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An Explosive Outbreak of Poliomyelitis in an Orphanage in Delhi: Risk Factors for the Unusually High Attack Rates

Jagvir Singh
Shashi Khare
R.S. Sharma
T. Verghese

Triva lent Oral polio vaccine (TOP V) was included in the Expanded Programme on Immuni zation in India in 1979. The overall reported coverage levels with the 3 doses of TOPV incr eased to about 93% in 1993-94(1). Consequently, the reported cases declined from 28257 in 1987 to 4055 in 1993(1). However, there had been wide variations in TOPV coverage between different areas(2). As a result, poli o outbreaks are still reported from many areas(3). We present here an account of a poliomyelitis outbreak which was marked by unusually

From the Nationa l Institute of Commun icable Diseases, 22 Shamnath Marg, Delhi 110 054.

Reprint requests: Dr. Jagvir Singh, Deputy Director, National Institute of Communicable Diseases, 22 Shamnath Marg, Delhi 110 054.

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high attack rates of paralytic as well as nonparalytic disease.

Subjects and Methods

The outbreak occurred in July 1992 in an orphanage in Delhi which inhabited young children, mostly from Bihar. The children were looked after in an apparently hygienic environment. There were adequate hand washing facilities and the sisters were aware of the importance of hand washing after diaper changing and cleaning the children. Municipal piped water and a private tube well were the sources of drinking water. All residents had access to sanitary latrines. Every month a nurse from a nearby hospital came to immunize the children. A physician kept detailed records on health and immunization status of all children.

There were 74 children in the orphanage. Their records revealed that one child had suffered from polio two years before admission in the orphanage. Two children had acute flaccid paralysis (AFP) in the first week of May 1992; one developed AFP while resident in the orphanage, whereas another had AFP 4 weeks before admission in the orphanage. These 3 children were not considered outbreak associated and were excluded from further analysis.

First outbreak associated case occurred on 15 July; 6 more developed AFP by 5 August. These 7 AFP cases were considered as paralytic poliomyelitis as they excreted wild poliovirus and/or developed residual paralysis after 60 days. Many cases had only febrile illness (not due to DPT) during the same period; there was enough evidence to consider them as nonparalytic poliomyelitis (see discussion for justification). Records were used to determine the vaccination status of children. Vaccination received within one month of disease onset were not considered as valid doses.

Sixty stool samples (one sample from each child) were collected by rectal tubing technique from cases and healthy contacts. The samples were processed for virus isolation by a standard procedure in the WHO Regional Poliovirus Reference Laboratory, Delhi (WHO Laboratory). All isolates were typed using antisera procured from RIVM, Netherlands. Poliovirus type 1 isolates were also tested for intratypic differentiation by Neutralization Test. Eight water samples collected from different sources were examined bacteriologically.

Most of the children were given a campaign dose of TOPV on 24th July. Inadvertently, DPT was also given to whom it was due on that date.

Results

Of 71 susceptible children present during the outbreak, 9.9% and 21.1% developed paralytic and nonparalytic poliomyelitis, respectively *(Table I)*. All the AFP and most of nonparalytic cases were infants. Males had paralytic as well as nonparalytic disease 1.5 times more than the females. Six AFP cases and 10 nonparalytic children were from Bihar. There was no clustering of cases by ward or by timing of admission. Both lower limbs were affected in AFP cases; 3 children had bulbar involvement also. Two AFP cases died.

Analysis of the cases by immunization status was done only in <3 children because 85% of polio cases occur in Delhi in this age group (4). Of 55 such children, 33 received at least 3 doses of TOPV in Delhi or native places. Six of these children (18.2%) suffered from paralytic disease. The rest of 22 children had no or less than 3 doses of TOPV; one of them (4.5%) had paralysis *(Table I)*. Thirty seven children were inadvertently administered DPT on 24th July. All the five paralytic cases which

occurred after this date were those who had DPT.

Laboratory Results

Of 60 stool samples, 44 (73%) were found positive for one or other entero viruses. Eight samples showed pure culture of wild poliovirus type 1; 3 from paralytic cases, 2 from non paralytic and 3 from healthy contacts. Running water was found to be satisfactory. However, water stored in a covered surface tank (Municipal supply) or in a pitcher was highly contaminated by fecal coli.

A TOPV sample lifted from the hospital which provided vaccines to the orphanage, was found to have satisfactory titer of poliovirus (10^{59} $TCID_{50}$/0.1 ml).

Discussion

Excretion of wild poliovirus type 1 by many cases and contacts and presence of residual paralysis in surviving AFP cases after 60 days confirmed the outbreak of poliomyelitis by poliovirus type 1.

The most striking feature in this outbreak was an unusually high attack rate of paralytic as well as nonparalytic disease. 'One outbreak which came near to the present one in terms of morbidity occurred in a nursery class in London where 4.9% had paralytic disease(5). Nevertheless, the outbreak was recorded when polio vaccine was not available. In this era of global eradication of poliomyelitis, such an outbreak is totally unacceptable.

