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HOMILADORLIKDA SIFILIS: TUG‘MA INFEKSIYA XAVFI VA UNING PATAGENETIK ASOSLARI

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Annotatsiya. Ushbu maqolada homiladorlik davrida uchraydigan Sifilis infeksiyasining ona va homila salomatligiga ta’siri hamda tug‘ma infeksiya rivojlanish xavfi zamonaviy tibbiy yondashuvlar asosida tahlil qilinadi. Kasallik qo‘zg‘atuvchisi — *Treponema pallidum* ning biologik xususiyatlari, platsenta orqali o‘tish mexanizmlari va vertikal yuqish yo‘llari yoritiladi. Homilador ayollarda kasallikning klinik kechishi, bosqichlari va yashirin shakllari ko‘rib chiqiladi. Tug‘ma sifilis rivojlanishiga olib keluvchi asosiy xavf omillari sifatida kech diagnostika va davolashning o‘z vaqtida boshlanmasligi baholanadi. Homilada yuzaga keladigan patologik o‘zgarishlar va perinatal asoratlar tavsiflanadi. Zamonaviy skrining va serologik diagnostika usullarining ahamiyati ta’kidlanib, erta tashxis va samarali davolash orqali tug‘ma infeksiya xavfini kamaytirish mumkinligi asoslab beriladi. Profilaktik choralar ona va bola salomatligini saqlashda muhim ahamiyat kasb etadi.

Kalit so‘zlar*:* Sifilis, Treponema pallidum, homiladorlik, tug‘ma sifilis, vertikal infeksiya, skrining, diagnostika, profilaktika, antibiotik terapiya, perinatal asoratlar

СИФИЛИС ПРИ БЕРЕМЕННОСТИ: РИСК ВРОЖДЁННОЙ ИНФЕКЦИИ, ЕЁ ПАТОГЕНЕТИЧЕСКИЕ МЕХАНИЗМЫ И ПРОФИЛАКТИКА

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Аннотация. В этой статье инфекция Сифилис во время беременности и её влияние на здоровье матери и плода, а также риск развития врождённой инфекции рассматриваются на основе современных медицинских подходов. Биологические особенности возбудителя — *Treponema pallidum*, механизмы его проникновения через плаценту и пути вертикальной передачи инфекции подробно освещаются. Рассматриваются клиническое течение сифилиса у беременных женщин, его стадии и латентные формы. Основными факторами риска развития врождённого сифилиса являются поздняя диагностика и несвоевременное начало лечения. Описываются патологические изменения у плода и перинатальные осложнения. Подчёркивается значение современных методов скрининга и серологической диагностики, а также эффективность раннего выявления и своевременной терапии в снижении риска врождённой инфекции. Профилактические меры играют важную роль в сохранении здоровья матери и ребёнка.

Ключевые слова: Сифилис, Treponema pallidum, беременность, врождённый сифилис, вертикальная инфекция, скрининг, диагностика, профилактика, антибиотикотерапия, перинатальные осложнения

SYPHILIS IN PREGNANCY: RISK OF CONGENITAL INFECTION, ITS PATHOGENETIC MECHANISMS, AND PREVENTION

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Abstract. In this article infection with Syphilis during pregnancy and its impact on maternal and fetal health, as well as the risk of congenital infection, are analyzed based on modern medical approaches. The biological characteristics of the causative agent — *Treponema pallidum*, its mechanisms of placental transmission, and vertical routes of infection are described in detail. The clinical course of syphilis in pregnant women, including its stages and latent forms, is reviewed. The main risk factors for congenital syphilis include late diagnosis and delayed initiation of treatment. Pathological changes in the fetus and perinatal complications are described. The importance of modern screening and serological diagnostic methods is emphasized, highlighting that early detection and timely treatment significantly reduce the risk of congenital infection. Preventive measures play a crucial role in protecting maternal and child health.

