



Prophylactic measures against vertical transmission of HIV between a pregnant woman and the fetus

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ABSTRACT

Introduction: During pregnancy and childbirth, HIV (the virus that causes AIDS), as well as syphilis and hepatitis B, can be transmitted to the fetus. HIV can also be transmitted during breastfeeding. **Aim:** The aim of this study was to identify the evidence on prophylactic measures against vertical transmission of HIV between the pregnant woman and the fetus. **Material and Methods:** The methodology used was a literature review. The research was carried out through an electronic search of scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. **Results:** Cases of HIV-positive pregnant women are increasing every year. This is a consequence of the recent increase in the number of people contracting the HIV virus. Even with all the progress that science has made over the last few decades, cases of mother-to-child transmission of HIV still occur. A few years ago, if a pregnant woman was carrying the virus, her unborn child would inevitably have it. Nowadays, with technology and new procedures performed on pregnant women, the fetus has the possibility of being born free of contamination and having a normal life, which is why early diagnosis and treatment are so important for the health of the newborn. **Conclusion:** Early treatment in the prenatal period ensures that the child is completely safe. Among the procedures are, at the time of delivery, clearing the newborn's airways so that the mother's fluids do not enter the baby's body. With prenatal diagnosis, early treatment can be started, which can reduce the vertical transmission of HIV and other STIs from mother to fetus, guaranteeing a completely healthy pregnancy and birth.

Key-words: Pregnancy and HIV, Vertical Transmission of HIV and Other STIs from Mother to Fetus, Prophylactic Measures Against Vertical Transmission of HIV.



INTRODUCTION

The HIV and AIDS epidemic continues to be one of the greatest public health challenges in the world. Since its discovery in the 1980s, millions of people have been infected and many have lost their lives. However, significant advances in medicine and awareness have provided new hope. Knowing the differences between HIV and AIDS, as well as the methods of diagnosis and treatment, is essential in order to combat stigma, prevent spread and offer adequate support to those living with the virus¹.

From 2011 to 2021, the number of HIV cases detected in pregnant women increased year on year in Brazil, rising from 62.4% in 2011 to 67.7% in 2021, with a higher proportion among pregnant women aged 15 to 29, who accounted for 69.6% of these notifications ³¹.

The rate of pregnant women with HIV has risen by 35% in ten years in Brazil. Data from the Ministry of Health points to the detection of 3 cases per thousand live births in 2021, compared to the 2.3 diagnosed in 2011 ³¹.

Women who have already been diagnosed, are adequately treated and have an undetectable viral load can be managed like any other pregnant woman. The choice of delivery route is obstetric. Also, with an undetectable viral load, there is no need to change the route of delivery, indicating an elective caesarean section. Caesarean section in women with viral detection should only be carried out on obstetric advice ³.

In pregnant women who maintain inadequate treatment and arrive for delivery with viral detection, it is necessary to deliver by high route (elective caesarean section), especially if she has a viral load above 1,000 copies/ml. In these cases, intravenous azidothymidine (AZT) should be administered three hours before the caesarean section. The newborn (NB) should be given booster prophylaxis (zidovudine syrup combined with nevirapine in the first week) ².

HIV (Human Immunodeficiency Virus) and AIDS (Acquired Immunodeficiency Syndrome) are often confused, but there is a crucial distinction between them. HIV is the virus that, when left untreated, can lead to AIDS, a condition that represents the most advanced stage of HIV infection. While a person can live with HIV for many years without developing AIDS, the lack of adequate treatment can eventually weaken the immune system, allowing the opportunistic diseases that characterize AIDS to emerge².

Early diagnosis is vital for the effective management of HIV and to prevent progression to AIDS¹.

Treatment for HIV involves antiretroviral therapy (ART), which is a combination of drugs that helps control the virus. ART doesn't cure HIV, but it suppresses viral replication, allowing the



immune system to strengthen and reducing the likelihood of transmitting the virus to other people. With strict adherence to treatment, many people with HIV can lead long and healthy lives ³.

