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Hepatitis B infection control in Colombian Amazon after 15 years of hepatitis B vaccination. Effectiveness of birth dose and current prevalence

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ABSTRACT

Background: Hepatitis B virus (HBV) infection is highly endemic in the Colombian Amazon basin. In Colombia, the universal hepatitis B vaccination in that area has been active since 1993. The program targets children aged under five years. Newborns receive at least three doses, and in 2001, HBV vaccine birth dose was included. This study aimed to evaluate the advances on HBV control in the Colombian Amazon.
Methods: A population-based cross-sectional study was conducted in children less than 11 years old in rural areas of the Colombian Amazon, in order to assess the current levels of HBV prevalence and evaluate the effectiveness of HBV vaccination. Participants were selected from villages scattered along the Amazon, Putumayo and Loretoyaco Rivers. Blood samples were taken from children. All the samples were examined for surface antigen (HBsAg) and IgG antibodies against core antigen (AntiHBc) of HBV. Data on HBV vaccination status and other risk factors were also collected.
Results: Blood samples from 1275 children were included in the study. The positivity for IgG AntiHBC and HBsAg was 3.8% and 0.5%, respectively. It was observed that receiving a dose of HBV vaccine within 48 h after birth decreased the risk of HBV infection and carriage by 95%. Being born to an AntiHBc positive mother increased 8 times the risk of HBV infection (OR = 7.8 CI 95% 3.3–10.2) and 7 times the risk of HBsAg carriage (OR = 6.6 CI 95% 2.1–10.1).
Conclusion: The prevalence of HBV infection and HBsAg carriage continues to decrease among children living in the Colombian Amazon. The high protective effectiveness of an HBV birth does suggest that perinatal transmission is important in endemic areas of Latin America, an aspect that has not been fully studied in the region.

1. Introduction

Currently, there are around 240 million chronic carriers of HBsAg around the world, which are at the highest risk of developing chronic liver diseases such as primary liver cirrhosis and hepatocelular carcinoma [1]. Most countries in Latin America and the Caribbean (LAC) are classified as low endemic areas, but there are some high endemicity spots as well [2]. One of the most extensively studied high endemic areas in LAC is the Amazon basin, an area that is shared by Brazil, Colombia, Venezuela, Peru, and Ecuador. In the pre-vaccine era, the prevalence of HBsAg among adults was above 7–26%, especially in rural areas, and there were frequent outbreaks of fulminant hepatitis related to hepatitis delta virus (HDV) [3–5].

A highly effective Hepatitis B vaccine is available since the 1980s [6]. Its effectiveness to decrease the prevalence of HBV infection, HBsAg carriage, and primary liver cancer has been

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demonstrated in high endemic areas, in particular in Africa [7] and South-East Asia [8–10].

The World Health Organization (WHO) recommends that all countries should use a scheme that includes a birth dose (administered within the first 24 h after birth) plus at least two doses using a monovalent or combined vaccine following the schedules with diphtheria, pertussis and tetanus vaccine (DTP) [11].

Despite LAC countries started universal hepatitis B vaccination in the mid-1990s, there are still gaps in knowledge about the effectiveness of HBV vaccination in high endemicity areas in the region [12]. Epidemiology of hepatitis B was extensively studied in the pre-vaccine era, but by contrast, there are only three studies published so far describing it after vaccine introduction [4,13,14]. Furthermore, these studies have produced conflicting results. Braga et al. 2012 [13], found a low effectiveness of HBV vaccination, around 30%, while De la Hoz et al., 2008 [14], and Cabezas et al., 2014 [4] reported a substantial reduction of HBsAg carriage and HBV infection in the post-vaccine era.

The Colombian Ministry of Health introduced universal HBV vaccination in the Amazon in 1993-targeting newborns and children <5 years- using a three doses scheme with a monovalent vaccine manufactured in Cuba. In 2001, it changed to a schedule composed of a birth dose, with a monovalent vaccine, and three subsequent doses using a pentavalent vaccine (DTP + *Haemophilus influenza* type b (Hib) + HBV). In 1999, a serological survey study found a reduction of ≈70% in HBV infection and HBsAg carriage among children of urban and rural areas in the Colombian Amazon state despite health services' struggle to provide timely access to HBV vaccine for rural population [14].

