

Related Factors of Mother-To-Child HIV Transmission: A Prospective Study in an Giang Province

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Abstract

Introduction: Vietnam has not yet conducted any studies reporting the rate of mother-to-child HIV transmission at 6 – 8 weeks. This study aims to determine some factors related to mother-to-child transmission of HIV in An Giang province.

Methods: A prospective study was conducted on pregnant women from An Giang residing in An Giang province from January 1, 2010, to December 31, 2010; and all pregnant women infected with HIV from August 1, 2008, to December 31, 2010, who were managed and monitored for mother-to-child HIV transmission in An Giang province.

Results: 98 pregnant women and their children infected with HIV were monitored for analysis. The average age of the mothers, the history of HIV infection in the mothers, the stage of HIV infection in the mothers, the number of childbirths, and the BMI index showed no relation to the transmission of HIV to the children. The average gestational age in the group of children infected with HIV was 37.11 weeks compared to 38.60 weeks in the group of children not infected with HIV, with the difference in gestational age between the two groups being statistically significant. No statistically significant differences were found related to the factors of episiotomy, baby weight, baby gender, and Apgar scores at 1 minute and 5 minutes between the groups of children infected with HIV and those not infected with HIV. There were 21 recorded cases of cesarean section, but none of the children in these cases were infected with HIV, while in the group of children born via vaginal delivery, 9 out of 77 cases were infected.

Conclusion: A fetus under 37 weeks is one of the risk factors associated with mother-to-child transmission of HIV compared to a more advanced gestational age, and this difference is statistically significant.

Keywords: HIV transmission; mother to child; An Giang province

Introduction

With comprehensive testing strategies during pregnancy, the use of anti-retroviral (ARV) drugs during pregnancy, intrapartum, and postnatally to the infant, elective cesarean delivery when HIV viral load remains detectable near the end of pregnancy, and avoidance of breastfeeding, mother-to-child transmission of HIV (MTCT) has been dramatically reduced, particularly in resource-rich settings [1, 2]. Advances are also being achieved in environments with low resources, where widespread implementation of prenatal ARV programs and ARV prophylaxis during nursing are underway [3, 4].

Most children living with HIV are infected through mother-to-child transmission occurring during pregnancy, labor, and delivery, or breastfeeding [5]. Without any intervention, the risk of this transmission is 15-30% in non-breastfeeding populations; mothers with HIV who breastfeed increase this risk by 5-20%, and the overall risk is 20-45% [6-8].

Currently, there are no studies in Vietnam reporting the rate of mother-to-child HIV transmission at 6-8 weeks. With the desire to provide good advice to policymakers to help reduce the rate of pregnant women with HIV and to identify some factors related to mother-to-child HIV transmission in An Giang province, we conducted this study.

Materials and Methods

Research Subjects

Inclusion criteria were all pregnant women with HIV who came for prenatal care and gave birth in An Giang province from August 1, 2008, to December 31, 2010. Newborns and mothers diagnosed with HIV are managed and monitored for mother-to-child HIV transmission.

Sample Size

Pregnant women from An Giang and residing in An Giang province from January 1, 2010, to December 31, 2010; and all pregnant women with HIV from August 1, 2008, to December 31, 2010, who are managed and monitored for mother-to-child HIV transmission in An Giang province.

Variables

Diagnosis of maternal HIV infection: confirmed as HIV positive when the serum sample tests positive for HIV antibodies three times using the ELISA method with three different reagents, each with different reaction principles and antigen preparation methods, conducted at the An Giang Provincial Preventive Medicine Center.

Diagnosis of HIV infection in children under 18 months: positive RT-PCR HIV DNA test and confirmed positive again with a second test on two separate samples taken more than 04 weeks after birth, conducted at the Pasteur Institute in Ho Chi Minh City.

