EPIDEMIOLOGIC INVESTIGATION OF AN OUTBREAK OF SHIGA BACILLUS DYSENTERY IN AN ISLAND POPULATION

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INTRODUCTION

Although dysentery ranks fourth in the list of the diseases causing greatest mortality in tropical countries (Tito de Morais *et al.*, 1962) it was a comparatively less important disease in Bangladesh before 1971 (Khan and Mosley, 1968). With the large movement of population during the war in Bangladesh in 1971, a severe dysentery in epidemic form made its appearance. Large scale morbidity and mortality were reported from many areas of Bangladesh. At about the same time the Cholera Research Laboratory which acts as the principal treatment centre for diarrhoeal diseases for the capital city of Dacca began to isolate large number of *Shigella dysenteriae* type 1 and a lesser number of *S. flexneri* from patients coming for treatment (Rahaman *et al.*, 1974). The percentage of all *Shigella* isolations in Dacca increased from 0.6% in 1970 to 14% in 1973. Before World War I, many outbreaks of Shiga dysentery were reported in East Asia and Europe and a few in America (Beck *et al.*, 1957). Though Shiga dysentery is a rare disease in modern times (Mata *et al.*, 1970), a multi-resistant strain of the Shiga bacillus was responsible for a severe pandemic involving 5 countries of Central America between 1969-70 (Gangarosa *et al.*, 1970). This report presents the results of an investigation of an epidemic, also caused by a multiresistant Shiga bacillus, on an island in the Bay of Bengal which occurred between May and July, 1973. It is not unlikely that an epidemic caused by a similar organism may spread to other areas of Southeast Asia, as the island is quite close to Burma. This paper deals with the epidemiologic aspect of this outbreak.

Description of Area

St. Martin is a small island about 5 miles long and 3/4th to 1/6th mile wide. It is situated in the Bay of Bengal nearly 150 miles south of Chittagong, 25 miles from Teknaf and about 10 miles from the coast of Burma. The highest part is about 12 feet above sea level. There were 214 families in the island. The livelihood of local people depended mainly on fishing. Ninety-five per cent of the families were concentrated in the northern part. People live in thatched huts with raised wooden or bamboo platforms. There were no privies and the inhabitants are used to defaecate indiscriminately at any convenient place. At the time of investigation drinking water was obtained mainly from small shallow ponds located within the compound of each family. In addition, there were two concrete ring wells of 8-10 ft depth, one in front of the police camp and the other in front of the local mosque. People occasionally went to Teknaf, the mainland trading place by ordinary fishing boats for purchasing essential commodities. However, during the monsoon, when this epidemic reached its peak the population was virtually isolated from the mainland due to the rough sea.

MATERIALS AND METHODS

The island was first visited on July 12, 1973 and 12 rectal swabs were collected for culture from the active cases. *Shigella dysenteriae* type 1 was isolated from 9. A public health

team was sent to chlorinate water sources on July 16. The third visit by a larger field team was made between July 20 and 25. During the third visit, a detailed census was carried out and histories of present or recent attacks from dysentery were obtained. Rectal swabs were obtained from acute, sub-acute and chronic cases which yielded three additional *Shigella dysenteriae* type 1 isolations. History of the use of any medicine was also recorded. By this time antidysenteric drugs and water sterilizing tablets (Halazone) were supplied to the whole population. The pathogens isolated gave similar biochemical reactions; all 12 isolates were found to be uniformly resistant to sulphonamides, tetracycline, streptomycin and chloramphenicol but sensitive to ampicillin and kanamycin. The patients had similar clinical symptoms. As other pathogens were not found it was assumed that all the cases of dysentery were caused by the Shiga bacillus of the same strain.

RESULTS

The census shown in Table 1 revealed a total of 1,318 persons residing on the island in 214 family units. The overall male to female population ratio was 1.1:1. Forty-nine per cent were aged below 15. In the age groups 25 and over there were fewer females than males. The average family size was 6.1.

Table 1

Population of St. Martin Island.

