

LATE POSTNATAL MOTHER-TO-CHILD TRANSMISSION OF THE HUMAN IMMUNODEFICIENCY VIRUS THROUGH BREASTFEEDING: ANALYSIS OF INFANT CASES OF PREVIOUSLY SERONEGATIVE MOTHERS INFECTED DURING LACTATION

TRANSMISSÃO VERTICAL TARDIA DO VÍRUS DA IMUNODEFICIÊNCIA HUMANA VIA ALEITAMENTO MATERNO: ANÁLISE DE CASOS DE INFECÇÃO PEDIÁTRICA COM HISTÓRIA MATERNA SORONEGATIVA DURANTE A GESTAÇÃO

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ABSTRACT

Introduction: Vertical transmission is considered an indication of human immunodeficiency virus (HIV) infection in children aged below five years. The main postnatal category of exposure is through breastfeeding. When maternal infection occurs in early postnatal period, the risk of infant infection is even higher, due to a high maternal viral rate in this period. **Objective:** To evaluate HIV infection in infants assisted by the Pediatric Infectology Service of Hospital de Clínicas da Universidade Federal do Paraná, emphasizing the cases where vertical transmission occurred postnatally through breastfeeding. **Methods:** Transversal, analytical and descriptive study, with quantitative and qualitative approach, analyzing all HIV-infected patients aged 0 to 16 years, assisted between 2010 and 2015. The analysis of category of exposure was carried out by a general protocol, followed by a specific protocol for cases where transmission was suspected to have occurred due to late postnatal transmission through breastfeeding, aiming at understanding pediatric and maternal characteristics. **Results:** Records from 122 patients were analyzed, with 95.0% of mother-to-child-transmission cases. Between these cases, 11 (9.5%) were considered possible or confirmed late postnatal transmission through breastfeeding, having the presence of breastfeeding as a requirement. By the time of diagnosis, 72.7% presented symptoms of HIV infection. In 45.4% of these cases, mother and children were diagnosed at the same time, and 72.7% of mothers were infected sexually. **Conclusion:** Mother-to-child-transmission was the main responsible for infant infection and there was a significant prevalence of late postnatal transmission through breastfeeding in our sample. Moreover, the severity of infant symptoms, the moment of diagnosis and mother's category of exposure highlight a gap on HIV prevention, and the importance of finding prophylactic measures and scientific improvement in order to reduce HIV transmission through breastfeeding.

Keywords: HIV infections; child; breastfeed; vertical infection transmission.

RESUMO

Introdução: Na faixa etária de 0 a 5 anos, considera-se a transmissão vertical o indicador da infecção pelo vírus da imunodeficiência humana (HIV). A principal via de exposição pós-natal ocorre pelo aleitamento materno. Quando a infecção aguda materna se dá no período puerperal, há maior risco de infecção infantil, devido à elevada carga viral materna. **Objetivo:** Avaliar as formas de infecção pediátrica pelo HIV no serviço de Infectologia Pediátrica do Complexo do Hospital de Clínicas da Universidade Federal do Paraná (UFPR), com ênfase na transmissão vertical tardia via aleitamento materno. **Métodos:** Estudo transversal e analítico, com coleta de dados retrospectiva, avaliando pacientes de 0 a 16 anos infectados pelo vírus HIV, acompanhados de 2010 a 2015. Realizada análise da categoria de exposição por protocolo geral, seguida de protocolo específico para casos sugestivos de transmissão vertical tardia via aleitamento materno, objetivando compreender as características maternas e pediátricas. **Resultados:** Dos 122 pacientes incluídos, 95,0% foram infectados via transmissão vertical. Desses, 11 (9,5%) casos foram de infecção tardia — possível ou confirmada — via aleitamento materno. Ao diagnóstico da criança, 72,7% apresentaram sintomas decorrentes da infecção pelo HIV. Em 45,4% desses casos, mães e filhos foram diagnosticados concomitantemente e 72,7% das mães apresentaram categoria de exposição sexual. **Conclusão:** A transmissão vertical confirmou-se como a principal forma de contaminação pelo vírus HIV, com importante prevalência da infecção tardia pelo aleitamento materno. Essa observação, a gravidade dos sintomas pediátricos, o momento do diagnóstico e categoria de exposição maternos destacam a importância da busca de medidas profiláticas e avanços científicos que objetivem a redução da transmissão do HIV via leite materno.

