Effect of Prevention of the Mother to Child Transmission Program on the Prevalence of Postnatal HIV Infection in Benin City, Nigeria

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The aim of this study was to determine the effect of prevention of the mother to child transmission (PMTCT) program in Benin City, Nigeria on the prevalence of postnatal infant HIV. Effects of the duration of PMTCT, place of birth and sex of the infants on the prevalence of postnatal HIV were also assessed. Dried blood spots were collected from 318 infants (6−8 weeks old) born to HIV-positive mothers and were screened for the presence of HIV using a qualitative polymerase chain reaction method. A questionnaire was used to obtain information about the duration of highly active antiretroviral therapy (HAART) and place of delivery. Male infants had a significantly (p=0.032) higher prevalence of postnatal HIV infection than females. Nonparticipation of mothers in the PMTCT program was a significant risk factor for acquiring postnatal HIV (odds ratio = 4.519; 95% confidence interval = 2.422, 8.429; p<0.0001). The duration of HAART use significantly (p=0.010) affected the prevalence of postnatal HIV with an inverse relationship. The place of delivery had no effect on the prevalence of postnatal HIV. An overall prevalence of 16.98% of postnatal HIV was observed in this study. Male sex and no participation in the PMTCT program were significant risk factors for acquiring postnatal HIV, while a lower prevalence of postnatal HIV infection was associated with longer use of HAART in the PMTCT program. We recommend an early diagnosis of maternal HIV status and commencement of HAART.

Key Words: HAART; HIV; maternal; Nigeria; PMTCT; postnatal

Introduction

Mother to child transmission of HIV-1 is estimated to be the cause of at least 90% of pediatric HIV infections, with more than 700,000 children newly infected in 2006 worldwide.¹ An estimated 2.3 million children in sub-Saharan Africa are infected with HIV, most of whom acquire the virus around the time of birth.² Prevention of mother to child transmission (PMTCT) is based on the use of highly active antiretroviral therapy (HAART) and elective caesarian delivery.³ Resource-rich countries are able to provide both, and HIV transmission from mother to child in this context is reported to be less than 20%.¹ However, developing countries do not have access to these strategies.

Prevention of mother to child transmission in developing countries is mostly performed by the use

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of antiretroviral therapy and the use of single dose nevirapine has been attempted in some African countries with 50% success. However, in Nigeria with the advent of the President’s Emergency Plan for AIDS Relief program, HAART is given freely to every HIV patient, thus making HAART available to every HIV-positive pregnant woman.

The problem of stigmatization reduces the chances of early determination of the HIV status of pregnant women, which may increase the chances of mother to child transmission of the disease. In the African setting, pregnant women deliver at home or at various levels of health care with various degrees of awareness of the PMTCT program. This study determined the effect of PMTCT on the prevalence of HIV on infants as well as the effect of duration of PMTCT and place of birth on the prevalence of HIV among infants born to HIV-positive women in Benin City, Nigeria.

Materials and Methods

Study area

This study was carried out in the University of Benin Teaching Hospital, Benin City, Nigeria. The hospital is a tertiary hospital with a referral status and is one of the sites for the Institute of Human Virology, Nigeria and the President’s Emergency Plan for AIDS Relief HIV/AIDS intervention program in the country. HIV testing, treatment and monitoring are rendered at no cost. The hospital also receives mothers with their newborn infants who may have delivered in locations outside the hospital.

Study population

The study population included infants (6–8 weeks old) born to HIV-positive mothers. The mothers comprised those who delivered in our hospital and participated in the PMTCT program, as well as those who delivered outside the hospital. The latter group was screened for HIV using a previously described method. The infants of these women were used for this study. Verbal informed consent from each infant’s mother was obtained prior to sample collection. A questionnaire was used to collect information on the sex of infants, use of HAART for PMTCT by mothers of infants, duration of HAART use before delivery and place of delivery of infants. The PMTCT program entailed a combination of the use of HAART by mothers and avoidance of breastfeeding infants. HAART agents used by the mothers included zidovudine, nevirapine and lamivudine. The dosage of HAART agents were as follows: 300 mg zidovudine, 200 mg nevirapine and 150 mg lamivudine twice daily. The study protocol was approved by the Ethical Committee of the University of Benin Teaching Hospital.

Collection and processing of samples

Dried blood spots were collected from each infant and tested for HIV using a qualitative DNA polymerase chain reaction (PCR) (AMPLICOR HIV-1 DNA test version 1.5; Roche, Basel, Switzerland).

Statistical analysis

Data were analyzed using the $\chi^2$ square test and odds ratio analysis was carried out using the statistical software INSTAT (GraphPad Software Inc., La Jolla, CA, USA).