Diagnosis of children not infected with HIV: when there are 2 consecutive negative RT-PCR HIV DNA tests, with the second test conducted more than 04 weeks after birth, performed at the Pasteur Institute in Ho Chi Minh City, and the child must be exclusively formula-fed. Specific situations are as follows: Child not infected with HIV at birth: when the RT-PCR HIV DNA test on umbilical cord blood is negative and the test at 6-8 weeks is also negative. Child not infected with HIV at 6-8 weeks: when the RT-PCR HIV DNA test at 6-8 weeks is negative and the test one month later is also negative. Child not infected with HIV at 06 months: when the RT-PCR HIV DNA test at 6 – 8 weeks and at 06 months are both negative or the child's blood ELISA test result is negative at 18 months of age. Extrapolating diagnostic results: In a few cases, RT-PCR HIV DNA tests confirm a negative PCR result after 6 – 8 weeks and/or the child's blood ELISA test result at 18 months of age is negative, allowing the assumption that the child was also negative at birth and at 6 – 8 weeks. Diagnosing HIV infection in a child with only one test: In a few cases where

there is only one positive RT-PCR HIV DNA test, we will analyze it as an HIV infection case. The timing of HIV infection diagnosis is based on the first positive RT-PCR HIV DNA test. In a few cases, to avoid sample loss, we need to confirm the child's HIV status at 03 or 04 months or earlier to avoid losing track.

Data Analysis

Statistical analysis was performed using the SPSS version 20.0 softwares. Categorical variables were analyzed by chi-square; continuous variables were analyzed by t-independent test. A p-value < 0.05 was considered statistically significant.

Results

Comparing the clinical characteristics of pregnant women with HIV in the two groups of children, we observed the following features (Table 1): Regarding the average age of the mothers, in the group of children not infected with HIV, it was lower at 26.66 ± 5.40 compared to the group of mothers with HIV-infected children at 28.22 ± 5.36 . However, this difference was not statistically significant, $p = 0.41$. Regarding the stage of HIV infection, we did not observe that the majority were in stage 1. In the group of HIV-infected children, all mothers were in stage 1. We did not find any difference in the stage of HIV infection among the HIV-infected mothers. Similarly, factors such as the mother's history of HIV infection, the number of childbirths, and BMI index were not related to the transmission of HIV to the child.

Table 1: Comparison of characteristics of pregnant women with HIV between the groups of babies with HIV and without HIV

Variables	n = 98		
	HIV (-) n = 89	HIV (+) n = 09	Value P
Mother's age	26.66 ± 5.40	28.22 ± 5.36	0.41
HIV infection stages + Stage 1 + Stage 2 + Stage 3 + Stage 4 + Total	78 (87.64%) 05 (5.62%) 05 (5.62%) 01 (1.12%) 89 (100%)	09 (100%) 00 00 00 09 (100%)	0.74
History of HIV infection + Unknown + Known HIV infection + Total	60 (67.42%) 29 (32.58%) 89 (100%)	8 (88.89%) 01 (11.11%) 09 (100%)	0.27
Medical history of childbirth + First child + Second child + Third child + Fourth child + Total	47 (52.81%) 31 (34.83%) 08 (8.99%) 03 (3.37%) 89 (100%)	05 (55.56%) 02 (22.22%) 02 (22.22%) 00 (00%) 09 (100%)	0.55
BMI	23.75 ± 2.23	23.83 ± 2.35	0.91

Comparing the clinical characteristics of the two groups of mothers of HIV-infected and non-HIV-infected babies, we did not find any statistically significant differences in hematological indices such as: red blood cell count, white blood cell count, lymphocyte count, platelet count, Hct, Hemoglobin, and liver enzyme indices (Table 2).