Keywords: Syphilis, Treponema pallidum, pregnancy, congenital syphilis, vertical transmission, screening, diagnosis, prevention, antibiotic therapy, perinatal complications

Introduction. The pregnancy period is considered a critical stage characterized by complex physiological and immunological changes within the female body. During this period, various infectious diseases, particularly sexually transmitted infections, pose a serious threat to the health of the mother and fetus. Among them, syphilis holds special clinical and epidemiological significance. Syphilis during pregnancy not only affects the female body but can also enter the fetus through the placenta, leading to the development of congenital syphilis [25]. The pathogen is Treponema pallidum, which develops slowly in the body and is dangerous due to its long-term latent course. According to the World Health Organization, approximately 7 million new cases of syphilis are registered worldwide annually. In some regions, the incidence of syphilis among pregnant women reaches 0.5-3%. In countries of Africa and Southeast Asia, this indicator is even higher, with up to 5% of pregnant women diagnosed with syphilis in some countries. Congenital syphilis is one of the most important causes of perinatal mortality, and in untreated cases, death or severe complications occur in up to 40% of fetal cases[28]. Recent studies have shown that the early failure to detect syphilis in pregnant women leads to perinatal mortality, premature births, and fetal malformations. According to statistical data, the risk of preterm labor increases by 20-30% in pregnant women infected with syphilis, and stillbirths by 25-40%. For this reason, this problem is relevant in modern obstetrics and infectious diseases. The causative agent of syphilis, Treponema pallidum, is a spiral-shaped, highly mobile, and microscopically thin bacterium [27]. Although it is not resistant to environmental conditions, it has the ability to live and reproduce very well in the human body. Since this microorganism penetrates tissues quickly and partially hides from the immune system, the disease can remain asymptomatic for a long time. The infection is primarily transmitted

sexually, but the most dangerous form of transmission during pregnancy is vertical, i.e., transmission from the mother's body to the fetus. The bacterium reaches the placenta through the bloodstream and enters the fetal body, disrupting its developmental processes. Studies have shown that untreated pregnant women have a 60-80% risk of fetal infection.[7] Infants born with congenital syphilis have low birth weight, respiratory failure, central nervous system damage, and multiple birth defects. Mechanism of syphilis development during pregnancy: It entered the pregnant woman's body. Treponema pallidum initially reproduces at the entry point and then spreads throughout the body through the lymphatic system and bloodstream. As a result of the spread of the infection, inflammatory processes begin in various organs and tissues[23]. The most dangerous feature of the bacterium during pregnancy is its ability to penetrate the placental barrier[30]. An infection that enters the fetus through the placenta enters its circulatory system and negatively affects the developing organs. As a result, fetal growth slows down, organ formation is disrupted, and the immune system is insufficiently developed. As a result of this process, congenital syphilis develops, which poses a serious threat to the fetus's vital functions[25].

The main purpose of the presented manuscript is to provide a brief analysis of syphilis in pregnancy: the risk of congenital infection and its pathogenetic basis based on the results of authoritative scientific works.

Risk of developing congenital syphilis: Congenital syphilis is one of the most severe complications during pregnancy. The earlier the time of infection to the fetus, the more severe the consequences. Infection, especially in the early stages of pregnancy, has a direct impact on the formation of fetal organs. Among the main factors leading to the development of congenital syphilis, late detection of the disease, untimely treatment of the pregnant woman, insufficient medical supervision, and weakness of the mother's immune system play an important role. Additionally, social and hygienic factors also play a role in the spread of the disease.[32]. Among the main pathological conditions observed in the fetus are intrauterine growth retardation, damage to the central nervous system and liver, bone system deformities, and fetal death or premature birth. These conditions significantly affect the child's quality of life and future health [18]. Pathogenetic and immunological features of syphilis during pregnancy: Syphilis developing during pregnancy causes complex pathophysiological processes in the body, which directly affect not only the mother's body but also the developing fetus. Upon entering the body, the pathogen Treponema pallidum initially undergoes a stage of local proliferation at the entrance gate, then spreads through the lymphatic system to regional nodes and subsequently disseminates throughout the body by hematogenous means [11].

One of the primary characteristics of the microorganism during pathogenesis is its ability to penetrate deep into tissues and partially "hide" from the immune system. Therefore, the infection may be clinically delayed or latent over a long period of time[18]. The pathogen spreads through the bloodstream, damaging various organs, causing inflammatory reactions in endothelial cells and leading to microcirculation disorders. As a result, hypoxia, degenerative changes, and immune inflammatory processes develop in the tissues. Physiological modulation of the immune system during pregnancy is of great importance, as this process serves to ensure that the fetus is not rejected by the mother's body as a "foreign body." In this case, a shift in the immune response from Th1 type to Th2 type is observed, i.e., the cellular immune response is relatively weakened, while the humoral immune response predominates [14]. While this physiological change serves as a protective mechanism for the fetus, it also reduces the body's defense capabilities against infectious agents, including Treponema pallidum[33]. As a result, a favorable immunological environment is formed for the survival and spread of bacteria in the body. This relative immunosuppression

observed during pregnancy contributes to the faster generalization of the infection, i.e., its spread through the blood to all systems. At the same time, cytokine imbalance also plays an important role in the pathogenesis of the disease: an imbalance between pro-inflammatory and anti-inflammatory cytokines leads to the chronic nature of inflammatory processes. Furthermore, placental tissue is an immunologically active structure that performs a protective function to a certain extent. However, the effectiveness of this barrier decreases as the syphilis pathogen disrupts placental microcirculation and damages trophoblast cells. This facilitates the infection's entry into the fetal circulatory system and sharply increases the risk of developing congenital syphilis[27].