In addition, one of the great advances in HIV treatment is that, by following the treatment correctly, the viral load can be reduced to undetectable levels. This means that the virus becomes so low in the blood that tests cannot detect it and, more importantly, the person does not transmit HIV to others. Living with HIV and maintaining an undetectable viral load makes it possible to live a normal, quality life without the risk of transmitting the virus ⁴.

Getting tested for HIV regularly is crucial, especially for those in risk groups or who engage in behaviors that increase the likelihood of infection. Early diagnosis allows treatment to begin immediately, significantly improving quality of life and reducing the chance of transmitting the virus³.

Understanding the difference between HIV and AIDS, knowing the diagnostic methods and the testing facilities available are fundamental steps towards effective prevention and treatment. Regular testing and access to treatment are everyone's rights and fundamental to controlling the spread of HIV and providing a healthy life for those living with the virus ⁵.

Combination prevention is a comprehensive and integrated approach to preventing HIV infection, using multiple strategies simultaneously. It includes condom use, pre-exposure prophylaxis (PrEP) for people at high risk of infection, post-exposure prophylaxis (PEP) after possible exposure to HIV, regular testing and immediate treatment for those who test positive. In addition, combined prevention involves education on safe sex practices, harm reduction for injecting drug users and the promotion of sexual and reproductive health. By combining these strategies, it is possible to significantly reduce HIV transmission and promote a healthy life for all people, regardless of their risk status ^{6,7}.

Whether by accident or out of a genuine desire to have children, women with HIV can get pregnant, and fortunately, they can have a healthy pregnancy for both themselves and their babies. It is necessary, of course, that the woman takes good care of herself to prevent the baby from being infected by the virus ⁶.

During pregnancy and childbirth, HIV (the virus that causes AIDS), as well as syphilis and hepatitis B, can be transmitted to the fetus. HIV can also be transmitted during breastfeeding ⁵.

HIV during pregnancy, although dangerous, can be controlled so that the baby comes into the world healthy and free from infection. It all depends on quick action to identify HIV and treat it immediately. With the right care and treatment, mother and baby can get through it all without complications ⁵.



When it infects a person, HIV may not show any symptoms for years, but it can also show medium to severe symptoms, usually similar to those of the common cold: fever, body aches, sore throat, malaise, the appearance of red spots on the skin and swelling in the lymph nodes, small nodules scattered around the body, which are responsible for filtering out toxins. There is also

Symptoms of HIV in pregnancy can be as mild as they can be severe and include dangerous symptoms, including enlarged lymph nodes, diarrhea, little weight gain during pregnancy and increased exposure to bacterial and viral infections. During pregnancy, HIV can affect a woman's organs in different ways, reaching the liver, heart, kidneys, or even the brain ².

OBJECTIVES

The aim of this study was to identify the evidence on prophylactic measures against mother-to-child transmission of HIV.

MATERIAL AND METHODS

The methodology used was a literature review. The research was carried out by means of an electronic search for scientific articles published on the Scielo (Scientific Electronic Library Online) and Lilacs (Latin American Health Sciences Literature) and Pubmed websites. We used the health terminologies consulted in the Health Sciences descriptors (DeCS/BIREME), evidence on prophylactic measures against vertical transmission of HIV between the pregnant woman and the fetus.

The inclusion criteria were: original article, published in Portuguese and English, freely accessible, in full, on the subject, in electronic format and published in the last ten years (2000 to 2024), totaling 33 articles.

RESULTS

The placenta is an organ found in eutherian mammals which has essential functions for the proper development of the fetus during pregnancy. The placenta is the place where substances are exchanged between the fetus and the pregnant individual, and is responsible for nutrition, excretion, respiration and the synthesis of hormones ⁸.

This transportation of substances by the placenta is guaranteed by its interaction with the umbilical cord, which allows the exchange of gases (such as oxygen and carbon dioxide), nutrients (such as water and vitamins), hormones, antibodies and excreta, both from the pregnant individual

to the fetus and from the fetus to the pregnant individual. In addition, the placenta is responsible for the synthesis of essential hormones during pregnancy ⁹.

