IMMUNOGENICITY OF ENHANCED POTENCY INACTIVATED POLIO VACCINE

J. Singh
R.N.M. Ravi
A.K. Dutta
S. Kumari
S. Khare

ABSTRACT

Fifty two children were immunized with two doses of enhanced potency inactivated polio vaccine in order to determine its efficacy. The vaccine was very efficacious with 92.3, 92.3 and 88.3% of the children seroconverting to the three poliovirus types, respectively. The vaccine was equally efficacious whether the two doses were given at 4-week or 8-week intervals or when immunization was started at 6-7 weeks of age or later. The presence of maternal antibodies did not interfere significantly with the seroresponse to two doses of IPV-E.

The study recommends that two doses of IPV-E give satisfactory seroconversion rates. Immunization can be started as early as 6 weeks age and the two doses can be given at 4 weeks interval to complete primary immunization against poliomyelitis.

Key words: *Immunization, Inactivated Polio Vaccine*

From the Department of Pediatrics, Lady Hardinge Medical College and Associated Kalawati Saran Children's Hospital, New Delhi and National Institute of Communicable Diseases, Delhi.

Reprint requests: Dr. J. Singh, C-5/4, Vasant Vihar, Delhi 110 057.

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Since the introduction of inactivated polio vaccine (IPV) in 1955 and oral polio vaccine (OPV) in 1961 and their subsequent widespread use there was a marked success in world wide poliomyelitis control. The disease, however, continues to be a major public health problem in India which alone accounts for more than 50% of the cases reported annually to the WHO(1).

Like most developing countries India uses OPV in its immunization programme. However, the efficacy of three doses of OPV has been reported to be low in India and the incidence of vaccine failure is high(2-4). In Kalawati Saran Children's Hospital which is a sentinel centre for poliomyelitis, 20% of the cases for acute poliomyelitis reported in 1988 had received 3 doses of OPV. Polio vaccination coverage, in India, was reported to be 74% in 1989(5). Despite an increasing immunization coverage the disease has not shown a satisfactory decline in incidence. These circumstances have renewed interest in the evaluation of IPV as an alternative vaccine especially its newer more potent forms which require only 2 doses for primary immunization(6). Experience with IPV in India is very limited and much more work is needed to evaluate its efficacy and an optimal schedule for immunization in our country. It is with this in view that the present study was undertaken.

Material and Methods

For the purpose of this study, children were selected out of those attending the Child Health Promotion Clinic of the Kalawati Saran Children's Hospital. The criteria for selection included: (*i*) Age 6 weeks to 24 weeks at the time of the first dose of vaccine; (*ii*) No previous immunization; (*iii*) and Absence of acute illness. Informed consent was taken from all parents. If child

was more than 3 days old for the corresponding week he was included in the next week age group. Fifty two children completed the study.

Enhanced potency IPV (IPV-E) was used for vaccinating all children. The IPV-E was formulated for the three poliovirus types as 40, 8 and 32 D antigen units, respectively as compared to conventional IPV which contains 20, 2 and 4 D antigen units. The vaccine was stored at 2-8°C. Vaccine was obtained from Pasteur Meriux Serums and Vaccines, France which has a regional office and representative in Delhi.

The children were randomly allocated into one of 2 subgroups. To one subgroup, the two doses of IPV-E were given 4 weeks apart while the second group received the vaccine at an interval of 8 weeks. The two groups were comparable in age, nutritional and socio-economic status and the presence of maternal antibodies.

Blood samples were drawn by venepuncture before administration of the first dose of vaccine and 4-6 weeks after the administration of the second dose. Blood samples were transported to the National Institute of Communicable Diseases where the separated serum was stored at -20°C till tested.

Antibody determination was done by the standard microneutralization technique using Hep 2 medium(7). The sera were heated for half an hour at 56°C and were tested in six steps of two fold dilution from 1 : 10 to 1 : 320. The paired samples from infants were tested together and the titres were expressed as the reciprocal of those serum dilutions inhibiting viral growth by 50% or more. If no antibody was detected in 1 : 10 dilution in prevaccination sample the serum was considered negative for polio antibodies. Detection of a four-fold rise in antibody titre or a change in titre from less than 1 : 10 to 1 : 10 or more on paired serum was considered as seroconversion. The antibodies in the sera from infants less than 6 months old prior to vaccination were assumed to be maternal in origin(7). The rate of decline of maternal antibody was calculated using a half life of four weeks. Antibody titres in the post immunizations sample four or more times higher than the calculated residual maternal antibody levels were also considered to be evidence of seroconversion.