Overall, the pathogenesis of syphilis during pregnancy is closely linked to physiological changes in the immune system, the invasive properties of bacteria, and the disruption of the placental barrier, which together pose a serious threat to the health of both mother and fetus [30]. Immunological response and mechanisms of inflammation: A complex immune response is formed in the body against syphilis infection. First, innate immunity is activated, and macrophages and neurophils attempt to destroy the bacterium[19]. However, since Treponema pallidum has the ability to penetrate and hide inside cells, the immune system cannot completely destroy it. At the next stage, the adaptive immune response is triggered, i.e., T-lymphocytes and B-lymphocytes are activated. As a result, antibodies are produced, but this response is often insufficient to completely eliminate the infection. In pregnancy, there is a deviation of the immune system to the Th2 type, which reduces inflammatory reactions but creates conditions for the persistence of the infection [12]. Placental barrier and fetal protection disorders: One of the most important biological protection mechanisms during pregnancy is the placental barrier. Normally, the placenta does not transfer many pathogens to the fetus[14]. However, syphilis infection has the ability to break through this barrier. Treponema pallidum passes through the placental vessels and enters the fetal bloodstream directly. During this process, inflammation, circulatory disorders, and hypoxic changes develop in the placenta. As a result, the fetus is in a state of oxygen and nutrient deficiency [7].

Mechanisms of fetal development disorders: During pregnancy, when syphilis infection enters the fetal body, several biological and systemic processes are disrupted simultaneously. The pathogen Treponema pallidum enters the fetus through the placenta, directly affecting its developing cells. As a result, the most important stages of embryonic and fetal development—cell division, migration, and differentiation—are disrupted [30]. The earliest pathological changes are observed at the stage of organogenesis. During this period, cells divide rapidly, forming various organs and tissues. Under the influence of infection, cell proliferation slows down, and DNA synthesis and the cell cycle are disrupted. This leads to the malformation of various organs, structural defects, and functional deficiencies. Infection, especially during early pregnancy, can result in the most severe birth defects. The central nervous system is one of the most sensitive and complex systems in fetal development [23]. Under the influence of infection, the migration of neuroblasts is disrupted, synapse formation slows down, and an imbalance in the development of the cerebral cortex occurs. As a result, later neurological disorders, cognitive developmental delays, and, in severe cases, anatomical defects of the brain structure may be observed. In the bone system, disruption of the mineralization process is one of the main pathological changes. As a result of the decrease in the activity of osteoblasts, incomplete formation of bone tissue, bone fragility, and various deformations develop. This condition significantly affects the child's motor system even after birth [11]. The organs of the reticuloendothelial system, such as the liver and spleen, are also susceptible to infection, and they exhibit inflammatory processes and enlargement (hepatosplenomegaly). This condition disrupts the body's detoxification and metabolic functions,

resulting in fetal delay in general development. Systemic disorders resulting from infection also disrupt the fetus's supply of oxygen and nutrients. This leads to the development of intrauterine hypoxia and reduces the viability of the fetus. In severe cases, cases of fetal death or premature birth are observed. In general, infection caused by Treponema pallidum affects almost all stages of fetal development, causing complex pathological processes ranging from the cellular level to organ systems[22].

Perinatal risk factors: A number of risk factors are observed in pregnant women with syphilis during the perinatal period. The most common complications include premature labor, fetal death, and low birth weight. The risk increases sharply, especially if the infection is contracted in the early stages of pregnancy. This is because during this period, the main organs are in the formation stage, and any pathological impact leads to serious defects [17]. The problem of clinical latentity: One of the most dangerous aspects of syphilis during pregnancy is its long-term asymptomatic (latent) course. Once the pathogen Treponema pallidum enters the body, it enters into a complex interaction with the immune system and, in most cases, proceeds in a latent form without clinical symptoms. This condition is especially complicated in pregnant women, as physiological immune changes can "mask" clear symptoms of the disease. As a result of a latent course, it is observed that the patient has no external visible symptoms, or the existing symptoms are very mild and are overlooked. In some cases, symptoms such as skin rashes, enlarged lymph nodes, or general malaise are mistaken for other infectious or hormonal changes. For this reason, pregnant women often do not seek medical attention in a timely manner, or the disease is misdiagnosed. The greatest danger of clinical concealment lies in the fact that the infection continues to actively develop in the body even without external symptoms. Treponema pallidum spreads through the blood and lymphatic system, gradually reaching the placental septum and entering the fetus. As a result, the likelihood of a congenital infection is increased, which can cause irreversible damage to fetal development[18].

