Seroprevalence of Bordetella pertussis Antibodies to Pertussis Toxin Among Healthy Children
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ABSTRACT

Pertussis or whooping cough is a highly communicable, vaccine-preventable acute respiratory tract disease, caused mainly by Bordetella pertussis. In this study, serosurveillance of IgG antibodies against pertussis toxin was carried out in healthy children, aged 3 months to 12 years, from the multiethnic cities of Islamabad and Rawalpindi, Pakistan. Kruskal-Wallis test was applied to determine the difference among groups. The results showed that the average values of pertussis toxin IgG dropped down significantly with age after getting the first dose in first 2 years (p < 0.001). Therefore, the researchers suggest introduction of booster vaccination with DTaP at second year of life and school going age to reduce the risk of getting B. pertussis infection.


Natural infection with B. pertussis develops long-lived acquired immunity to subsequent infections. Both humoral as well as cellular arms of immunity play their role in conferring protection against B. pertussis infection. Antibodies produced against a number of bacterial antigens such as pertactin, pertussis toxin, fimbriae, lipopolysaccharide, filamentous haemagglutinin etc., play a protective role against B. pertussis infection by blocking bacterial attachment in the mucosal tract, neutralizing their toxins and enabling bacterial uptake by macrophages. However, there is no consensus over the type of antigen against which the antibody is raised and its protective levels.

Vaccine induced immunity wanes after 4 – 6 years and children remain susceptible to B. pertussis infections. Serosurveillance with ELISA for the detection of antibodies raised against B. pertussis is a widely used strategy for the monitoring of vaccine efficacy as well as infection with B. pertussis. Antibodies raised against pertussis toxin (PT) of B. pertussis are an indication of both the protection against the organism as well as infection. As pertussis toxin (PT) is only produced by B. pertussis species, ELISA for the detection of antibodies raised against it rules out the possibility of cross reactivity with B. parapertussis antibodies.

The aim of the present study was to carry out serosurveillance of B. pertussis infections by measuring PT IgG level in the sera collected from children of age group 3 months to 12 years. A comparison between the median titer values of PT IgG at different age groups was made to study the vaccine efficacy and the ages of waning immunity (Table I).

A total of 220 blood samples were collected from children aged 3 months to 12 years (average age = 5.45 ± 4.12 years) attending the OPD of Pakistan Institute of Medical Sciences in Islamabad city during the period of August to September 2010. Most of the participants were the multiethnic population of Islamabad and Rawalpindi districts. The participants were divided into seven age groups; (1) = prevaccination; (2) = ≥ 2 years; (3) = 2 – 4 years; (4) = 4 – 6 years; (5) = 6 – 8 years; (6) = 8 – 10 years and (7) = 10 – 12 years. Information
by EPI in Pakistan. Although there has been a marked
introduction. DTP vaccine is administered at 6, 10 and
there has been an increase in its coverage since its
DTP vaccination was introduced in Pakistan in 1979 and
from 1 through 7 respectively.

25.9%, 18.5%, 39.4%, 14.8%, and 22.6% for each group
using the cutoffs of the ELISA kit was 27.6%, 51.35%,
(Table I). The seropositivity to pertussis toxin ELISA kit
dropped down in all groups except group 5 from group 2
the recently vaccinated age group from pre-vaccinated
This represents a 1.39 fold increase in antibody titer in
the vaccinated group of age 2 years or less (29 IU/ml).
level in each age group showed the highest value of titer
significantly (p < 0.0001). The median values of PT IgG
were identical. The median of all the groups differed
was applied to test if the median of all the groups
were used as a representative of central tendency in all
groups (Table I). A non-parametric, Kruskal-Wallis test
was performed using a commercially available kit
(Virion-Serion GmbH, Germany) for pertussis toxin IgG
detection using manufacturer's protocol. The
lower and upper cutoffs of the kits were 20 and 30 IU/ml
respectively.

The data was not normally distributed so median values
were used as a representative of central tendency in all
groups (Table I). A non-parametric, Kruskal-Wallis test
was applied to test if the median of all the groups
were identical. The median of all the groups differed
significantly (p < 0.0001). The median values of PT IgG
level in each age group showed the highest value of titer
in the vaccinated group of age 2 years or less (29 IU/ml).
This represents a 1.39 fold increase in antibody titer in
the recently vaccinated age group from pre-vaccinated
individuals (Table I). However, the values of IgG titer
dropped down in all groups except group 5 from group 2
(Table I). The seropositivity to pertussis toxin ELISA kit
using the cutoffs of the ELISA kit was 27.6%, 51.35%,
25.9%, 18.5%, 39.4%, 14.8%, and 22.6% for each group
from 1 through 7 respectively.

DTP vaccination was introduced in Pakistan in 1979 and
there has been an increase in its coverage since its
introduction. DTP vaccine is administered at 6, 10 and
14 weeks and there is no booster dose recommended
by EPI in Pakistan. Although there has been a marked
reduction in the reported pertussis cases since the
introduction of vaccination, it still causes significant
number of infections in both vaccinated and non-
vaccinated children.5 It has previously been reported
that the vaccine-induced immunity wanes in children
over a period of time making them vulnerable to
B. pertussis infections.1,3 Infants acquire IgG from
mothers through transplacental passage which
diminishes after some time.1 The IgG level in group 2
indicates maternal IgG which was supposed to decline in
the age group 2. However, group 2 shows highest level
of PT IgG titer due to recent vaccination. However,
absolute cut-off values for recent infection and the
vaccine induced immunity have not so far been
established. In this study, a significant drop in the titer
values from group 2 to groups 3, 4 and 6 indicates
waning humoral immunity and, therefore, vulnerability
of the children to B. pertussis infections.

The results of this study are in agreement with the
previous reports. Booster dose of DTP vaccine is
administered in many countries of world including USA,
Canada and European countries.1 Therefore, we
recommend the introduction of booster vaccination in
the second year of life as well as at school going age or
before to protect children at these ages.

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