Palavras-chave: infecções por HIV; criança; aleitamento materno; transmissão vertical.

INTRODUCTION

The human immunodeficiency virus (HIV) is considered the main infectious agent causing death in the world. According to the World Health Organization (WHO), about 39 million people have died since the first cases described in 1981. The HIV epidemic affects not only the health of individuals with the virus, but it also has an impact on

families, communities, countries and entire societies, even contributing to socioeconomic changes in several nations⁽¹⁾.

According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), since the beginning of the AIDS epidemic until June 2015, 798,366 cases of HIV infection were registered in Brazil, and 290,929 deaths were recorded in all age groups⁽²⁾. Specifically in the pediatric group, there were 17,539 cases among children aged under 5 years old, and 4,435 cases among children aged between 5 and 9 years. Vertical transmission accounts for approximately 100% of AIDS cases among children aged under 5 years old, making infection rates in this group the indicator of vertical transmission in the country. Based on these data, the

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undeniable importance of vertical HIV transmission in children in Brazil is noteworthy⁽³⁾.

Vertical transmission occurs through the spread of the virus from the mother to the baby, and can occur at different times: intrauterine, peripartum or postnatal via breastfeeding — in this case, it is called late vertical transmission⁽⁴⁾. The general principles governing the various forms of vertical transmission are complex, involving the interaction of different aspects, such as clinical and immunological factors of the mother, the newborn and of breastfeeding. Despite this high complexity, it is known that the main influence on vertical transmission is the maternal viral load⁽²⁾.

Regarding the postnatal exposure of the newborn to HIV through breastfeeding, there is no doubt about the presence of the virus in breast milk or about its infecting potential, resulting in the contraindication of breastfeeding in HIV-positive mothers. There is a significant increase in the risk of infection through breastfeeding due to factors such as primary maternal infection, high viral load, maternal immunosuppression and inflammatory breast conditions such as mastitis⁽⁵⁾. Even in the case of seronegative mothers during pregnancy, there are situations in which maternal infection occurs in the puerperal period, which constitutes an extreme risk for the child, since there is a high viral load for HIV and a reduction in maternal T-CD4 + lymphocytes count in such situations⁽⁴⁾. It is estimated that the intake of each liter of milk presents a risk of infection corresponding to the risk offered by an unprotected heterosexual relationship, which is the main route of HIV transmission⁽⁶⁾.

Given this scenario, a greater emphasis is placed on the importance of breastfeeding for vertical transmission of HIV, especially in cases of puerperal infection of the mother. In order to inform and stimulate interventions that promote prevention against this type of HIV transmission, it is essential to improve knowledge about the epidemiology of these cases.

OBJECTIVE

To identify, among HIV-infected children during follow-up care at the Pediatric Infectious Diseases Service of the Clinical Hospital Complex of *Universidade Federal do Paraná* (CHC-UFPR), the forms of virus acquisition, with emphasis on late vertical transmission through breastfeeding, analyzing the prevalence of children infected via breast milk, and describing the cases in which the maternal infection occurred during the puerperal period.

METHODS

The study was carried out in a cross-sectional, analytical and descriptive manner. Data collection was retrospective, through the analysis of medical records of children and adolescents aged between 0 and 16 years, of both genders, who were diagnosed with HIV and were being followed up by the CHC-UFPR Pediatric Infectious Disease Service between January 2010 and July 2015. Patients with incomplete or missing data were excluded from the study. The study was submitted to *Plataforma Brasil*, under Certificate of Presentation for Ethical Appreciation (CAAE) No. 50905215.0.0000.0096, and approved by the Research Ethics Committee of CHC-UFPR.

All patient charts that met the inclusion criteria were initially assessed using a general profile analysis form. Data were collected

on sociodemographic characteristics and general characteristics of HIV infection, specifying: period of follow-up at the Pediatric Infectious Disease Service; date of diagnosis; and category of virus exposure, which was divided into five subcategories:

1. late vertical transmission through breastfeeding: negative prenatal tests and rapid HIV testing at birth, with subsequent post-treatment and breastfeeding;
2. possible late vertical transmission through breastfeeding: mothers with some negative HIV test during pregnancy and postpartum HIV diagnosis, with breastfeeding;
3. vertical transmission at unknown moment: when the mother presented positive serology for HIV and it was not possible to determine the moment of transmission to the child — due to the proximity of the events;
4. transmission through sexual abuse: when other forms of transmission were discarded and the offender had positive HIV serology;
5. transmission by unknown route: when the mother had HIV negative serology and other transmission routes described in the literature were discarded, or in cases of adoptive or institutionalized children in which maternal data were not known.

