



EPIDEMIOLOGICAL AND VIROLOGICAL STUDIES ON
THE OFF-SEASON SMALLPOX CASES IN CALCUTTA

by

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Summary

Smallpox cases occur throughout the year in Calcutta, although in reduced numbers during the period June through November. Epidemiological and virological studies of 73 off-season cases during 1967 and 1968 revealed that a majority of the patients were residents of "bustees" or slum areas and that 76 per cent. of them had never been vaccinated. Decreases in the clinical severity, case mortality and virulence of the virus strains recovered, as measured by laboratory tests, differentiated the infections from those encountered during the smallpox season. Histories obtained from five of the cases suggest that the infection was introduced from outside Calcutta. In one instance, smallpox transmitted from Calcutta to a village in June and maintained there by person to person transfer was reintroduced into a different part of Calcutta in September.

Smallpox outbreaks occur in Calcutta regularly during the winter and spring every year, in some years in epidemic proportion. During other seasons, only sporadic cases occur. A study of the 1962-1966 admission records at the Infectious Diseases Hospital (IDH), the only hospital in the city for isolation of smallpox cases, shows that there are significantly fewer admissions during June to November than during the period December to May (Table 1). In the present study, conducted during 1967 and 1968, cases during the off-season months (June-November) were investigated to determine incidence, clinical severity, epidemiological pattern and the virulence of the causative virus strains.

Materials and methods

The cases studied were generally patients at the IDH although others were located through the Health Department of the Calcutta Corporation and through private medical practitioners. The patients' residences were visited and other smallpox cases, if found, were examined. Epidemiological information was collected from local medical practitioners and responsible persons in the area. A particular effort was made to obtain information regarding the source of infection of the primary case in each locality. Careful histories of the illnesses and previous vaccinations were obtained from the patients or their relatives and the presence or absence of vaccination scars was noted. Proof of primary vaccination was the presence of a scar; for revaccination, reliance had to be placed on histories.

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The patients were classified, for the sake of simplicity, into "haemorrhagic", "discrete" and "confluent" categories as per criteria laid down by Sarkar & Mitra (1967). The "haemorrhagic" cases of the present series corresponded to the "fulminating" and "malignant confluent" cases of Dixon (1962), the "confluent" cases to his "confluent" and "benign confluent" and the "discrete" cases to his "discrete mild" and "abortive" cases.

Of the cases studied, some could not be personally contacted because they were either cured or dead at the time of the investigation or, in some instances, because of practical difficulties, which prevented visiting them. Details of these patients were obtained from other patients or contacts.

All patients admitted to the smallpox ward of the IDH were investigated but only the virologically positive cases were included in the present series.

Vesicular or pustular material from the cases was inoculated on the chorioallantoic membrane (CAM) of embryonated eggs in the standard manner (Sarkar et al., 1959).

For virulence testing of the isolated virus strains, the laboratory tests as described by Sarkar & Mitra (loc. cit.) were employed. The four tests used were:

1. Mortality of chick embryo after CAM inoculation of 10^6 pockforming units (pfu) of the virus strains.
2. Mortality of infant mice after intraperitoneal inoculation of 3×10^5 pfu of the virus.
3. Concentration of the virus in the liver of chick embryos 72 hours after CAM inoculation of 10^6 pfu of the virus.
4. Histopathological study of the pock on the CAM.

Results

Incidence and geographical distribution of cases

For the period June to November, 38 cases were detected in 1967 and 35 cases in 1968. These were randomly distributed in all months of the period except August 1968.

During the months of lowest incidence, two-thirds or more of all cases occurred in only three of the 41 postal zones of Calcutta (Table 2). Almost all patients were in low socio-economic groups and concentrations of cases invariably occurred in congested "bustees" (slum areas) where each room in a house is occupied by several members of a family and where sanitary conditions are unsatisfactory. Twelve of the 73 patients were, in fact, beggars or footpath dwellers.

Vaccination status

Fifty-six of these 73 patients (77 per cent.) had never been vaccinated and of the unvaccinated 17 (30 per cent.) died. Nine patients had primary vaccination in childhood; two of these (aged 25 and 30 years respectively) died. Eight patients were reported to have been vaccinated and also revaccinated at some time in the past; none died (Table 3).

Age and sex of patients

Thirty-two of the 73 patients (44 per cent.) were children less than 15 years of age and in this group males and females were about equally afflicted. In the older age groups there were significantly more cases among males than females. The excess of male cases is accounted for principally by the large number of cases among beggars and footpath dwellers.