One may argue whether the classification of all cases of febrile illness as "nonparalytic cases" was justified. We feel, there was enough evidence to classify them so: *(i)* Records did not show an unusual rise of fever cases in 1992(6), although 21% of orphanage children had febrile illness; *(ii)* Both AFP and febrile cases occurred during the same time period and affected same age group; older children and adult contacts neither had paralysis nor febrile illness as they must have had immunizing infection much early in the life; *(iii)* Children vaccinated with = 3 doses of a potent vaccine (in Delhi) neither had AFP nor febrile illness, while a large number of children administered TOPV of doubtful value (in Bihar) had AFP or febrile illness; *(iv)* The incidence of unapparent infection and "minor illness" usually exceeds that of paralytic cases by a hundred fold or even greater, especially when infection occurs early in life(7). With 7 paralytic cases, we may expect many more nonparalytic cases; and *(v)* Two nonparalytic cases were found excreting wild poliovirus type 1, although only one sample was collected from each child; the isolation rate could have been more if two samples had been collected from each child(8). It was therefore, reasonable to infer that these fever cases were indeed nonparalytic poliomyelitis.

The children were not vaccinated in a timely fashion after admission to the orphanage. For example, 22 children who should have received 3 doses of TOPV (according to age) by the time the outbreak occurred, were either unimmunized or partially immunized *(Table I)*. There were no valid reasons for not immunizing these infants in time. There was also a missed opportunity to immunize with a campaign dose when a child developed AFP in May while a resident in the orphanage or another child was admitted with AFP in June. If immunization campaigns can interrupt wild poliovirus transmission nationally, a campaign dose in such setting can also interrupt the transmission. It was demonstrated by the effectiveness of campaign dose given on 24 July.

The attack rate of paralysis was 18.2% (6/33) in the vaccinated children and 4.5% (1/22) in others, if TOPV received any-

TABLE I– *Paralytic and Nonparalytic Cases by Age in All Children (n=71), and by TOPV Doses in 3-35 Months Old Children (n=55).*

Characteristic	n	Paralytic cases	Nonparalytic cases
Age			
< 3 mo	6	0 (0)	0 (0)
3-<6 mo	8	1 (12.5)	1 (12.5)
6-<9 mo	14	2 (14.3)	3 (21.4)
9-<12 mo	15	4 (26.6)	7 (46.7)
1-<2 yrs	16	0 (0)	4 (25.0)
2-<3 yrs	2	0	0
3-<10 yrs	10	0	0
All ages	71	7 (9.9)	15 (21.1)
No. of TOPV doses given anywhere			
0	10	1 (10.0)	0
1	5	0	3 (60.0)
2	7	0	5 (71.4)
3	19	5 (26.3)	2 (10.5)
4-5	14	1 (7.1)	5 (35.8)
0-5	55	7 (12.7)	15 (27.3)
No. of TOPV doses given in Delhi only			
0	19	3 (15.8)	3 (15.8)
1	11	1 (9.1)	4 (36.3)
2	16	3 (18.8)	8 (50.0)
3	7	0	0
4-5	2	0	0
0-5	55	7 (12.7)	15 (27.3)

Figures in parentheses show attack rates in per cent.

where is taken into account *(Table I)*. The results do not make any sense. Perhaps, the potency of TOPV was unsatisfactory in some areas (for example, Bihar), from where most of the children came to orphanage. The data from WHO Laboratory support this possibility; only 21.3% (13/61) and 5.3% (9/170) of TOPV samples from Bihar were found to be potent in 1991 and 1992, respectively. By contrast, 83.1% (167/201) and 93.3% (318/341) Delhi samples tested satisfactory during the same period. It seems many children who received vaccine in Bihar, were not adequately protected. The outbreak underscores the important problems with TOPV failure in some states, problems that will need to be investigated and overcome if the goal of worldwide eradication of poliomyelitis is to become a reality.

Many workers have described the role of intramuscular injections in provoking paralytic poliomyelitis in children with poliovirus infection(9). Here also all the five paralytic cases which occurred after the DPT was given to many children were those who had DPT. It seems, the DPT injections were an important risk factor during this outbreak. The outbreak highlights the importance of avoiding all intramuscular injections in such a situations.

The laboratory results are indicative of: (i) widespread transmission of virus both among the diseased and healthy children, and (ii) fecal contamination of water supplies, suggesting a potential mode of transmission in addition to person-to-person. Despite the apparently hygienic environment in the orphanage, the break in hygiene and sanitation is indicative of the human tendency of not reporting the negative practices.

After witnessing the severity of poliovirus in an orphanage setting and the possibility of different apparent versus effective vaccination observed in this outbreak, it is suggested that all children should be considered unvaccinated at admission in an orphanage in spite of the history of vaccination elsewhere; a campaign dose should

also be provided if a case of AFP occurs. The outbreak also highlights the importance of administering the recommended doses of a potent TOPV vaccine to all the children at the earliest recommended age for prevention of such outbreaks in future.

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