The most dangerous aspect is that in some cases, syphilis is detected only after severe complications in the fetus, premature labor, or fetal death. This leads to late diagnosis of the disease and limited treatment options. Therefore, early detection of latent forms is of particular importance in clinical practice. One of the most effective approaches to overcoming this problem is regular laboratory screening. Serological examinations of pregnant women during the first prenatal examination and follow-up monitoring in the subsequent trimesters allow for the early detection of the disease. This protects not only the mother's health but also the life of the fetus. In general, the clinical latent nature of syphilis is one of its most dangerous epidemiological features, which continues to spread the disease imperceptibly. Therefore, early diagnosis, regular examinations, and screening programs are the most important directions in the fight against syphilis during pregnancy [32]. Principles of treating syphilis during pregnancy: The treatment of syphilis during pregnancy is one of the highest priority areas in clinical practice, as this disease poses a direct threat to the life and development of the fetus. The pathogen Treponema pallidum is sensitive to antibiotics, especially penicillin group drugs, which are used as the primary treatment [6].

The primary goal of treatment for pregnant women is not only to eliminate clinical symptoms but also to prevent the transmission of infection to the fetus. Therefore, therapy should be initiated as early as possible. In cases of delayed treatment, the bacterium may have already entered the fetus through the placenta, significantly increasing the risk of congenital syphilis. Penicillin preparations exert a bactericidal effect by destroying the cell wall of Treponema pallidum. During pregnancy, these drugs are considered safe and have minimal toxic effects on the fetus. In some cases, if allergic reactions are observed, treatment is continued using the desensitization

method [31]. During the treatment process, the patient's clinical condition, serological parameters, and fetal development are regularly monitored. This process is important for assessing the effectiveness of therapy and reducing the risk of recurrence[15]. In syphilis, prevention is the most effective and most important strategy, as preventing the disease is much safer and more cost-effective than treating it. Preventive measures are carried out at several levels: primary, secondary, and tertiary prevention [9]. Primary prevention is aimed at preventing infection in healthy women, where an important role is played by increasing medical knowledge about sexually transmitted diseases, using protected sexual means, and reducing risk factors[30].

Secondary prevention is aimed at early detection of the disease, and regular serological screening of pregnant women is the main measure. Testing for syphilis is mandatory, especially during the first prenatal examination. If the disease is detected at this stage, fetal harm is prevented[30]. Tertiary prevention is aimed at preventing complications in patients who have already been diagnosed with the infection and includes a full course of treatment, constant monitoring of the fetus, and the prevention of relapses[19].

Conclusions. In conclusion, syphilis infection during pregnancy is one of the most important medical problems posing a serious threat to the health of the mother and fetus. The biological characteristics of the pathogen of this disease, Treponema pallidum, particularly its ability to penetrate the placental barrier, play a decisive role in the development of congenital syphilis. As discussed in the article, the pathogenesis of the infection is complex, manifesting through immunological changes in the body, microcirculatory disorders, and systemic inflammatory processes, negatively affecting various stages of fetal development.

Physiological changes in the immune system during pregnancy can lead to a latent course of infection and delayed detection. This, in turn, increases the risk of severe complications such as congenital syphilis, intrauterine developmental delay, organ deformation, and perinatal death. In particular, the failure to detect the infection at early stages leads to irreversible pathological changes for the fetus. Therefore, early detection and timely treatment of syphilis in pregnant women is one of the main priorities. Modern serological diagnostic methods and regular screening examinations allow for the early detection of the disease.

Timely treatment with antibiotics of the penicillin group significantly reduces the transmission of infection to the fetus. Particular attention should be paid to preventive measures, namely increasing the medical literacy of the population, reducing risk factors, mandatory screening of pregnant women, and ensuring a full course of treatment to reduce the incidence of congenital syphilis. Overall, a comprehensive approach - early diagnosis, effective treatment, and systemic prevention - is essential for maintaining maternal and child health.

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