The placenta is the site of gas and nutrient exchange between the pregnant individual and the fetus. Together with the umbilical cord, the placenta acts in the transportation of substances that pass from the pregnant individual to the fetus, such as nutrients and oxygen, as well as the transportation of substances from the fetus to the pregnant individual, such as carbon dioxide and excreta, from where they will be eliminated into the external environment ⁹.

The placenta is a temporary structure that performs an ancillary function to the development of the embryo and, after delivery, is completely removed. These functions include placental metabolism, which, especially in the early stages of pregnancy, is responsible for the synthesis of glycogen, cholesterol and fatty acids, which are used as a source of nutrition and energy for the development of the embryo ⁹⁻¹¹.

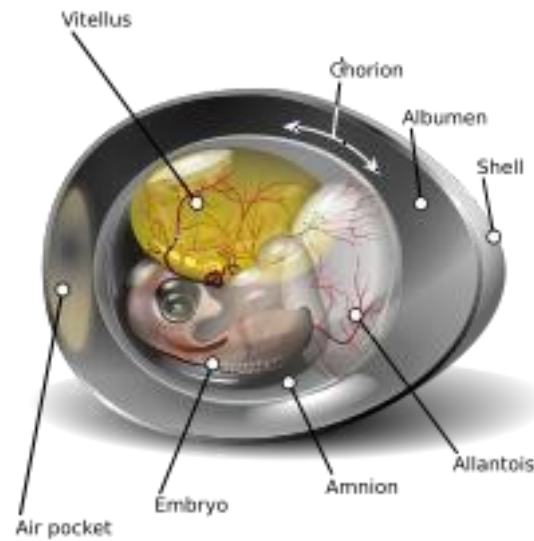
Substances are transported both from the pregnant individual to the fetus and from the fetus to the pregnant individual. The substances that are transported are gases such as oxygen and carbon dioxide, nutritional substances such as water, glucose, amino acids and vitamins, as well as hormones, antibodies and excreta. Oxygen, nutritional substances, hormones and antibodies are transported from the pregnant individual towards the fetus, while carbon dioxide and excretion products are transported from the fetus towards the pregnant individual. This ensures that the body receives the substances necessary for its development, as well as releasing the toxic substances that are generated from cellular metabolism ¹².

In the third month of pregnancy, the placenta secretes the following hormones: human chorionic gonadotrophin (hCG), human placental lactogen (hPL), estrogen and progesterone. The secretion of hCG is responsible for the maintenance of the corpus luteum and, consequently, the maintenance of pregnancy and the continuous secretion of estrogen and progesterone. LPH is involved in breast development and also in altering the metabolism of pregnant women, reducing their use of glucose and making more glucose available to the fetus ¹¹.

Estrogen and progesterone are synthesized throughout pregnancy, the former being responsible for the growth and development of the uterus, while progesterone inhibits uterine contractions, ensuring that the embryo remains inside the uterus ¹².

The placenta is made up of a fetal region, called the chorion (FIGURE 1), and a region formed by the uterine endometrium, called the decidua. The decidua, in turn, is divided into three regions, the basal decidua, capsular decidua and parietal decidua ¹³.