Clinical severity of cases and virulence of causative virus

There were no haemorrhagic cases except one doubtful case in 1967, who reportedly had some unverified bleeding from his mouth. Over half (53.4 per cent.) of the cases were "confluent"; the remainder were "discrete". Discrete cases, not surprisingly, occurred more frequently among those previously vaccinated than among the unvaccinated (Table 4). In comparison, among 80 cases which occurred during the smallpox season, seven (8.7 per cent.) were haemorrhagic, 48 (60 per cent.) were confluent and 25 (31.3 per cent.) were discrete. Nineteen out of 73 cases of the present series (26 per cent.) died; all except two were unvaccinated (Table 4). This case-fatality ratio is similar to that observed in each of the preceding five years during the off-season period but less than that seen during the smallpox season. It is noted that although 1963 was an unusually severe epidemic year, the case-fatality ratio was lower than in 1965 and 1966. During the off-season period preceding the epidemic of 1963, the case-fatality ratio of 45.3 per cent. was higher than during the smallpox season. Whether the virus strain gained virulence while in circulation during the off-season months of 1962, or a new virulent strain was introduced in the community during this period to cause an epidemic in 1963 or whether the findings were just incidental, is a matter for speculation.

The cases reported are recorded by type of disease and age in Table 4. Attempts to characterize the virus were conducted with isolates from 28 of these patients. Twenty strains of virus isolated from confluent cases and eight strains from discrete cases were tested for virulence in the laboratory; 20 per cent. of the strains from confluent cases and none from discrete cases were found to be "virulent". These percentages are lower than those found by Sarkar & Mitra (loc. cit.) in strains collected from cases occurring during the smallpox season (36 per cent. of strains from confluent and none from discrete cases). This is consistent with the finding of a lower case-fatality ratio, the absence of haemorrhagic cases and the lower proportion of confluent cases during the off-season months. It may be mentioned that none of the strains in the present series proved to be variola minor when tested for growth at 38.5°C (Nizamuddin & Dumbell, 1961).

Origin and spread of cases

In three cases in 1967 and two cases in 1968 the case histories suggested that the infection might have been introduced into the city from elsewhere. The widely separated areas of occurrence of some of the cases are not surprising considering the potentiality of beggars, footpath dwellers and bustee dwellers (who are usually employed as manual workers in different parts of the city) to spread the infection widely. Most of the cases in 1967 and 1968 can be grouped into six outbreaks in bustees where spread occurred mainly due to close contact of the inhabitants.

One outbreak was of particular interest. The first case detected, although living at a distance from the postal zone where many cases had occurred, frequently visited the house of one of the cases during her illness. On further investigation of the second case, the source of infection was traced to a previous case whose family had moved from a village (Shibganja) in the Howrah district, about 30 miles from Calcutta. On inquiry at the village Shibganja, it was revealed that cases had been occurring there continually since the preceding June, when the first case of smallpox came to the village from the port area of Calcutta city. Thus it seems that the infection was introduced into the village from Calcutta in June 1968, maintained there by person to person transmission until September 1968 and was reintroduced into another part of Calcutta to initiate a small off-season outbreak.

TABLE 1. HIGHEST AND LOWEST SMALLPOX INCIDENCE - BY SIX-MONTH PERIODS 1962-1966

	1962		1963		1964		1965		1966	
	Admission	Death	Admission	Death	Admission	Death	Admission	Death	Admission	Death
December	124	48	28	8	9	0	7	3	14	3
January	8	2	282	101	45	14	12	6	30	11
February	11	1	373	149	23	15	7	2	44	21
March	24	10	290	102	40	9	34	21	57	26
April	25	3	184	89	39	8	18	10	38	21
May	14	1	78	44	10	2	10	4	32	15
Total	206	65 (31.5%)	1235	493 (39.9%)	166	48 (28.8%)	88	46 (52.3%)	215	97 (45.1%)
June	4	3	30	10	3	2	3	1	21	4
July	11	4	27	7	8	1	10	3	18	6
August	7	6	12	9	2	0	0	0	5	2
September	3	1	8	4	6	0	2	2	2	1
October	3	2	4	0	2	0	0	0	1	0
November	25	8	17	4	1	0	2	0	1	0
Total	53	24 (45.3%)	98	34 (34.6%)	22	3 (13.6%)	17	6 (35.3%)	48	13 (27%)

TABLE 2. CASES OF SMALLPOX DURING MONTHS OF LOWEST INCIDENCE
1967-1968 BY POSTAL ZONE NUMBER

Postal zone	Cases		
	1967	1968	Total
4	2	13	15
7	8	0	8
8	0	8	8
23	0	6	6
28	8	2	10
40	8	1	9
All other	12	15	17
	38	35	73

TABLE 3. OUTCOME OF ILLNESS BY AGE-GROUP AND VACCINATION STATUS.
SMALLPOX CASES DURING MONTHS OF LOWEST INCIDENCE

Age	Total No. of cases	Previously vaccinated		Unvaccinated	
		No. of cases	No. of deaths	No. of cases	No. of deaths
0-4	12	1	0	11	8
5-14	20	1	0	19	3
15-24	11	3	0	8	3
25-44	25	9	2	16	3
45	5	3	0	2	0
Total	73	17 (12%)	2	56 (30%)	17

TABLE 4. TYPE OF SMALLPOX BY AGE AND VACCINATION STATUS,
MONTHS OF LOWEST INCIDENCE 1962-1968

Age	Vaccinated		Unvaccinated	
	Confluent	Discrete	Confluent	Discrete
0-4	1	0	9	2
5-14	0	1	12	7
15-24	1	2	3	5
25-44	3	6	8	8
45+	0	3	2	0
	5	12	34	22

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