Once the overall HIV transmission profile was established in the study population, patients whose data were suggestive of late infection via breastfeeding were submitted to detailed data analysis using a specific collection form. Included in this group were patients classified as possible late transmission and late transmission through breastfeeding in the collection of general data. At this stage, maternal data were collected, including age, parity, exposure category, and date and time of HIV diagnosis and testing. Regarding the gestation of the patient in question, the following variables were considered: prenatal care, HIV testing during prenatal care and type of delivery. As for the infected child, the characteristics analyzed were: birth weight, gestational age, complications in the neonatal period, tests that confirmed the diagnosis, breastfeeding time, age at diagnosis, presence of symptoms at diagnosis, clinical and immunological classification according to the Center for Disease Control and Prevention (CDC)⁽⁷⁾, current viral load, current CD4 lymphocytes (Cluster of Differentiation 4), and the treatment and occurrence of previous hospitalizations.

All data were collected, reviewed and tabulated in Excel[®] before statistical analysis, which was carried out in a descriptive way.

RESULTS

Of the 122 children attended by the CHC-UFPR Pediatric Infectious Disease Service between 2010 and 2015 and included in the study, 63 were males (51.6%), with a median age of 11.05 years, ranging from 0.26 to 16.97 years.

As to the origin, 74 cases were from Curitiba (60.7%), 24 from the Metropolitan Region of Curitiba (19.7%), and 24 from other locations in Paraná (19.7%). Of the 122 patients, 66 (54.1%) lived with their parents, 24 (19.7%) lived with relatives, 17 (13.9%) were institutionalized and 15 (12.3%) were adopted.

The total follow-up time presented an average of 86.2±54.6 months. Regarding the category of exposure, 116 (95.1%) cases were classified as vertical transmission. In 1 (0.8%) case, the exposure category was sexual; and 5 (4.1%) were due to unknown transmission (it was not possible to identify the form of HIV transmission). The cases of

vertical transmission were then evaluated for the moment of infection (**Figure 1**).

Specifically among the 116 cases of vertical transmission: 105 were vertical transmission at an unknown moment (90.5%); 9, possible late vertical transmission via breastfeeding (7.7%); and 2, confirmed late transmission by breastfeeding (1.7%) (**Graphic 1**).

The nine cases classified as possible late vertical transmission via breastfeeding and the two confirmed cases of late transmission through breastfeeding were submitted to detailed analysis. Maternal characteristics are presented in **Table 1**.

The median age of the mothers of children classified as possible transmission via breastfeeding and late transmission via breastfeeding was 34 years old, ranging from 21 to 49 years. From the previous obstetric data, the average number of pregnancies was 3.1 ± 2.18 per mother.