The data was analysed for significance using the Fischer exact test.

Results

The response to 2 doses of IPV-E was very satisfactory with 92.3, 92.3 and 88.3% of the children seroconverting to types 1, 2 and 3 polio virus, respectively. A total of 82.3% of children seroconverted to all 3 poliovirus types, while only one child failed to seroconvert to any virus type. Seroconversion index calculated as the average of seroconversion rates of the three virus types was 90.6%.

Seroconversion rates according to age at immunization are show in *Table I* which

TABLE I– *Seroconversion Rates After Two Doses of IPV*

Poliovirus type	Age group	
	6-7 weeks (n = 32)	8-24 weeks (n = 20)
Type 1	30	18
Type 2	29	18
Type 3	27	19
Type 1 + 2 + 3	25	18

Fischer exact test, $p > 0.05$.

compared the seroresponse in the two age groups 6-7 weeks and 8 weeks or more. No significant differences were found in the seroconversion rates in the two age groups.

Table II compares the seroresponse in infants who had no antibody in the preimmunization sample (triple seronegative) with that of infants who were non-triple seronegative in order to assess the effect of maternal antibodies on the response to IPV-E. There was no statistically significant difference in the response of these two groups and hence maternal antibodies appeared to have no effect on the seroresponse to two doses of IPV-E.

The seroconversion rates in children who received the two doses of vaccine at 4 weeks intervals are compared with those of children receiving vaccine 8 weeks apart in *Table III*. There was no significant difference in the seroresponse of those two groups and thus IPV-E was equally effective whether given at 4-week or 8-week intervals.

TABLE II— *Seroconversion to IPV in Relation to Maternal Antibodies*

Poliovirus type	No maternal antibody (n = 34)	Maternal antibody present (n = 18)
Type 1	31	17
Type 2	31	17
Type 3	38	18
Type 1 + 2 + 3	28	15

Fischer exact test, $p > 0.05$.

TABLE III— *Seroconversion to IPV in Relation to Interval Between Doses*

Poliovirus type	Interval between doses	
	4-weeks (n = 30)	8-weeks (n = 22)
Type 1	28	20
Type 2	28	20
Type 3	26	20
Type 1 + 2 + 3	24	19

Fischer exact test, $p > 0.05$.

Discussion

The first objective of the present study was to determine the immunogenic efficacy of the vaccine as shown by seroconversion rates. The results presented confirm the high immunogenic efficacy of IPV-E and are comparable to those obtained by Simoes *et al.* from Vellore(8).

Since poliomyelitis may occur in infants under six months of age in endemic regions, immunization should ideally be completed before this age. Some infants, however, have maternal antibodies against poliovirus at this age which diminished their immunological response to conventional IPV(10). It is also known that higher antibody levels are achieved by increasing the interval between the two doses of conventional IPV(10). In non-endemic countries where circulation of wild poliovirus is negligible, IPV is given 6 months apart. This would not be advisable in our country. The effect of age at immunization, interval between doses and presence of maternal antibodies on the seroresponse to the new IPV-E was hence evaluated.

The present study indicates that the presence of maternal antibodies does not have any significant effect on the seroconversion rates after two doses of IPV-E. These results are similar to those of Grenier *et al.*(11) and McBean *et al.*(12). Simoes *et al.*(8), however, noted that the best seroconverson rates were in infants without maternal antibodies. The serologi-

cal response to IPV-E was similar whether vaccination was started at 6-7 weeks or later. Thus an earlier age at immunization did not adversely affect seroresponse to two doses of IPV-E. An eight-week interval between the doses also did not offer any advantage in seroconversion rates over a four-week interval.

The present study, therefore, recommends that two doses of IPV-E give very satisfactory seroconversion states and that immunization can be started as early as 6 weeks age without compromising efficacy. The two doses can be given four weeks apart to complete immunization quickly without lowering seroconversion rates.

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NOTES AND NEWS

IMA-AGARWAL ORATION AWARD

Dr. (Mrs) Prema Lakshminarayana received the IMA, late Dr. S.P. Agarwal Oration Award on "Scope of Genetic Counselling" in September, 1992 at Calcutta.