Age	Male	Female	Total	Per cent
0-1	28	14	42	3.2
1-4	109	88	197	15.0
5-9	101	111	212	16.1
10-14	91	101	192	14.5
15-19	65	80	145	11.0
20-24	54	56	110	8.3
25-29	56	39	95	7.2
30-34	32	34	66	5.0
35-39	40	22	62	4.7
40-44	31	19	50	3.8
45-49	16	11	27	2.0
50+	66	54	120	9.1
Total	689	629	1,318	100

Table 2 shows that the attack rate was highest in the younger age groups. In the older age groups, the rates were comparatively lower. Females between 15-44 had higher attack rates than males of the same age

Table 2

Attack and death rate per 100 persons on St. Martin Island.

Ages	Male		Female		Total		
	Attack rate	Death rate	Attack rate	Death rate	Attack rate	Death rate	Case fatality rate
0-1	42.8	14.2	35.7	21.4	40.4	16.6	41.1
1-4	56.8	7.3	47.7	1.1	52.2	4.5	8.6
5-9	40.5	3.9	41.4	1.8	41.0	2.8	6.9
10-14	36.2	-	32.6	-	34.3	-	-
15-19	23.0	-	30.0	-	28.2	-	-
20-24	24.0	-	26.7	-	25.4	-	-
25-29	25.0	-	23.1	-	24.2	-	-
30-34	21.8	-	32.3	-	28.7	-	-
35-39	17.5	-	27.2	-	22.5	-	-
40-44	9.6	-	21.0	-	14.0	-	-
45-49	18.7	-	18.1	-	18.5	-	-
50+	21.2	4.5	24.1	5.5	23.3	5.0	21.4
Total	32.6	2.7	33.3	1.4	32.9	2.1	6.4

groups. The overall attack rate was 32.9%. The attack rate below 1 year was 40.4% where the death rate was highest, i.e., 16.6%. In age-group 50 and over, the attack rate was 24% and the death rate was 5.5%. The death rate in the entire population was 2.1% and the case fatality rate was 6.4%.

The primary case rate (index case) was 15.4%, secondary case rate occurring in the first week was 6.6%, in the second week 6.5% and beyond the second week 8.7% (Table 3). The total secondary case rate was nearly 22%. Thirteen per cent of the families were free from infection and there was 100% infection in 4% of the families.

Table 3

Secondary attack rate per 100 people on St. Martin Island.

	Total Cases	Index Cases	All Secondary Cases			
			Cases during the 1st week from the date of index	Cases during 2nd week	Subsequent cases	Total
Number	434	203	74	68	85	227
Rate	32.93	15.40	6.63	6.53	8.73	21.89

The overall attack rate in small (1-5) families was 33.6%, in medium sized (6-8) families 34.3% and in larger families (9 and above) 29.7% (Table 4). The secondary cases in these families were 15.3, 23.2 and 22.6 per cent respectively. In 25% of small families there were only 2 members or less. Amongst the children up to the age of 9, the rates between the smallest and largest families were significantly different(55.1% and 37.7%), $p < 0.05$.

The attack rates among people using drinking water from different sources is shown in Table 5. The attack rate among mosque-well users was 34.9%, among police-camp-well users 34.1%, among dug-well users of eastern zone 32.6% and of the western zone 25.8%.

The incidence in chronological order is shown in Table 6. The attack rate gradually increased from the 3rd week of May till it attained a peak during the 1st week of July. In spite of the use of water sterilizing and chlorine generating paracarboxybenzenesulphon dichloroamide (Halazone) tablets supplied by health agencies, the peak was maintained up to the 2nd week of July. During the 2nd and 3rd week of that month, drugs such as sulphonamides, iodohydroxyquinolines, tetracyclines and furazolidone were supplied. Though *S. dysenteriae* type 1 was fairly sensitive to furoxone *in vitro*, the supply of drug was inadequate. The most effective antibiotic, ampicillin, was used in adequate doses from the middle of the 3rd week of July. During the 4th week, the incidence came down dramatically.

Table 4

Size of family and the attack rate.

Size of family	Total			10 years +			0-9 years			All secondary cases		
	Memb.	Infect.	%	Memb.	Infect.	%	Memb.	Infect.	%	Memb.	Infect.	%
1-5	373	132	33.6	256	71	27.7	107	59	55.1	274	42	15.3
6-8	464	159	34.3	281	67	23.8	193	93	48.2	408	95	23.3
9+	481	143	29.7	338	87	25.7	154	58	37.7	452	102	22.6
Total	1,318	434	32.9	875	225	25.7	454	210	46.3	1,134	239	21.1

Table 5

Attack and death rate of members using different sources for drinking water on St. Martin Island.