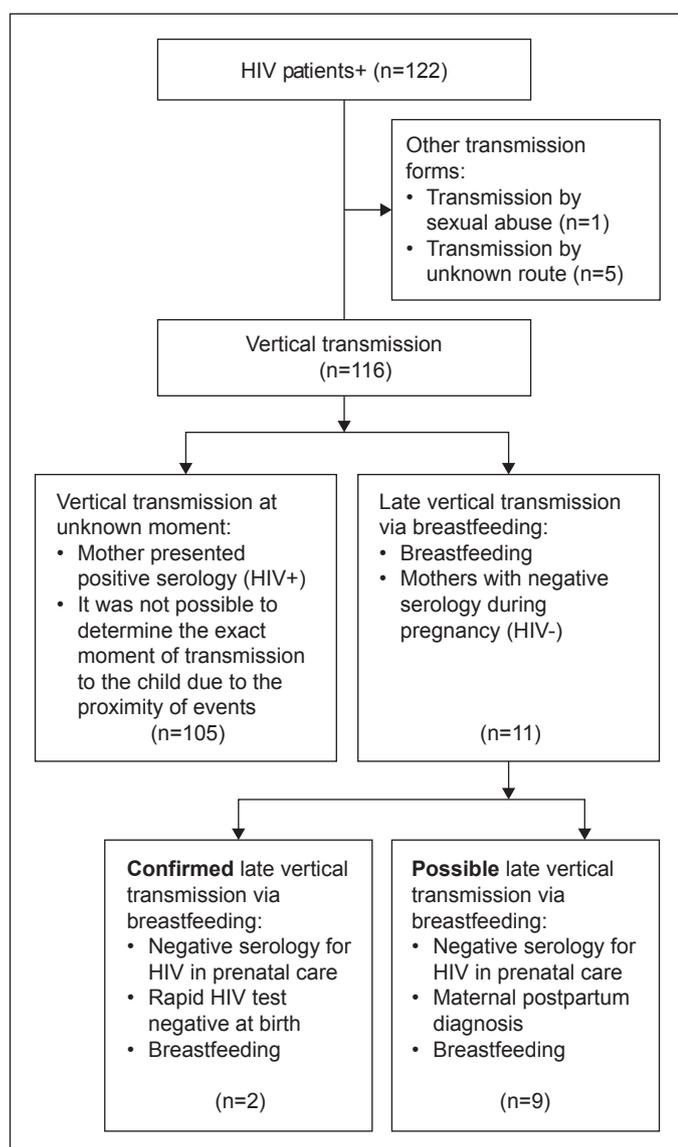
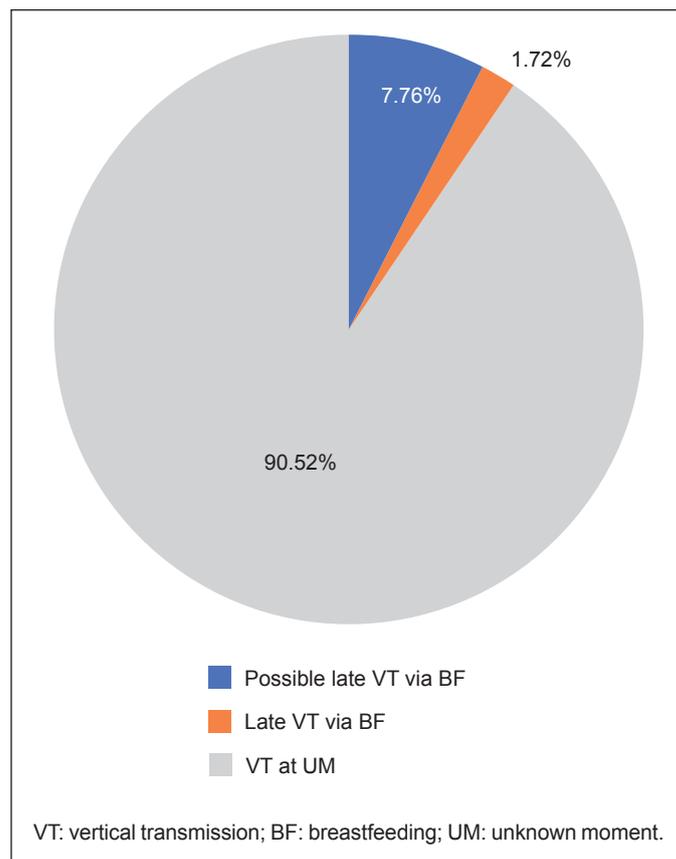


Figure 1 – Distribution of the 122 cases of pediatric patients being followed up at the HIV/AIDS Outpatient Clinic of the Pediatric Infectious Disease Service of Complexo Hospital de Clínicas da Universidade Federal do Paraná from 2010 to 2015, according to the category of exposure and criteria of eligibility of the study.

As observed in **Table 1**, 45.4% of mothers were diagnosed as seropositive only at the time of their child's diagnosis. Furthermore, the main category of maternal exposure was sexual: mothers had contact with the virus through an infected partner, relations with multiple partners or both (as in the case of 2 of the 11 mothers).

Regarding gestational data and specific pediatric characteristics, the 11 mothers underwent prenatal care: 8 (72.2%) were performed at primary health care units (BHU) and 2 (18.1%) at CHC-UFPR;



Graph 1 – Distribution of the 116 cases of vertical transmission in follow-up at the HIV/AIDS Outpatient Clinic of the Pediatric Infectious Disease Service of Complexo Hospital de Clínicas, Universidade Federal do Paraná, from 2010 to 2015.