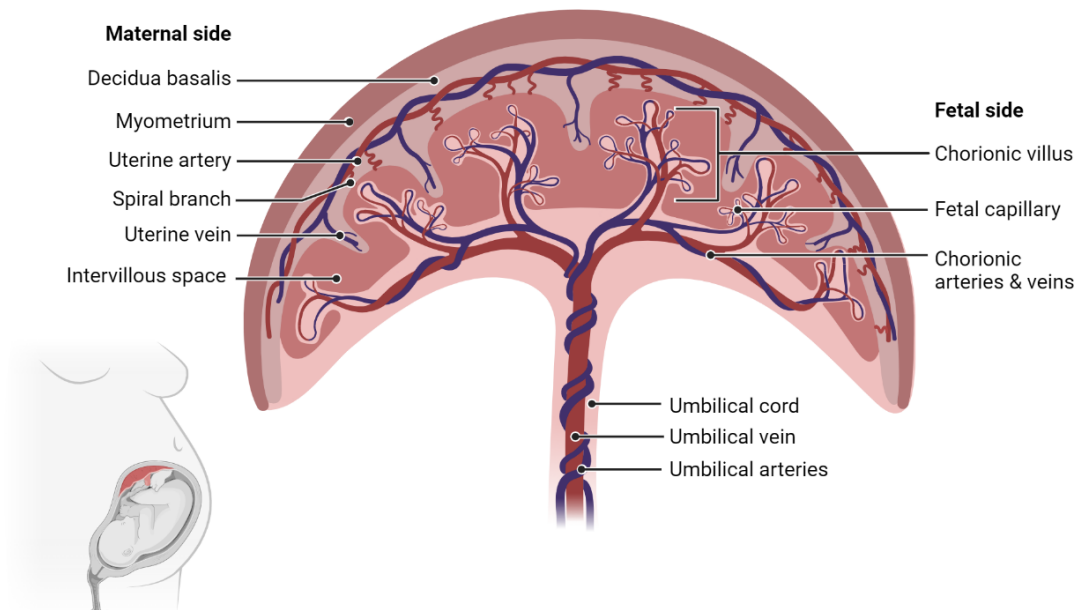
Figure 1. Placental Chorium. Source:²².



The link that allows the exchange of substances between the fetus and the pregnant individual is the interconnection between the placenta and the umbilical cord, which is made up of two arteries that carry deoxygenated fetal blood to the placenta and a vein that carries oxygenated blood to the fetus (FIGURE 2). The arteries and veins of the umbilical cord branch off into capillaries present in the chorionic villi located in the region of the basal decidua, which is irrigated by the blood of the pregnant individual and is where substances are exchanged ¹⁴.

Figure 2. Placental Anatomy. Source: ²².

Placenta Anatomy



A mature placenta weighs around 500-600 grams and consists of 15-28 “cotyledons”. The stem villi are the main structural unit of the fetal cotyledon. Each cotyledon begins with a stem villus that divides into 3-5 immature/mature intermediate villi, which branch into 10-12 terminal villi ¹⁵.

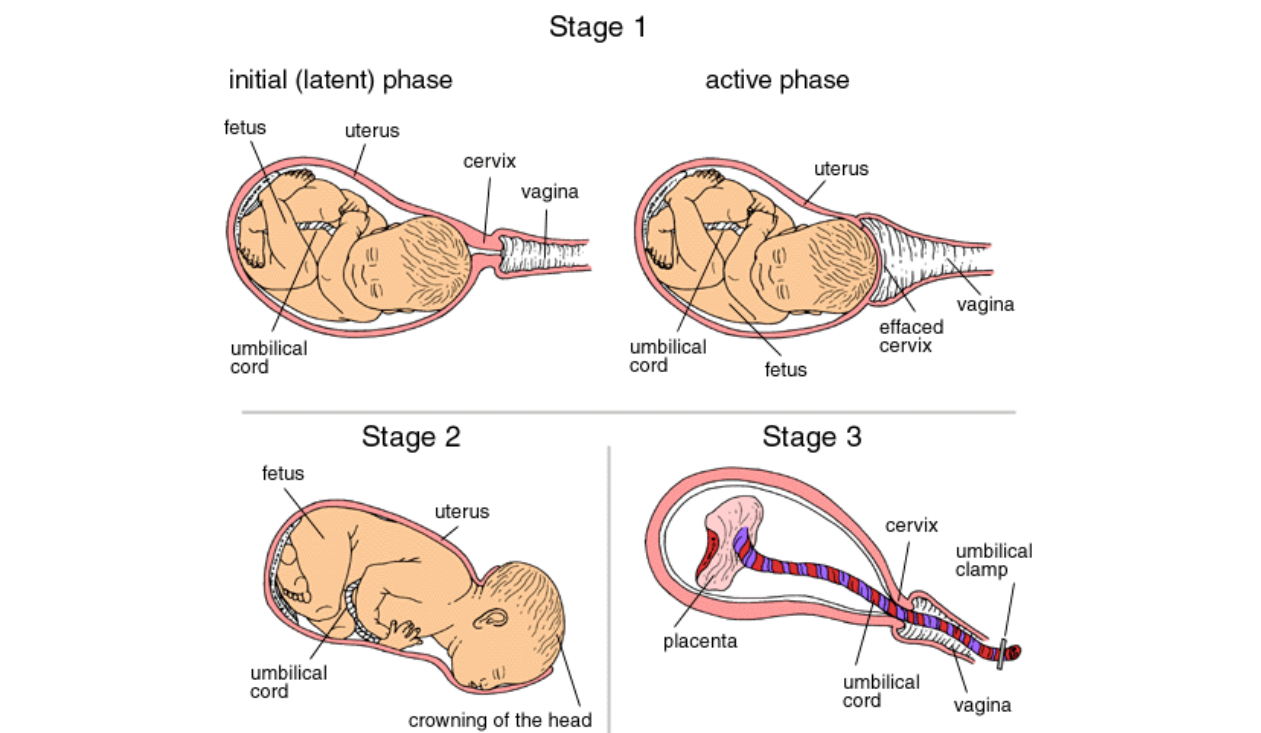
After fertilization, the zygote travels between the fallopian tube and the uterine cavity until it is implanted in the endometrium, where it undergoes various cell divisions and is called a blastocyst, which continues to divide until it becomes an embryo ¹⁸.