Mosque well users (shallow ring well)			Thana well users (shallow ring well)			Pubpara (Eastern Zone) dug pit users			Paschimpara (Western Zone) dug pit users			Miscellaneous dug pit users		
Memb.	Attk.	Death	Memb.	Attk.	Death	Memb.	Attk.	Death	Memb.	Attk.	Death	Memb.	Attk.	Death
528	185	14	164	56	0	410	134	8	120	31	0	97	27	6
Rate	34.9	2.8	-	34.1	-	-	32.6	1.8	-	25.8	-	-	27.8	6.1

Table 6

Area and weekly incidence on St. Martin Island.

Areas \ Weeks	April 29-May 5	May 6-12	May 13-19	May 20-26	May 27-June 2	June 3-9	June 10-16	June 17-23	June 24-30	July 1-7	July 8-14	July 15-21	July 22-25	Total	Rate/100
Mosque well users			3	5	3	2	5	14	20	50	49	28	6	185	34.9
Thana well users						2		2		11	16	19	5	55	34.1
Eastern dug well users				6		4	9	17	7	31	28	29	3	152	32.9
Western dug well users	1					2	2	5		7	8	5	3	33	28.3
Miscellaneous dug well users	1			2		2	1	2	3	6	3	6	1	27	28.8
Total	2		3	13	3	12	17	40	30	105	104	87	18	434	32.9
Per cent	0.46	-	0.69	3.89	1.14	2.75	3.89	8.24	6.86	23.80	23.57	20.14	3.89		

DISCUSSION

The disease was concentrated in the extremes of the population spectrum. The age specific attack rate was higher up to the age of 9 than in succeeding age groups. This was higher than the findings of Mata *et al.*, (1966). The mortality rate in this group was also higher than in the older age groups. Mendizabal-Morris *et al.*, (1971) reported that the attack rate in male was higher in all age groups. But in this population, the attack rate amongst females aged 15-44 years was higher than males. This may have been due to frequent exposure during the care of sick children. The case fatality rate was 6.2% which is nearly twice that reported from Central America (Gangarosa *et al.*, 1970). The morbidity rate from *Shigella dysenteriae* type 1 in the Somali Republic (Cahill *et al.*, 1966) was identical with that reported in this paper. The appearance of secondary cases in the families took varying lengths of time. As the incubation period was short and the

organisms virulent (Levine *et al.*, 1973) and as there was no history of a communal feast, it seems that the agents may not have been transmitted at one time in a common-source outbreak. The higher attack rate, both in children and adults of small families as compared with large families, suggests that there was limited possibility of person-to-person transmission. This, however, differs from the opinion of Reller *et al.*, (1969). The attack rates in different zones using different sources of water were not significantly different. There were sporadic cases prevailing in different zones for some time and the peak was attained in about three months (Table 6).

Culture of ring well water did not show *Shigella* but there were large coliform counts (between 130-900/100 ml) suggesting contamination by faeces. People usually drank water from small, shallow ponds filled with apparently clear water located within their own premises. Some families who lived close to the ring-well used its water for drinking. Contamination of all the water sources by rain water from a single source was unlikely. But contamination of individual ponds by stool passed by patients within their premises was possible. Flies were abundant throughout the year. Flies carrying the infection from stool passed in the premises and bushes could easily reach the kitchen and food of the neighbouring houses. The people were not careful in covering food and drink. The epidemic took a number of weeks to attain its peak. The isolated and relatively non-immune population had not experienced such an infection in the past. It is possible that flies might also have played a role in spreading the disease by transmitting the agents initially from house to house.

SUMMARY

An epidemic of dysentery broke out in St. Martin island during May through July 1973. The epidemic was caused by *Shigella dysenteriae* type 1. The dysentery could not be controlled by conventional antibiotics and other antidysenteric drugs.

The average attack rate was 32.9%. The age specific attack rate was highest in the age group 1-4 years (52.2%). The attack rates were higher in smaller families. The rates were not greatly different amongst people using different sources of water. The overall death rate was 2.1%. The overall infection-to-death rate was 6.4% but amongst children less than a year old, it was 41.1%. A common source outbreak was unlikely. The higher attack rate in smaller families suggested limited possibility of person to person spread. No particular water source could be implicated with higher attack rate. Flies may have played an active role in transmission.

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