ORIGINAL ARTICLE

Bordetella pertussis IgG level among pregnant women and their newborns in Najran, Southwestern, Saudi Arabia, an evidence for urgent update of the local maternal vaccination guidelines

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ABSTRACT

Objective: To determine the pertussis IgG among pregnant women and their newborns at delivery in Najran Maternity and Children Hospital, Saudi Arabia. ***Methods:*** paired maternal-neonatal cord blood samples collected at delivery between November 2016 and July 2017 at Najran Maternity and Children hospital. Using ELISA, sera analyzed for pertussis IgG. According to the manufacturer instructions (Diagnostic Automation, INC, DA-B. Pertussis IgG, USA). ***Results:*** Out of 271 samples, the maternal mean age was 28 years (range 16-46) and that of gestation age was 38.5 weeks (range 33-42). Forty mothers (14.76%) were seropositive, thirty-five (12.91%) were borderline and 196 (72.32%) were seronegative. Only two (0.73%) infants were seropositive and their maternal antibodies were > 40 U/ml. ***Conclusion:*** this is the first report of maternal pertussis immunity from Saudi Arabia, which will stimulate serious discussion on updating maternal vaccination policy in our country. Maternal immunization with Tdap before pregnancy or during the second or third trimester could provide protective immunity to the newborns, covering the gap between birth and the first dose of Tdap. However, still further larger research on safety and effectiveness of maternal vaccination would be very valuable.

Key words: Bordetella pertussis, IgG, pregnant women, maternal vaccination, Najran.

INTRODUCTION

The gram-negative Bordetella (B.) pertussis bacterium causes a very contagious infection called "Whooping cough". In the early stage of the disease, the symptoms will be mild but serious and fatal complications can develop particularly in infants under three months of age.[1] Despite continuous extensive childhood vaccination, it is still a major public health problem internationally. During the past two decades, a breakthrough of the disease reported in countries with > 90 percent immunization coverage.[2,3]

All age groups are at risk for B. pertussis, but the incompletely vaccinated infants are at the highest risk of the disease and its complications.[4]

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B. pertussis related deaths occur usually during the first few months of life especially before the first dose of the vaccine.[5,6]

Infants who did not receive the full B. pertussis vaccine series are at great risk of the disease complications and the only protection they may have is from transplacenal maternal antibodies. However, low levels of maternal antibodies and a rapid decrease in neonatal serum antibodies make them prone for its complications.

A third trimester Tetanus, diphtheria, and acellular pertussis (Tdap) vaccine dose had been recommended by the Center for Disease Control and Prevention (CDC).[7]
Neonatal immunization usually affected by immature immune system, however, maternal immunization against vaccine preventable diseases is simple and reliable that protect infants during the first six months of age. [8] In addition, neither the vaccine nor the disease can give a lifelong immunity against B. pertussis.[9]

On the other hand, more importantly, adult family members are the most likely major reservoir of the infection putting the susceptible infants at risk for the disease.

For these reasons, getting protective maternal antibodies is the best and easiest method to protect newborns, simply by mother's Tdap vaccination during pregnancy as recommended by the CDC.

The aim of this study was to determine the B. pertussis IgG antibody levels among pregnant women and their newborn infants at the time of delivery in Najran Maternity and Children Hospital (NMCH), Southwestern of Saudi Arabia. Paired maternal and cord blood samples were tested for the presence of B. pertussis antibodies (IgG).

MATERIAL AND METHODS

Searching for prior published articles using the PubMed and the Mendeley databases, carried out.

In this cross-sectional study, all pregnant women who came to NMCH in labor from November 2016 to July 2017 were asked to participate in this study according to principles of Helsinki Declaration. NMCH hospital is the main pediatric and gynecology and obstetrics center in Najran, Southwestern of Saudi Arabia, with population of approximately 620,000. After obtaining informed consent, 271 consecutive pregnant mothers and their babies were enrolled.
The first part of a pretested questionnaire filled by a trained physician covered demographic information, including age, place of residency and the vaccination history before or during pregnancy, asking mainly for B. pertussis vaccination. Laboratory test results of the B. pertussis antibody concentration (IgG) (U/ mL) were entered into the second part of every participant's initial questionnaire.

From each participants, five milliliters paired maternal blood and neonatal cord blood samples collected and immediately kept in -20 °C freezer. At the research laboratory in the college of medicine, Najran University, ELISA was used to determine the serum level of B. pertussis antibody (IgG). According to the instructions provided by the manufacturer (Diagnostic Automation, INC, DA-B. Pertussis IgG, USA), antibody levels higher than 24 U/ml were considered positive and 16-23 U/ml as borderline (grey zone) whereas IgG level 1-15 U/ml considered negative.