Vaccinating rural communities in the Amazon state also was introduced in 1993, and it was considered an area of high endemicity for hepatitis which has the highest endemicity for hepatitis B. In this area, it was a particularly challenging because of geographical, logistical, and cultural constraints. Several studies have shown that most children have received at least two doses of HBV vaccine, but timely coverage is low, especially with the birth dose [15,16]. The present study aimed to assess the current epidemiology of HBV infection and carriage among Amazonian children born after the vaccine policy shift-introduction of birth dose and switch to pentavalent vaccine, in order to inform the public and health authorities on the advances to control HBV infection, and the current challenges faced by the policy. It presents the magnitude of HBV infection as well as the estimated effectiveness of HBV vaccination.

2. Methods

A serological and epidemiological survey was carried out in order to assess the advances in the control of HBV infection in the Colombian Amazon state, Southeast, Colombia. The study comprised two main objectives: (1) the evaluation of the coverage with HBV vaccine including the proportion of children vaccinated with a timely birth dose and, (2) the prevalence of HBV infection and HBsAg carriage in children under 11 years old, and their mothers and the effectiveness of HBV vaccination strategies. Results from the HBV vaccination coverage and factors hampering vaccination timeliness have been already been studied [15,16].

The main population methods used in this study have been described previously [15]. The present study presents the specific methodological aspects related to the serological study. The survey was conducted between July 2011 and March 2012. This study was approved by the Ethical Committee of the School of Medicine at the National University.

2.1. Study site

The study was carried out in three municipalities of the Amazonas state: Leticia, Puerto Nariño, and Tarapaca. The municipalities were selected based on previous knowledge of HBV infection epidemiology in this region. Leticia and Puerto Nariño concentrated the largest proportion of the region's population, while Tarapaca was included because it represents the isolated rural areas of the Amazon where a substantial proportion of HBV infection occurred in the pre-vaccine era [5].

2.2. Sample size

The sample size was calculated to assess an HBsAg carriage prevalence of 1% within a margin of error of 0.5% and 95% of confidence level. A sample size of 1300 children would be needed to fulfill those assumptions. At the end, 1275 children were included in the serological study.

2.3. Study population and field procedures

Rural areas from the municipalities selected for the study were included in the sampling due to previous data showing that rural areas bear the largest burden of HBV infection [5,14]. In Leticia, 12 out of 21 rural communities were included in the study. In Puerto Nariño, 17 out of 20 were included, and 8 out of 13 rural communities were included in Tarapacá.

The community approval was obtained from community leaders after explaining the objectives and procedures of the study. A field work team, composed of bacteriologists and nurses visited every household with children of an eligible age in every selected village once approval was obtained from the community. At every household with eligible children, parents were asked to give the permission for their children to participate in the study. If they agreed to participate, then they were invited to sign a consent form. They were specifically asked to allow for a blood sample to be drawn from children and children's mothers, as well to answer a questionnaire on the vaccination status of the children, the potential risk factors for HBV infection. Children less than 11 years of age with HBV vaccination status data information were considered eligible for the study.

2.4. Serological outcomes

A person with HBV infection was defined as someone who has a positive result for the serological Anti-HBc marker by ELISA. Anti-HBc-positive and HBsAg-negative markers were considered as a resolved infection with or without lifelong immunity. An HBsAg carrier was defined as someone with a positive result for the serological marker HBsAg after 6 months of age. The positivity for HBsAg was considered as a marker for asymptomatic carrier status, which in the presence of other markers may show active or chronic active infection. Individuals with a positive result to both, anti-HBc and HBsAg were considered as a frequent infection and a risk of transmitting the disease (Table 1).

2.5. Exposures

The main exposures were: (1) HBV vaccination status with a separate analysis for timely vaccination with the birth dose of HBV vaccine. When vaccination records were not available or difficult to read, the Expanded Program on Immunization (EPI) databases was consulted (SIVIGILA, Instituto Nacional de Salud Colombia). These databases are updated by the EPI nurses and contain vaccination data from every child from rural areas.

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