Table 2: Comparison of clinical characteristics of pregnant women with HIV in two groups: babies with HIV and babies without HIV

Variables	n = 98		
	HIV (-) n = 89	HIV (+) n = 09	Value P
Hematology test:			
+ Red blood cells (million/mm ³)	3.74 ± 0.54	3.856 ± 0.38	0.43

+ Hemoglobin (g/dl)	11.94 ± 1.46	11.84 ± 1.20	0.82
+ Hct %	33.84 ± 4.78	34.44 ± 3.38	0.63
+ White blood cells (thousand/mm ³)	9.87 ± 4.1	12.543 ± 7.9	0.21
+ Lymphocyte (thousand /mm ³)	2.3 ± 0.87	2.07 ± 0.55	0.29
+ Platelets (thousand/mm ³)	255 ± 77	235 ± 114	0.65
Biochemical test:			
+ AST (UI/L)	29 ± 33	23 ± 7.7	0.90
+ ALT (UI/L)	27 ± 27.74	19.77 ± 8.44	0.14

The average gestational age in the group of HIV-infected infants is 37.11 weeks compared to 38.60 weeks in the group of non-HIV-infected infants. The difference in gestational age between the two groups is statistically significant, $p = 0.037$. When stratifying by gestational age, we found that in cases where the gestational age is less than 37 weeks, the HIV infection rate is 66.67% in the HIV-infected infant group compared to only 23.60% in the non-HIV-infected infant group. This difference is statistically significant, $p = 0.012$. This leads us to infer that preterm infants have a higher risk of HIV infection compared to full-term infants. Regarding the labor stage, we found that in the group of HIV-infected babies, 100% of pregnancies had entered the labor stage compared to 82% in the group of non-HIV-infected babies. However, we did not find a statistically significant difference in this factor. The time from hospital admission to delivery shows that in the group of HIV-infected babies, the preparation time for delivery was shorter, averaging about 6 hours compared to 21 hours in the group of non-HIV-infected babies. We did not find a statistically significant difference in this time factor, $p = 0.09$. Regarding the duration of early membrane rupture, we found that in the group of HIV-infected babies, the duration of membrane rupture over 4 hours accounted for 22.22%, higher than the 11.24% in the group of non-HIV-infected babies. However, the difference was not statistically significant, $p = 0.3$. Similarly, we did not find a correlation between the use of oxytocin and HIV infection in babies (Table 3).

Table 3: Comparison of characteristics between two groups of babies with HIV and without HIV during pregnancy

Variables	n = 98		
	HIV (-) n = 89	HIV (+) n = 09	Value P
Gestational age	38.60 ± 1.66	37.11 ± 2.15	0.037
Gestational age grouping + < 37 weeks + ≥ 37 weeks + Total	21 (23.60%)68 (76.40%)89 (100%)	06 (66.67%)03 (33.33%)09 (100%)	0.012
Labor stage + Not in labor + Latent + Active + Total	16 (17.98%)49 (55.06%)24 (26.96%)89 (100%)	00 (00%)04 (44.44%)05 (55.56%)09 (100%)	0.15
Time from hospital admission to delivery (hours)	21 ± 33	6 ± 5.34	0.09
Time from water breaking to birth: + < 4 hours + ≥ 4 hours + Total	79 (88.76%)10 (11.24%)89 (100%)	07 (77.78%)02 (22.22%)09 (100%)	0.3
Oxytocin + Do not use Oxytocin + Use Oxytocin + Total	58 (65.17%)31 (34.83%)89 (100%)	06 (66.67%)06 (33.33%)09 (100%)	0.62

We did not find any statistically significant differences related to the factors of episiotomy, baby weight, baby gender, and Apgar scores at 1 minute and 5 minutes between the groups of HIV-infected and non-HIV-infected babies. We are particularly concerned and noted that there were 21 cases of cesarean section, but none of these cases involved HIV-infected babies, whereas in the group of babies born vaginally, there were 9 HIV-infected babies out of a total of 77 vaginal births (Table 4).

