



Contents lists available at ScienceDirect

Transactions of the Royal Society of Tropical Medicine and Hygiene

journal homepage: <http://www.elsevier.com/locate/trstmh>

Short Communication

Gap in the prevalence of neutralising antibodies to polioviruses in antenatal women in southern India

Jacob John^{a,*}, Asha M. Abraham^b, Jayaprakash Muliyl^a, T. Jacob John^c, J.M. Deshpande^d, Gagandeep Kang^e

^a Department of Community Health, Christian Medical College, Vellore 632002, Tamil Nadu, India

^b Department of Virology, Christian Medical College, Vellore, India

^c Christian Medical College, Vellore, India

^d Enterovirus Research Centre, Indian Council for Medical Research, Mumbai, India

^e Department of Gastrointestinal Sciences, Christian Medical College, Vellore, India

ARTICLE INFO

Article history:

Received 17 June 2010

Received in revised form 7 December 2010

Accepted 7 December 2010

Available online 31 January 2011

Keywords:

Poliovirus

Seroepidemiological studies

India

Adult

Oral poliovirus vaccine

Immunity

ABSTRACT

With the disappearance of circulating wild poliovirus and improved sanitation, protective antibody levels may wane over time following oral poliovirus vaccine (OPV) administration. This study evaluated the seroprevalence of neutralising antibodies to vaccine polioviruses among young Indian women who had received at least three doses of OPV as primary immunisation. Of 60 women studied, 27 (45%) had antibody titres of <1:8 to one or more polioviruses, with the lowest levels for poliovirus types 3 and 1. These findings represent a possible immunity gap and this needs to be confirmed with further studies, which could include a challenge with vaccine virus.

© 2010 Royal Society of Tropical Medicine and Hygiene. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Ten years past the deadline for polio eradication set by the World Health Assembly, polio still persists in India. Low vaccine 'take', decreased intestinal immunity, high infant density and the reluctance of some communities to accept vaccination have prevented realisation of this goal in northern India.¹ Southern India has been polio-free since the 1990s, and birth cohorts over at least two decades have received five or more doses of oral poliovirus vaccine (OPV) through routine immunisation and National Immunization Days (NID). With no circulating wild poliovirus and improved sanitation, protective antibody levels may wane over time following either inactivated or OPV vaccination,

leading to a potential immunity gap among young adults, leaving them at risk of disease due to wild or circulating vaccine-derived poliovirus.² Between 2003 and 2005, 25 previously polio-free countries were reinfected through virus importation,³ suggesting that these concerns might be real. In this study, the hypothesis that persons immunised with three to five doses of OPV not subsequently exposed to circulating poliovirus may develop a gap in immunity in early adulthood was evaluated.

2. Materials and methods

The Community Health Department of the Christian Medical College (Vellore, India) serves a local population of 100 000 persons in Kaniyambadi and offers antenatal screening for HIV and hepatitis B surface antigen. Consent is sought for unlinked anonymous testing of residual serum. Sixty sera collected in 2008–2009 from antenatal

* Corresponding author. Tel.: +91 94 4263 1628.

E-mail address: jebu@cmcvellore.ac.in (J. John).

Table 1

Neutralising antibodies against poliovirus types 1, 2 and 3 (PV1–3) in antenatal women in Kaniyambadi (Vellore, India)

	PV1	PV2	PV3
Total samples	60	60	60
<1:4 dilution	4	3	9
1:4 dilution	7	2	6
≥1:8 dilution	49	55	45
GMT for adults	18.64	27.93	12.26
95% CI of GMT	12.99–26.76	20.44–38.17	9.07–16.69
GMT for children ^a	423.59	393.93	100.58

GMT: geometric mean titre.

