OUTBREAK OF EPIDEMIC DIARRHOEA AND VOMITING IN A GENERAL HOSPITAL AND SURROUNDING DISTRICT

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The hospital in question is a general hospital of 1,000 beds with a nursing staff of 365, and serves a compact, densely populated industrial area. Attention in the hospital was first drawn to the outbreak on May 1, 1945, when five babies in a maternity ward, whose ages ranged from 3 to 6 days, were reported to have developed diarrhoea. The maternity ward in question ("A") consists of 20 beds and 20 cots. It is the ground-floor ward of a block of three maternity wards, the second ward ("B") consisting of 22 beds and 22 cots on the first floor, and the third ward ("C") consisting of 24 beds and 24 cots directly above. These wards are separate structurally from each other, but the nursing staffs are in contact at meal-times, lecture-times, etc., and the same medical staff serves both wards. There are 10 nurses on each ward.

On inquiry it was found that two cases of diarrhoea had been admitted previously to a surgical ward as suspected acute abdominal conditions, but no trace could be discovered of any contact with the babies in Ward A, which was far distant from the surgical ward. The cleaner of Ward A had had some diarrhoea on April 13, 1945, and she would have been in the nursery as part of her normal duties, although she would have no direct contact with the babies. On May 2 the sister of Ward A and another baby developed symptoms, and on May 3 another member of the nursing staff and one of the mothers on the same ward had diarrhoea. On May 4 a third nurse, a mother, and a baby in Ward A were affected, while a baby in Ward A developed the condition. On May 5 a member of the medical staff reported an attack of diarrhoea, while a mother in Ward A and two babies in Ward B were also reported. After this initial outbreak there occurred a succession of fresh cases in both wards, involving members of the nursing staff, mothers, and babies, and in the succeeding 15 weeks a total of 7 nurses, 11 babies, and 17 mothers had been affected in Ward A, while the figures for Ward B were 3 nurses, 11 babies, and 17 mothers. During this length of time there were two intervals of 20 days and 18 days (Ward A) and two of 26 and 18 days (Ward B) during which no cases occurred (see accompanying histogram).

The total admissions to these wards over the same period were 209 mothers and 184 babies to Ward A and 135 mothers and 132 babies to Ward B. During the whole period of 15 weeks there was not a single case of diarrhoea reported in

patients or staff in the third maternity ward (Ward C), adjoining the other two and bearing an exactly similar relationship in regard to nursing and medical staff.

Four patients admitted to the ante-natal ward reported symptoms which had in each case developed before admission, and one of these patients subsequently gave birth to a child who developed diarrhoea on its second day of life. Sixteen other patients were admitted to the general wards with similar symptoms, while 9 patients already in the general wards of the hospital became affected. Seventeen further cases occurred in nurses working in the general wards of the hospital, and it is possible that further members of the nursing staff may have had mild and transient symptoms which were never reported. During the fourth and fifth weeks there was an outbreak of Sonne dysentery in the hospital; 20 cases occurred in one ward, in 14 of which the diagnosis was confirmed bacteriologically.

It was soon apparent in respect of the young babies that this outbreak in no way resembled in severity a previous epidemic of neonatal diarrhoea which had occurred in the maternity wards at the beginning of the year, and which had been associated with a high mortality. Moreover, on that occasion no adults had been involved. Of the total of 111 cases in the present series, 20 adults were admitted to hospital with a history of symptoms, and the remaining 91 cases (including 27 members of the nursing staff and 22 babies) acquired the condition in the hospital. Daily visiting to the patients provided a constant contact with the outside community, and in several instances histories were available of other members of the family suffering from diarrhoea and vomiting about the same time. The possibility of infection having been brought in from outside cannot be entirely ruled out, but the fact that 65 of the cases occurred in two neighbouring wards points to a degree of local spread within the hospital, yet it should be noted that Ward C remained entirely clear. Careful inquiry failed to throw suspicion on any foodstuff, milk, or water supply as a possible source of infection.

Clinical Features

There were no noticeable prodromal signs, the onset of the condition being ushered in by diarrhoea and perhaps abdominal pains, but in a few cases there were preliminary feelings of malaise and general discomfort, not unlike the onset of an attack of influenza.

Diarrhoea was the main symptom and also the most constant, usually being the first to appear and the last to clear up. It was present in every case, and sometimes was the only material complaint. The number of stools in 24 hours varied from 4 to 22. The diarrhoea was characterized by profuse loose watery stools which were invariably negative to bacteriological examination. No blood or mucus was present, except that the babies' stools tended to become green and contain mucus. At the onset the stools of the babies were also typically watery and seemed to soak into the napkins. Abdominal pain was not constant, and was present in 45 out of 89 adults (50.5%). It varied considerably in severity, and in 5 cases was so severe that the patient was admitted as a suspected abdominal catastrophe, with a tender rigid abdomen and generalized pains. This feature was limited to patients admitted from outside, and none of the cases occurring in the hospital and coming rapidly under observation and treatment showed such severe abdominal signs. Nausea and anorexia were present in practically all the adults—the nausea being pronounced in 25 (28.1%); but vomiting was found in only 46 cases of the total of 111 (41.4%), affecting 42 adults (47.2%) and 4 infants (18.2%).