Table 1 – Maternal characteristics of patients infected by late vertical transmission in follow-up at the HIV/AIDS outpatient clinic of the Pediatric Infectious Disease Service of Complexo Hospital de Clínicas, Universidade Federal do Paraná.

Characteristics	n	%
Moment of diagnosis		
Due to maternal illness	2	18.1
Moment of child's diagnosed	5	45.4
In new pregnancy	2	18.1
Other	1	9.0
Unknown	1	9.0
Category of exposure		
Sexual	8	72.7
Intravenous drug use	2	18.1
Blood transfusion	1	9.0
Unknown	2	18.1

in 1 case (9.0%), the place of prenatal care was unknown. Of the 11 children, 9 (81.9%) were born full term, 1 (9.0%) was preterm, and 1 (9.0%) had no known gestational age. The median weeks of gestation were 38.75 — ranging from 30 to 40 weeks. Regarding delivery, 8 (72.7%) patients were born via vaginal delivery and 3 (27.3%) were cesarean. The median birth weight was 3,157.5 g ranging from 2,900 to 3,925 g. The occurrence of neonatal complications in the patients in question was also analyzed, with only 1 (1.0%) presenting some kind of intercurrent.

The median age of these patients was 7.63, ranging from 3.14 to 14.95 years. Concerning sociodemographic data, 63.3% of the patients were from Curitiba and 36.2% lived in the Metropolitan Region of Curitiba or other cities of Paraná. Among the 11 patients evaluated for late HIV infection via breastfeeding, 9 (81.8%) had their relatives as their guardians, and 2 (18.2%) lived with their parents. All patients were breastfed. The mean duration of the breastfeeding period was 13.36±9.68 months. Of these children, 7 (63.6%) were diagnosed through the HIV ELISA test and 4 (36.4%) through the viral load test. The mean age at diagnosis was 23±17.5 months.

At the time of diagnosis, 8 (72.7%) children had symptoms of HIV infection. All children underwent CDC clinical and immunological classification for HIV patients, carried out at two moments: at the worst clinical and immunological moment during follow-up at the service and at the moment of data collection, as explained in **Table 2**.

It is observed that, at the worst clinical moment, 5 children were classified as B and C (moderate or severe signs and symptoms). In the clinical evaluation in the period of the research, 10 children were classified as N or A, that is, with slight or absent clinical signs or symptoms. Regarding immunological classification, at the worst time (CDC classification), 63.6% of the patients had moderate or severe immunosuppression; at the time of this study's evaluation, 72.7% of the children presented no immunosuppression.

Of the 11 patients, 9 (81.8%) were hospitalized at some time during follow-up at CHC-UFPR: 3 patients due to thrombocytopenic purpura secondary to HIV (2 of them with more than one hospitalization); 5 patients with bronchopneumonia (one of the cases had recurrent episodes); and 1 patient due to pneumocystosis. Conditions such as gingivostomatitis, malnutrition, urinary tract infection, diarrhea, lymphadenopathy and moniliasis were associated with clinical

conditions that led to hospitalizations; and, in five cases, there was more than one reason for hospitalization.

The viral load in the evaluation during the study period was undetectable for 5 patients (45.45%); for the other 6, it ranged from 81 to 27,676 copies/mL. The mean value of T-CD4 lymphocytes for the 11 patients was 1,761.18±1,456.53 cells/mm³. At the time of this study, 9 (81.8%) patients were undergoing antiretroviral therapy, and 2 (18.2%) did not use the medication.

DISCUSSION

In this study, the prevalence of vertical HIV transmission was confirmed as the main cause of childhood infection. In agreement with the Epidemiological Bulletin of the Brazilian Ministry of Health of 2016, this form of transmission was responsible for more than 90.0% of all cases analyzed in our sample, regardless of the time of infection⁽⁸⁾. Within the vertical transmission category, literature estimates that the infection can occur in utero in 35.0% of cases; peripartum in 65.0% of them; or postpartum via breastfeeding, in 7 to 22% of the cases⁽⁴⁾. With the focus on this last form of transmission, our study detected the existence of cases in which breastfeeding was the probable or confirmed cause for the infection in the puerperal period, totaling 9.5% of the patients with HIV seen in CHC-UFPR.