The cells present in the outer layer of the blastocyst, called the trophoblast, will give rise to the placenta. The cells of the trophoblast begin a process of differentiation, giving rise to two distinct layers, the cytotrophoblast and the syncytiotrophoblast. The cells of the cytotrophoblast adhere to the endometrium, forming a region containing blood vessels called the chorion, which fuses with the uterine region to form the placenta¹².

The placenta is a temporary structure that performs essential functions for the maintenance and development of the fetus within the uterus, ensuring its health and protection. It provides nutrition, waste removal, immune protection, as well as synthesizing essential hormones during pregnancy ¹³.

In short, the main function of the placenta is to ensure that the fetus develops in a healthy way; therefore, after birth, it is expelled from the body of the pregnant individual at the moment the child is born (FIGURE 3) ¹⁴.

Figure 3. Stages of expulsion of the fetus from the placenta. Source: ²⁹.





In addition to the above functions, the placenta also provides fetal protection by preventing the passage of microorganisms and allowing antibodies to pass from the pregnant individual to the fetus. However, some viruses, such as AIDS, rubella, measles, chickenpox, among others, can cross this barrier and settle in the developing fetus¹⁶.

Other diseases directly related to the placenta are placenta accreta and placenta previa. Placenta accreta is one of the main causes of death in pregnant women and can be avoided with good prenatal care. In this condition, the placenta is more adherent to the uterus than it would be under normal conditions, which leads to heavy bleeding at the time of delivery. Placenta previa, on the other hand, is related to the low insertion of the placenta in a lower segment of the uterus, which can lead to complications during pregnancy¹⁷.

The number of HIV-positive pregnant women is increasing every year. This is a consequence of the recent growth in the number of people contracting the HIV virus¹⁷.

Even with all the progress that science has made over the last few decades, cases of mother-to-child transmission of HIV still occur. A few years ago, if a pregnant woman was carrying the virus, her unborn child would inevitably have it¹⁸.

But today, with technology and new procedures carried out on pregnant women, the fetus has the possibility of being born free of contamination and having a normal life, which is why early diagnosis and treatment are so important for the health of the newborn¹⁸.

Vertical transmission is when the mother transmits the HIV virus to her baby during pregnancy, childbirth or breastfeeding¹⁵.

It was in 1985 that a medical bulletin recorded the first case of vertical transmission. Since then, according to the Brazilian Ministry of Health, by 2022 around 78.1% of children up to the age of 13 who are carriers of the virus have been contaminated in this way³¹.