Results

A total of 54 of the 318 infants (16.98%) were positive for HIV. The prevalence of HIV was significantly higher in males (35/161, 27.72%) than that in females (19/157 (12.10%); $p=0.0324$) and male sex was a risk factor for HIV infection [odds ratio (OR) = 2.018; 95% confidence interval (CI) = 1.098, 3.708]. Use of antiretroviral therapy for PMTCT was not a risk factor for HIV acquisition among the infants (OR = 0.221; 95% CI = 0.119, 0.413) as the prevalence of HIV was significantly ($p<0.0001$) higher in those infants whose mothers did not use antiretrovirals than in those whose mothers did use antiretrovirals (Table 1).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Tested n</th>
<th>Positive for HIV n (%)</th>
<th>OR</th>
<th>95% CI</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex of offspring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>161</td>
<td>35 (27.74)</td>
<td>2.018</td>
<td>1.098, 3.708</td>
<td>0.0324</td>
</tr>
<tr>
<td>Female</td>
<td>157</td>
<td>19 (12.10)</td>
<td>0.496</td>
<td>0.270, 0.911</td>
<td></td>
</tr>
<tr>
<td>PMTCT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>201</td>
<td>18 (8.96)</td>
<td>0.221</td>
<td>0.119, 0.413</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>No</td>
<td>117</td>
<td>36 (30.77)</td>
<td>4.519</td>
<td>2.422, 8.429</td>
<td></td>
</tr>
</tbody>
</table>

OR: odds ratio; CI: confidence interval; PMTCT: prevention of mother to child transmission.
The predelivery duration of HAART use by mothers significantly ($p=0.01$) affected the prevalence of HIV infection among the infants with mothers who had used HAART 10−12 months before delivery had zero prevalence of HIV infection among their infants (Table 2). Although mothers who delivered in our tertiary institution and those who delivered at home had a lower prevalence of HIV infection in their infants compared with those who delivered in primary and secondary health institutions, the difference was not statistically significant (Table 2).

### Discussion

In developing countries such as Nigeria, people are often stigmatized because of HIV infection despite the availability of free services (testing and treatment). In Nigeria, mothers also often give birth at home, either alone or assisted by traditional birth attendant. The majority of these mothers have varying levels of information on the country’s PMTCT program. The effect of these factors on the prevalence of infant HIV was investigated in this study.

We found that male infants have approximately a 1-fold to 4-fold increased risk of acquiring HIV infection compared with their female counterparts. This finding disagrees with earlier reports where no sex difference was observed.\(^7,8\) However, our results are consistent with the findings of an earlier study, where male sex was a risk factor for acquisition of late postnatal HIV infection.\(^9\) The reason for the high prevalence in male infants is unclear.

Mothers who took antiretrovirals before and during pregnancy (participated in the PMTCT program) gave birth to infants with a lower prevalence of HIV compared with those who did not participate in the PMTCT program. Use of antiretrovirals in the PMTCT program is a known method of preventing mother to child transmission of HIV infection.\(^1,2\)

The duration of antiretroviral use before delivery significantly affected the prevalence of infant HIV infection. The longer the PMTCT use before delivery, the lower the prevalence. Therefore it is important to determine the HIV status of pregnant women to give HAART treatment to those who are HIV-positive, as this could be beneficial for reducing or totally eliminating mother to child transmission. However, further studies are needed to substantiate this reasoning.

More women who delivered in a tertiary hospital compared with those who delivered elsewhere were aware of the President’s Emergency Plan for AIDS Relief program including PMTCT (data not shown). All women who delivered at home and those who delivered in a primary health care centre, and a large proportion of women who delivered in a secondary health care centre had no information on PMTCT. However, because of the benefit of PMTCT and the duration of HAART, it is recommended that the PMTCT program be made available at all levels of the health system. It should be noted, however, that the place of delivery had no significant effect on the prevalence of HIV among the infants. This may be because of the presence of HIV and immune status of HIV-infected mothers as a low CD4 count is a risk factor for transmission of HIV infection \textit{in utero}.\(^9\) The CD4 count of pregnant women was not assessed and all pregnant women used in this study had no signs or symptoms of opportunistic infection, which may indicate a high CD4 count.

This study revealed an overall infant HIV prevalence of 16.98%. Male sex and non-use of HAART for PMTCT were risk factors for acquiring HIV infection for infants. The longer the use of HAART in HIV-positive mothers before delivery, the less likely it is they will give birth to an HIV-positive infant. Thus the use of antiretrovirals needs to be

<table>
<thead>
<tr>
<th>Characteristics Tested (n)</th>
<th>HIV-positive n (%)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration of HAART use before delivery (mo)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1−3</td>
<td>70</td>
<td>12 (17.14)</td>
</tr>
<tr>
<td>4−6</td>
<td>54</td>
<td>5 (9.26)</td>
</tr>
<tr>
<td>7−9</td>
<td>63</td>
<td>1 (1.59)</td>
</tr>
<tr>
<td>10−12</td>
<td>14</td>
<td>0 (0.00)</td>
</tr>
<tr>
<td><strong>Place of delivery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tertiary</td>
<td>185</td>
<td>8 (4.32)</td>
</tr>
<tr>
<td>Secondary</td>
<td>45</td>
<td>5 (11.11)</td>
</tr>
<tr>
<td>Primary</td>
<td>20</td>
<td>3 (15.00)</td>
</tr>
<tr>
<td>Home</td>
<td>68</td>
<td>2 (2.94)</td>
</tr>
</tbody>
</table>

HAART: highly active antiretroviral therapy.
expanded to all levels of health care responsible for antenatal services.

Acknowledgments

We thank the management of University of Benin Teaching Hospital, Benin City for granting us permission to carry out this study.

References