Determining the exact timing of the transmission and calculating the rate of transmission in each case is challenging. It may be impossible to determine the exact timing of the virus transmission, considering the closeness of the events between the end of gestation, delivery and start of breastfeeding⁽⁹⁾. This fact and the sometimes undesirable quality of medical records were a limitation of our study, since 90.5% of the cases of vertical transmission were classified as vertical transmission at an unknown moment. However, the establishment of a protocol in the methodology of the study to identify cases of transmission via breastfeeding made it possible to identify two confirmed cases and nine possible cases of late vertical transmission via breastfeeding. Included in this protocol are quality prenatal care, presentation of the results of the two anti-HIV serologies recommended by the Ministry of Health, as well as the rapid test for HIV at the time of delivery⁽¹⁰⁾.

Reducing HIV transmission is one of the most important public health dilemmas in the world, involving researchers, health professionals, and policy makers. Especially in developing countries, transmission via breast milk is an important source of virus infection. The average risk of mother-to-fetal transmission has increased in newly-infected lactating women and is estimated to be around 29.0%, illustrating the importance of preventing primary infection during breastfeeding⁽¹¹⁾. However, its mechanism is still not fully elucidated, which makes it difficult to implement effective measures to eradicate this form of transmission⁽¹²⁾. Up to the present time, it is known that maternal and child-related factors are involved. Maternal factors include seroconversion during lactation, immunological clinical progression of the disease, viral load in plasma and in breast milk, breast milk immune factors, breast health (e.g., mastitis, abscess or breast fissure), maternal nutritional status and duration of breastfeeding. Child-related factors related to this type of infection include those associated with the immune system and the breastfeeding pattern (mixed or exclusive)⁽⁶⁾.

Table 2 – Distribution of children infected with human immunodeficiency virus via possible or proven late vertical transmission by breastfeeding, according to the Clinical-Immunological classification of Center for Disease Control and Prevention and current evaluation.

Variable	Degree	CDC Classification		Current Evaluation	
		n	%	n	%
Clinical signs and/or symptoms	Absent / low	6	54.55	10	90.91
	Moderate / high	5	45.45	1	9.09
Immunological changes	Absent	4	36.36	8	72.73
	Moderate / high	7	63.64	3	27.27

CDC: Centers for Disease Control and Prevention

Most studies have considered maternal HIV viral load as the most significant predictor of vertical transmission^(13,14). In a meta-analysis that evaluated the incidence of HIV in pregnant and postpartum women with studies conducted between 1980 and 2013, it was found that in acute infection, where viral load is high, there is a 2.8-fold higher risk of vertical transmission compared to chronically infected mothers⁽¹⁵⁾. That is, seroconversion in the breastfeeding period is associated with a high risk of postnatal transmission⁽¹⁶⁾. It has been reported that mothers who undergo seroconversion in the puerperal period are more likely to be single, with multiple partners, with adulterous partners and/or infected with other concomitant sexually transmitted agents⁽¹⁷⁾. In our study, this trend was confirmed, since 72.7% of the mothers of the infants infected in the breastfeeding period were in the sexual exposure category, which included sexual promiscuity behaviors associated or not with the presence of an HIV-positive partner. In addition, 45.4% of the mothers obtained the diagnosis of infection only at the time of their children's diagnosis, with negative prior tests, which indicates the maternal unawareness of the disease and the probable acute infection in the puerperal period, allowing breastfeeding and consequent infection.

In the newborn, it is believed that the gateway for the virus are the nasopharyngeal and gastrointestinal mucosae. During breastfeeding, virus transmission can occur at any stage, but it appears to be more frequent in the first few weeks and especially in more recent maternal infections⁽¹⁸⁾. It has been shown that the viral load in the colostrum is higher than in mature milk⁽¹⁹⁾. However, the number of feedings increases with the child's growth, increasing the risk of transmission by accumulated exposure to the virus⁽²⁰⁾. In addition to biological factors, there are socioeconomic and cultural factors related to a higher risk of vertical transmission via breast milk, such as mixed and cross-fed breastfeeding. There are reports, for example, of children with no previous history of exposure to the virus but who were infected with milk from milk banks and from women other than their mothers⁽²¹⁾.