Most vertical transmission happens at birth. Whether during labor or conception, cases of transmission at this stage account for 65%. The other 35% occur during pregnancy, especially in the last few months¹⁹.

Breastfeeding is also considered a risk for mothers who are carriers of the virus. The risk of transmission is 30% higher²⁰.

However, the transmission rate can be reduced to 8.3% if prenatal care is carried out correctly. This is indicated by studies carried out in the United States and France, which led to the ACTG 076 Protocol²¹.

This protocol deals with preventive practices to avoid the transmission of the HIV virus to babies, even when they are still pregnant²¹.



Mother-to-child transmission is the main route of infection for the HIV-1 virus (Human Immunodeficiency Virus) and is responsible for around 80% to 90% of AIDS (Acquired Human Immunodeficiency Syndrome) cases in children in Brazil and worldwide. Vertical transmission has become the main target of prophylaxis with the ACTG 076 Protocol (AIDS Clinical Trial Group), which involves the use of Zidovudine during pregnancy, childbirth and the newborn ²¹.

ACTG is a global network of clinical trials that conducts research to improve the management of HIV and its comorbidities; develop a cure for HIV; and innovative treatments for tuberculosis, hepatitis B and emerging infectious diseases ²¹.

Despite the dangers posed by HIV during pregnancy, it is possible to avoid all of them so that both mother and fetus remain healthy before, during and after childbirth. And the main form of protection is during prenatal care ²².

Once a woman knows she is pregnant, she should go to a gynecologist as soon as possible to start prenatal care. The examinations and tests carried out in this period before the birth of the child are intended to guarantee its safe arrival. Many tests are repeated even during childbirth, when there is a greater chance of the fetus coming into contact with the mother's fluids ²².

With prenatal diagnosis, early treatment can be started, which can reduce the vertical transmission of HIV and other STIs from mother to fetus by up to 99%, guaranteeing a completely healthy pregnancy and birth ²³.

To identify the presence of HIV during pregnancy, rapid HIV tests and/or HIV serology tests are carried out at the first appointment with the gynecologist. The same tests are carried out again in the third trimester of pregnancy (around 28 weeks) and again at the time of delivery ²⁴.

These tests are carried out by taking blood from the patient, and testing should be done as soon as possible if the mother already knows she is HIV positive. Rapid tests, which can be carried out using Remote Laboratory Tests (RLTs) such as those from Hilab, generate a reliable diagnosis, which goes through a double-checking system and is ready in just 25 minutes ²⁶.

Other more precise tests can also be carried out, but they take longer to deliver a diagnosis. In view of the urgent need for results in order to start treatment as soon as possible, rapid tests tend to be the most suitable, which includes the practicality of TLRs ²⁷.

Carrying out prenatal care correctly, carrying out HIV tests correctly and starting treatment early already greatly reduces the chances of transmitting the virus to the fetus. But there are still other actions that the mother can take to ensure the health of the child ²⁷.

To begin with, the pregnant woman must take care to avoid HIV reinfection during pregnancy. Re-infection increases the HIV viral load in the body, exposing the woman to greater



risks and, consequently, putting the fetus at risk. To avoid this, condoms should be used during sexual intercourse throughout pregnancy and during the breastfeeding period ²⁸.

Still on the subject of breastfeeding, unfortunately mothers living with HIV cannot breastfeed their newborns, as breastfeeding is one of the vectors for vertical transmission. Mothers living with HIV must replace breast milk with artificial milk or use milk banks ²¹.

The treatment of HIV during pregnancy is no different to the usual treatment for the infection. It is done through antiretroviral treatment, with the use of drugs to control the HIV viral load, preventing vertical transmission. This treatment must be carried out throughout pregnancy and, if necessary, even at the time of delivery ²⁸.

The NB will also have to be treated with antiretroviral medication (in syrup form). The NB should receive the medication immediately after birth and be closely monitored by the health service to ensure their well-being ²⁸.