Table 4: Comparison of characteristics between two groups of babies born with and without HIV

Variables	n = 98		
	HIV (-) n = 89	HIV (+) n = 09	Value P
Episiotomy + No + Yes + Total	59 (66.29%) 30 (33.71%) 89 (100%)	06 (66.67%) 03 (33.33%) 09 (100%)	0.65
Method of delivery + Vaginal delivery + Cesarean section + Total	68 (76.40%) 21 (23.60%) 89 (100%)	09 (100%) 00 (00%) 09 (100%)	0.19
Gender of the baby + Girl + Boy + Total	47 (52.81%) 42 (47.19%) 89 (100%)	06 (66.67%) 03 (33.33%) 09 (100%)	0.50
Child weight (grams)	2861 ± 471	2988 ± 388	0.52
Weight classification for children + < 2500 grams + ≥ 2500 grams + Total	13 (14.61%) 76 (85.39%) 89 (100%)	01 (11.11%) 08 (88.89%) 09 (100%)	0.62
Apgar 1 minute + Asphyxia + No asphyxia + Total	08 (8.99%) 91 (9.01%) 89 (100%)	00 (00%) 09 (100%) 09 (100%)	0.45
Apgar 5 minutes + Asphyxia + No asphyxia + Total	05 (5.62%) 84 (94.34%) 89 (100%)	00 (00%) 09 (100%) 09 (100%)	0.61

Discussion

All of our cases of children with HIV have mothers with HIV in stage 1. We have not found a correlation between the stage of the mother's HIV infection and the likelihood of HIV transmission to the child, $p = 0.74$. However, according to a study by Dabis (2005) [9] conducted on a sample size of 986 pregnant women with HIV, it was shown that the transmission rate of HIV from mother to child in stages 1-2 is 6.5%, compared to 13.4% in stages 3-4, and this difference is statistically significant, $p = 0.002$. We have not been able to detect this difference, possibly due to the insufficient sample size of our study.

Comparing the average gestational age between the two groups, we found that the average gestational age in the non-HIV-infected group was 38.60 ± 1.66 weeks, compared to 37.11 ± 2.15 weeks in the HIV-infected group. This difference is statistically significant, $p = 0.036$. When dividing the study groups, it was found that among the 09 HIV-infected cases, 06 had a gestational age of less than 37 weeks, accounting for 66.67%, compared to 21/89 cases in the non-HIV-infected group, accounting for 23.60%. This difference is statistically significant, $p = 0.012$. Our research results are similar to those of Garcia (1999) [10], who studied 552 pregnant women with HIV and found that the rate of HIV infection in children under 37 weeks was 30.30% (30/99) compared to 18.50% (84/453) in children from 37 weeks and older, showing a statistically significant difference, $p = 0.01$.

We found that all 09 children infected with HIV were born to mothers who were admitted to the hospital during labor. However, our analysis of the differences in mother-to-child HIV transmission during labor stages did not reveal any statistically significant differences, $p = 0.15$. We have not recorded reports from other authors on this issue, so we cannot compare with other authors' reports.

From the research results, we found that the average time in the group of children infected with HIV was significantly shorter, 6 ± 5.34 (hours) compared to 21 ± 33 (hours). This raises the hypothesis that women who are admitted to the hospital late may have a delayed opportunity to use ARV drugs, making the effect of ARV drugs insufficient for prevention. However, comparing the average time between the two groups, we did not find a statistically significant difference, $p = 0.09$.

Reviewing the literature, we noted that author Newell (2004) [11] studied mortality in children born to HIV-infected mothers in Africa and found that the longer the delivery time, the higher the risk of HIV infection. Author Shaffer (1999) [12] recorded that

in the group using Zidovudine, the HIV transmission rate from mother to child was 8.4% for those with labor time under 10 hours compared to 11.6% for those with labor time over 10 hours, but this difference was not statistically significant, $p = 0.47$.