^a GMT of neutralising antibody titres for 85 infants aged 1 year who received at least five doses of oral poliovirus vaccine in 2003–2004 is provided for comparison with the 60 immunised antenatal women.

women from Kaniyambadi born in 1990–1991 were tested at dilutions of 1:4 to 1:512 for neutralising antibodies to poliovirus types 1–3 (PV1–3) in a microneutralization assay as recommended by the WHO.⁴

This population was selected because documented coverage has been >95% for three doses of OPV since the 1980s, two to three NID a year have been implemented since the 1990s, and the last known transmission of poliovirus occurred before 1994. Antibody levels in the 60 recruited women were compared with 85 infants aged 1 year with five documented doses of OPV from a local birth cohort recruited in 2002–2003, whose sera were tested at the WHO Reference Centre in Mumbai (India).

The sample size was calculated to detect a 20% prevalence of absence of protective antibodies to at least one poliovirus in the adults with 10% precision. Data were analysed using Stata 11 (StataCorp LP, College Station, TX, USA).

3. Results and Discussion

Twenty-seven women (45%) had titres of <1:8 dilution of neutralising antibodies to one or more poliovirus serotypes (Table 1). Eleven (18.3%), 5 (8.3%) and 15 (25%) samples did not have protective levels of neutralising antibodies to serotypes PV1, PV2 and PV3, respectively. All women had detectable antibodies to at least one of the three polioviruses. There was a statistically significant difference in titres of antibodies against the three serotypes (Friedman's test 18.17, $P < 0.001$). Geometric mean titres (GMT) of neutralising antibodies were 18.64, 27.93 and 12.26 in the adults and 423.59, 393.93 and 100.58 in the recently immunised 1-year-olds against PV1, PV2 and PV3, respectively.

The finding that 45% of young women, who may have received about eight doses of OPV in childhood, do not have protective levels of antibodies is a matter of grave concern as they could be at risk from wild or vaccine-derived

poliovirus. This is possibly mitigated by the finding that 7/11, 2/5 and 6/15 samples with less than protective levels of 1:8 did have neutralising antibodies at 1:4 dilution to PV1, PV2 and PV3, respectively, which may rapidly boost in the presence of exposure to wild or vaccine virus. On the other hand, these titres are against vaccine strains and effective titres against wild virus may be lower, resulting in a larger immunity gap than estimated in this study.

The significantly lower GMTs and the low prevalence of seroprotection in young adults, when recently immunised children in the same area make high levels of antibodies, suggests that the immunity gap in this highly immunised population might be due to waning of antibodies. However, these findings may also have been due to an initial low immune response to OPV, inadequate OPV coverage or the combined effect of both. Lower titres of neutralising antibody in older populations have also been noted in other populations.⁵ Prospective studies looking at shedding and immune response following OPV challenge might provide insight into concerns surrounding polio eradication and the susceptibility of older age groups.

Authors' contributions: JJ, JM, TJJ and GK designed the study protocol; JJ collected patient data; AMA and JMD carried out the immunoassays; all authors performed the analysis and interpreted the data; JJ and GK drafted the manuscript. All authors contributed to and read and approved the final manuscript. JJ and GK are guarantors of the paper.

Funding: Fluid Research Fund for intramural research from the Christian Medical College (Vellore, India).

Conflicts of interest: None declared.

Ethical approval: The study protocol was cleared by the Institutional Review Board of the Christian Medical College (Vellore, India), with a waiver of repeat consent.

References

1. Paul Y. Why polio has not been eradicated in India despite many remedial interventions? *Vaccine* 2009;27:3700–3.
2. Swartz TA, Green MS, Handscher R, Sofer D, Cohen-Dar M, Shohat T, et al. Intestinal immunity following a combined enhanced inactivated polio vaccine/oral polio vaccine programme in Israel. *Vaccine* 2008;26:1083–90.
3. WHO. Poliomyelitis. Fact sheet No. 114. Geneva: World Health Organization; 2010. <http://www.who.int/mediacentre/factsheets/fs114/en/> [accessed 4 December 2010].
4. WHO. *Manual for the virological investigation of polio*. Geneva: World Health Organization; 1997. WHO/EPI/GEN/97.01.
5. Pérez MC, Olivera I, Diabarbouré H, Montano A, Barañano R, Badía F, et al. Seroprevalence of anti-polio antibodies in a population 7 months to 39 years of age in Uruguay: implications for future polio vaccination strategies. *Vaccine* 2009;27:2689–94.