The Health Surveillance Secretariat employs a series of postpartum procedures to continue the treatment of the NB and ensure that, even after early treatment in the prenatal period, the child is fully safe. Among the procedures are, at the time of delivery, cleaning the NB's airways so that the mother's fluids don't enter their body ²⁹.

After discharge from hospital, the newborn should continue to be monitored until they are one year old. In the first two weeks after giving birth, the first medical appointment is made to check on the child's health. Between the first and sixth month of life, the child should be tested for viral load. When the child is one year old and has tested negative for HIV in the first few months of life, they are considered to be out of risk and fully healthy ²⁶.

HIV during pregnancy, although it represents a danger, can be controlled so that the child enters the world healthy and free from infection. Everything depends on quick action to identify HIV and treat it immediately. With appropriate care and treatments, mother and fetus can go through all of this without complications ³⁰.

Basic Family Health Units are a great ally in the early diagnosis of HIV. This is because these units are often where the first prenatal exams take place. Ease of contact with the community is also a factor that determines the importance of units in containing the transmission of the HIV virus ³¹⁻³³.

Pregnant women's adherence to anti-HIV tests is still low. This low adherence may indicate limited access to tests. Another factor that may contribute to this result is the lack of access to information about the importance of prenatal care ³¹.



This phase begins with the diagnosis of the pregnant woman with HIV. When a positive case is determined, psychological and emotional support is offered to the pregnant woman and her family ³².

There are cases in which the pregnant woman is already aware that she is HIV positive and is already taking antiretrovirals (ARV) due to her immunological/clinical status (ART-Treatment). When the diagnosis is only obtained during pregnancy, prophylactic use of Antiretrovirals (ARV) begins. This is to avoid vertical transmission during pregnancy ³⁰.

When the patient is diagnosed prenatally, prophylaxis indicates that the recommended gestational age for starting treatment is from the 14th week of pregnancy ²².

The medication used to treat pregnant women is zidovudine (AZT). It must also be inserted into the medication of pregnant women who were already undergoing treatment before pregnancy. An exam for CD4+ count and viral quantification is also necessary before treatment ²⁶.

The effects of zidovudine (AZT) on the fetus and mother during the gestation period are not yet fully clear. The Ministry of Health also announced that there are no studies that present the consequences of the medication used in ARV treatment for the fetus ³¹.

Both ARV and AZT can be used in treatment. Always follow the guidance of starting from the 14th week of pregnancy. AZT is administered intravenously and should also be used during labor and delivery. It is highly recommended that it be maintained until the umbilical cord is clamped.

Even if the pregnant woman has not started ARV prophylaxis, AZT must be administered intravenously. Pregnant women who are using AZT need to be periodically evaluated ³².

These periodic exams ensure that liver level monitoring is done correctly. This makes it possible to detect anemia associated with these types of treatment. This exam also checks the CD4 level. The level of this molecule determines prophylaxis in cases of recurrent infections in this treatment ³³.

The Ministry of Health recommends the following ARV regimen to be used during pregnancy: Lamivudine (3TC) and AZT combined with Nelfinavir (NFV) or Nevirapine (NVP). In situations where infections occur, chemoprophylaxis is also used ³³.

The success of pregnant women adhering to treatment is closely linked to the assistance offered. From diagnosis, through symptom monitoring to appropriate medical referral. In some situations it is necessary to suspend ARV treatment, due to adverse reactions. But it is worth remembering that only if there is medical instruction should ARV treatment be suspended ²⁹.

Cases of suspension occur due to the half-life of ARV medications. When this happens, they must be suspended immediately².

Every pregnant woman who is HIV positive must be informed about the oral use of AZT from the 14th week of pregnancy. In this approach, the pregnant woman must also be informed about ART treatment, which may be indicated after a careful medical evaluation, based on clinical and laboratory tests⁹.

Still regarding ART treatment, gestational age is extremely important information so that the medication is applied correctly².