In the present study, the characteristics of the current and past morbid history of the children were discussed, including the moment of diagnosis, their evolution and follow-up in the Pediatric Infectology Service. It was observed that 90.9% of the children with possible or confirmed HIV infection through late vertical transmission due to breastfeeding did not present complications in the neonatal period and 81.9% were born full term, which allows to infer that these patients were born, in the majority, in overall good condition. However, at the time of diagnosis, 72.7% of them had symptoms and 81.8% were hospitalized for some important clinical condition — either at some time prior to diagnosis or during the follow-up period at CHC-UFPR. Recurrent bronchopneumonia, thrombocytopenic purpura secondary to HIV, pneumocystosis, gingivostomatitis, malnutrition, urinary tract infection, diarrhea, lymphadenopathy and moniliasis revealed the reasons for various hospitalizations, and in 45.4% of cases there was more than one reason for hospitalization.

Regardless of the timing of HIV infection, once it has occurred, it is known that the progression of the disease is generally faster in infected children compared to adults, with rapid decline of CD4 cells and development of difficult-to-treat recurrent infections⁽²²⁾. Symptoms of acute infection in children may be nonspecific, as they often coincide with other common childhood infectious conditions, such as upper airway infections, fever, and dermatitis. However, when

concomitant, symptoms such as these may increase the predictive value of HIV infection⁽²³⁾.

In the present study, 45.4% of the children investigated for suspected infection by late vertical transmission presented moderate to severe symptoms at the time of diagnosis, and 63.6% presented moderate to severe immunological changes according to the CDC classification. After treatment with antiretroviral therapy (ART) in 81.8% of the patients in this category, 90.9% of them had mild or absent signs and symptoms, and 72.7% had immunological changes absent in evolution.

Therefore, it can be concluded that the clinical evaluation of HIV infection, even if challenging, is a very important diagnostic tool. When associated with a high degree of suspicion for early diagnosis and treatment, it may contribute to the reduction of infant morbidity and mortality.

The results of this study show the need for concrete definition of preventive measures for vertical transmission via breastfeeding, mainly in the puerperal period. There are already recommendations from the WHO, the United Nations Children's Fund (UNICEF) and the Brazilian Ministry of Health on effective prophylactic measures implemented in Brazil to reduce vertical transmission during pregnancy and peripartum, which include use of ART during gestation and the recommendation of non-breastfeeding in the case of women known to be infected, for example^(11,18). However, as demonstrated in this study, in maternal postpartum infections, these measures are not applied, mainly due to the lack of screening and diagnosis during breastfeeding.

In view of the fact that heterosexual transmission is the main mode of transmission of HIV in underdeveloped regions, and is becoming a major route of infection in developed countries, it is believed that the best measure against infection via breastfeeding would be prevention of HIV infection in young women of child-bearing age⁽²⁴⁾. To this end, prevention strategies should be linked to primary public health and prevention programs, promoting education on safe sex, condom use, diagnosis and treatment of sexually transmitted infections, taking advantage of the timing of prenatal care for the implementation of such measures. HIV prevention deserves special emphasis among mothers with seronegative testing during pregnancy because of the particularly high risk of mother-to-child transmission of HIV at the time of infection in the puerperium⁽¹³⁾. Prenatal testing and the guarantee of continued contact of the health system with the mothers for up to 24 months postpartum are very important procedures in this process⁽²⁵⁾. Also, within this context of sexual transmission, it is important to increase the bond with the children's fathers in the pre- and postnatal periods, highlighting the risks of sexually transmitted infections acquired by them for maternal-fetal health. An example of this was the implementation of the National Policy for Comprehensive Health Care for Men, through the 2008 Male Pre-Natal Program⁽²⁶⁾.

Prenatal care is also an opportune time for the implementation of safe and healthy breastfeeding practices. In the context of HIV, it is important to educate mothers about the greatest risks of transmitting the virus to children when implementing cross-breastfeeding, even if it is by someone from the same family.

New possibilities for prevention of HIV transmission via breast milk have been emerging, such as the use of ART in mothers during breastfeeding and the use of pre- and post-exposure prophylaxis for

the children. New research on the real potential of these measures is still necessary, so that they can be implemented in the future as public policies⁽¹¹⁾.

CONCLUSION

It can be concluded that the main form of childhood HIV infection was vertical transmission, with a significant prevalence of cases in which infant infection occurred through breastfeeding after maternal infection in the puerperal period. Due to the significant clinical presentation showed by these children, as well as due to maternal unawareness about their infection status, the need to implement more effective preventive measures is evident.

Conflict of interests

The authors declare no conflict of interests.

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