Through our research, we did not find a statistically significant difference in the factor of prolonged early rupture of membranes over 4 hours between the two groups, $p = 0.3$. Our research results are similar to the report by Mofenson (1999) [13], which studied 480 pregnant women with HIV and analyzed the factor of time from membrane rupture to delivery under 4 hours, showing an HIV infection rate of 4.4% compared to the group over 4 hours with a rate of 6.1%. This difference was not statistically significant, $p = 0.41$.

However, according to the study by Garcia (1999) [10], which analyzed the univariate relationship in 515 cases of HIV-infected mothers, it was shown that in the group with a time from membrane rupture to delivery under 4 hours, the rate of HIV-infected children was 14.4% (43/298) compared to the group over 4 hours with a rate of 26.7% (58/217).

Based on the results of the study and analysis to find a correlation between the use of oxytocin and an increased risk of mother-to-child transmission of HIV, we did not find this difference, $p = 0.62$. Reviewing the literature both domestically and internationally, we have not found any reports related to this oxytocin factor, so we cannot analyze and compare in this study.

In our study, we did not find that episiotomy was associated with the transmission of HIV to the child, $p = 0.65$. However, according to McGowan (2000) [14], he suggested that episiotomy is related to the transmission of HIV from mother to child as it increases the risk of exposure for the child when born vaginally. This was studied by Boyer (1994) [15] on 68 children born to HIV-infected mothers, showing that when comparing the factor of increased direct contact between the child and the mother's blood, the rate of HIV infection in the group with contact was 31% (4/13) compared to 5% (3/55) in the group without contact, this difference was statistically significant, $p = 0.02$.

The research results show that among 98 cases monitored up to 6-8 weeks, we recorded 09 cases of HIV infection. All these HIV-infected children were born vaginally out of a total of 77 cases, accounting for 11.68%. There were 21 cases of children born to HIV-infected mothers who underwent cesarean section, and upon monitoring up to 6-8 weeks, we did not detect any cases of HIV infection in these children. This led us to hypothesize that cesarean section might reduce the risk of mother-to-child HIV transmission. However, statistical analysis did not reveal a significant difference between the vaginal birth group and the cesarean section group in terms of the rate of mother-to-child HIV transmission, $p = 0.19$. Our study is similar to the report by Mofenson (1999) [13], which studied 444 pregnant women with HIV. When comparing the modes of delivery, the HIV infection rate in children born vaginally was 5.7% (20/352) compared to 4.3% (4/92) in the cesarean section group, showing no statistically significant difference, $p = 0.42$. Similarly, Garcia (1999) [10] studied 540 pregnant women with HIV, and the HIV infection rate in children born via cesarean section was 20.4% (21/103) compared to 19.9% (87/437) in the vaginal birth group, with no statistically significant difference.

However, many studies have demonstrated that elective cesarean section (performed before labor and before membrane rupture) reduces the rate of mother-to-child HIV transmission [16-19]. Additionally, the effectiveness of elective cesarean section has been demonstrated and confirmed by many observational studies, showing that elective cesarean section is associated with a reduced risk of mother-to-child HIV transmission [20-22]. However, research on cesarean section in HIV-infected women to reduce the rate of mother-to-child HIV transmission in developing countries has not been reported, and recommendations for this method are not yet convincing due to the lack of high-evidence studies on this method.

Several limitations need to be considered when interpreting this study's findings, such as the small sample size at a single center and the lack of a comparison or control group. A multicenter study with a large sample size is required to accurately assess the related factors of mother-to-child HIV transmission.

Conclusion

Related factors of mother-to-child transmission of HIV include: A gestational age of less than 37 weeks is one of the risk factors associated with mother-to-child transmission of HIV compared to a greater gestational age, and this difference is statistically significant, $p = 0.012$. Additionally, we found that although not statistically significant cesarean section has considerable clinical value. In 21 cases of cesarean section, we did not record any instances of the child being infected with HIV, compared to 9 cases of HIV infection out of 77 vaginal deliveries.

Conflict of Interest

None declared.

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