during pregnancy.

Based on the data presented on the prevalence of anaemia in pregnant women and its association with endothelial dysfunction, several practical recommendations can be made:

1. It is important to conduct regular medical examinations and blood tests for early detection of anaemia, especially in early pregnancy and in the third trimester, which allows for timely diagnosis and correction of the condition.

2. It is recommended to consider taking iron supplements, especially if there is a risk of iron deficiency anaemia. This can help prevent the development of anaemia and improve endothelial function, which in turn reduces the risk of cardiovascular disease.

3. Include foods rich in iron (red meat, poultry, fish, legumes, nuts, green leafy vegetables) and vitamin C (citrus fruits, berries, broccoli), which aids iron absorption, in your diet. This will help maintain optimal haemoglobin levels.

4. You should closely monitor the symptoms of anaemia (fatigue, weakness, dizziness) and consult a doctor if they appear. It is especially important for women to actively monitor their health during pregnancy.

5. Moderate physical activity can help improve blood circulation and overall health.

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