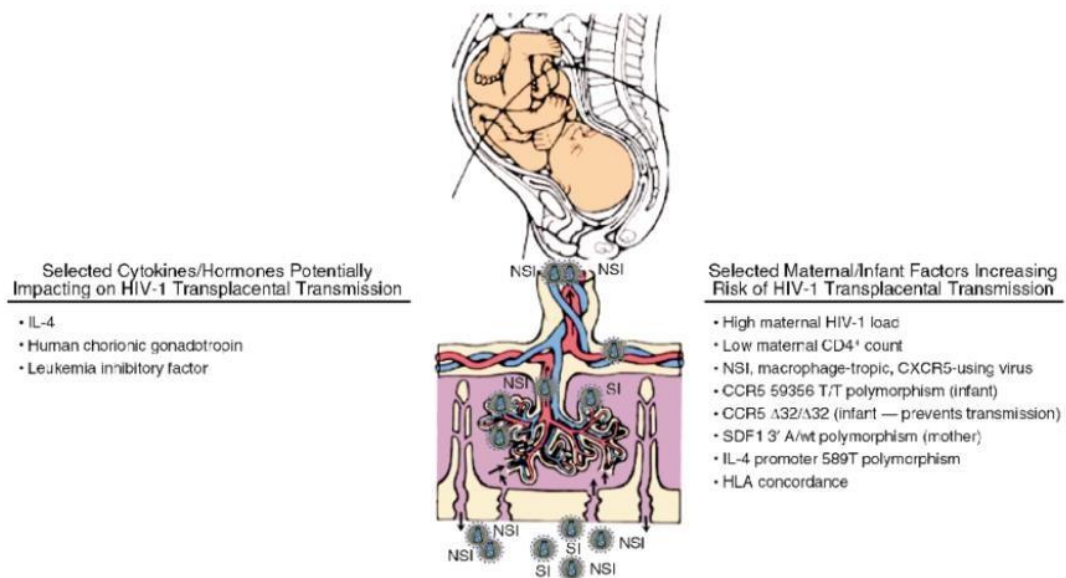
The virus somehow gets past the placental membrane and into the fetal blood. Placental cells produce a huge group of soluble factors and receptors, such as cytokines, chemokines, hormones and the main compatibility complex (MHC) class I, including HLA-G, which may contribute to the outcome of virus transmission to the conceptus⁹.

Increasing evidence indicates that transplacental transmission of HIV-1 is the result of a complex interaction between genetic factors of the virus, mother and fetus²⁸.

High maternal viral load and low CD4⁺ lymphocyte count are more often associated with transmission with viruses that use CCR5 (non-syncytium-inducing [NSI], macrophage-tropic), more often transmitted even when viruses that use CXCR4 (FIGURE 4).

Polymorphisms in the genes encoding the CCR5 chemokine receptor in children may reduce the risk of transmission. Furthermore, polymorphisms in genes encoding cytokines and hormones such as LIF, hCG and IL-4 likely contribute to the placental barrier to viral transmission²⁸.

Figure 4. Most genetic factors in the mother and fetus are also important determinants of transmission. Source: ²¹.





In addition to increasing viral replication, oxytocins have been associated with the ability to weaken the placental barrier, damaging its trophoblasts. Under these circumstances, placental cells become more susceptible to infection, increasing the likelihood of viral transmission (VT)².

CONCLUSION

The placenta is the organ responsible for gestational success, however, its role in the vertical transmission of HIV-1 is still far from being completely understood.

There is evidence that the placenta plays a direct role in vertical transmission (VT) and studies have shown that factors related to the maternal immune system and infection of placental tissue by HIV-1 may be associated with the outcome of transmission. However, the mechanism by which the virus is able to breach the placental barrier and the consequences of placental viral infection are not completely elucidated. Research in the area may contribute to understanding the role of the placenta in this context and to the development of effective prophylactic technologies in reducing the risks of vertical transmission of HIV-1.

Among the procedures, at the time of birth, are cleaning the newborn's airways, so that the mother's fluids do not enter her body.

Early treatment during prenatal care is essential to ensure the safety of the newborn. With prenatal diagnoses, early treatment begins, which is capable of reducing the vertical transmission of HIV and other STIs from mother to fetus, ensuring a completely healthy pregnancy and birth.



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