Data were analyzed using SPSS software version 23 (IBM). The chi-square test, with the threshold for statistical significance set at $P< 0.05$ was used.

The research committee of the college of medicine, Najran University approved this project.

RESULTS

During the period of the study, paired 271 mother's and their newborn infant's serum samples were collected. The age of two hundred fifty six mothers (94.4%) were between 16 to 39 years and fifteen (5.6%) were 40 years and above. The mean age at the time of delivery was 28 years (range, 16-46 years). The median gestation age was 38.5 weeks (range, 33-42 weeks). Two hundred seventeen (80%) women were from Najran city and fifty-four (20%) were from the surrounding villages of Najran area. Only fifty-four (20%) of mothers confirmed that they were vaccinated at time of childhood with pertussis vaccine and the rest

were not sure whether they were vaccinated or not but none of them were vaccinated before or during current pregnancy or previous pregnancies. All of the above variables were with nonsignificant *P* values.

Out of 271 mother's serum samples, 40 (14.76%) were seropositive, thirty-five (12.91%) were in the grey zone and 196 (72.32%) were negative. Only two (5%) of the 40 seropositive mothers were older than 40 years of age. Whereas the rest of them, 38 (95%) and all of 35 mothers in the grey zone were between 16-39 years. Out of 40 seropositive mothers, thirty-five (87.5%) living in Najran city (urban) and the rest (12.5%) living outside.

Out of 271 newborn infants cord blood samples, only 2 (0.73%) were seropositive and their maternal antibodies were > 40 U/ml, and 269 (99.26%) were seronegative.

DISCUSSION

Since early last century, the idea of immunizing pregnant mothers for possible newborn's protection against B. pertussis was under investigation.[10] The feasibility of maternal vaccination is hampered by concerns regarding adverse effects of the vaccine on the mother and/or newborn. It have been proved that maternal immunization with Tdap increases the infant's pertussis antibodies concentrations and lower rate of B. pertussis infection during infancy.[11-15]The type of vaccine and the time of administration are crucial for the success of neonatal vaccination programs.[16]

However, a randomized controlled trial of the safety and immunogenicity of Tdap immunization during pregnancy demonstrated that it resulted in lower levels of B. pertussis antibodies after the primary vaccine series, which can be explained by blunted immune response, although, it resulted in higher levels of antibodies early in infancy.[17] It has been reported that post-booster blunting effect is short-lived and longer-term protection in infants from active immunization is not compromised.[18]

A booster dose for young children and adolescents of pertussis was recommended in china based on study involved 1616 subjected younger than twenty years of age.[19]This study showed higher protective antibody level against B. pertussis in only 234 (14.46%) of the study population, were 87.5% of them living in urban areas. The low antibody titer against B. pertussis in the present study is similar to what have been published before worldwide. [20, 21] In another study performed in USA, serum antibody level against B. pertussisof 81 mothers, and their newborn infants showed only 21% of mothers and 26% of newborns had an acceptable level of protective antibodies.[22]

Lower neonatal B. pertussis antibodies can give an idea about the maternal antibody level; therefore, the maternal booster immunization dose of the Tdap during pregnancy may increase their antibody level and protect the newborn infants in the first few months after birth. The CDC and the American College of Obstetrics and Gynecology have recommended a maternal booster dose of Tdap vaccine right after delivery and before discharge from hospital.[23,24] In a very recent study, they found no association between vaccination during pregnancy and the risk of infantile hospitalization or death in the first six months of life supporting the safety of current recommendations for influenza and Tdap vaccination during pregnancy.[25]

The results of this study with the lack of prior studies in this regards in Saudi Arabia indicates the need for larger nationwide study and to initiate a serious discussion regarding updating the national vaccination guidelines for pregnant women and its implementation.

Limitations: there is no prior study in our country to compare the results with and although we are seeing cases of suspected neonatal pertussis with complications including deaths, with lack of the facilities to confirm the diagnosis and no local neonatal pertussis infection data, making the need for meticulous registration of these cases mandatory.

CONCLUSION

Although, the study is small sized but it surely opens door for serious arguments that favor maternal

vaccination with Tdap vaccine before or during the second or third trimester of pregnancy in KSA as per the international guidelines. In addition, further nationwide studies are necessary to address in depth the impact of the disease on the health system and the safety and cost effectiveness of this practice.

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