Pyrexia was present in 32 out of 89 adults (34.8%) but in none of the babies. In every such case it was under 100° F. and of brief duration, usually 24 to 36 hours. There was one exception, however—a boy aged 15 who had a sustained temperature up to 102° F. over a period of some 10 days, and who was admitted as a suspected case of peritonitis. In this particular instance there was a history of 6 other members of the family having suffered from diarrhoea and vomiting at home. It is interesting to note that out of 37 mothers affected, 24 (63.3%) had a pyrexia of brief duration which never exceeded 100° F., thus giving a higher incidence of pyrexia than any of the other groups.

Vertigo was not found, but in 10 adults (11.2%) there were severe headaches. Injection of the fauces was not a feature of any of the cases. Two cases were admitted in a state of collapse with well-marked dehydration, which responded quickly to treatment. None of the patients could be regarded as dangerously ill, although in 7 the illness was of a considerable degree of severity. The average duration of symptoms was 4.6 days, the shortest being 24 hours and the longest 14 days. With the babies they averaged 4 days, the mothers 3.1 days, members of the nursing staff 6.1 days, and cases admitted from outside, which might be regarded as the more severely affected of those occurring outside, 7.3 days. There were no relapses during the period of observation. Except for the babies in the maternity wards the age incidence varied from 1 year 3 months up to 84 years, most of the patients being in the young adult group.

In general the patients in the maternity wards—the babies and the mothers—were the least severely affected. The weight charts of the babies presented a very typical appearance, the onset of the symptoms being associated with a loss of weight which varied from 2 to 21 oz. and which averaged 13 oz. This loss of weight usually occurred during the period when the weight of the baby was climbing back to the birth weight after the customary initial fall. The appearance of a sharp fall in the rising curve was very characteristic. As soon as the symptoms cleared there was a rapid improvement and the baby very soon regained its lost ground. The condition of the babies did not give rise to anxiety at any time. As a rule, it was not necessary to retain mothers or babies in hospital longer than the normal period, and this occurred only when the symptoms appeared shortly before the usual expected date of discharge. The delay was never significant. In 8 cases the mother of an affected baby subsequently developed the condition, the average interval being 4.4 days. In only one case did the baby develop symptoms after the mother, that being the one already mentioned, in which the mother had diarrhoea and vomiting before admission to the ante-natal ward and the baby developed loose stools on its second day after birth. In 28 cases the mothers were affected while the babies remained perfectly well, and in 13 the babies were involved and the mothers remained clear. The babies were all breast-fed, but during the first few days of life were given sterile water with sterile precautions.

Treatment of the adults was on simple empirical lines—rest in bed, fluid milk diet, and a simple bismuth-and-chlorodyne mixture being given as a routine. Thirteen members of the nursing staff were also given sulphaguanidine, but there was no evidence that this affected the course of the illness in any way. Most of the symptoms cleared quickly as soon as the patient went to bed, the diarrhoea being the most persistent and lasting throughout, gradually lessening in severity. In a few instances the abdominal pains remained for several days, but were usually associated with the most persistent cases of diarrhoea.

Investigation by Questionary

Sonne and Flexner dysentery have been endemic in the surrounding area for several years, and occasionally small outbreaks have occurred in the hospital, in the day nurseries, and also in the district. These outbreaks have been easily identified bacteriologically, the numbers notified have not been large, and the general practitioners accept them as part of their usual routine. During the past few months it was noted that a large proportion of the stools sent in from practitioners were negative; some practitioners who sent in stools regularly for examination commented on this and also stated that they were having large numbers of cases attending their surgeries with an unusual type of acute diarrhoea, sometimes preceded by vomiting. The cases were so numerous that they did not attempt to have more than a fraction of them examined bacteriologically. When the hospital outbreak occurred and had been systematically investigated from the laboratory standpoint, with negative results as described above, the following questionnaire was sent to 20 of the principal Salford practitioners, who had been established in different parts of the city—population approximately 160,000—for at least several years before the war. Of these, sixteen replied, and their answers are summarized after each question. Extra faeces outfits were also forwarded

to each practitioner, with a request to send in fresh samples of faeces from any further cases they might have.

1. *Have you had an outbreak of gastro-enteritis in your practice?*—Sixteen replied, "Yes."

2. *Can you give any idea as to when it began?*—Early 1944, 1; autumn, 1944, 3; Feb., 1945, 1; March, 1945, 1; April or early May, 1945, 9; not stated, 1.

3. *When did it abate?*—June, 1; July, 11; end of July, 2; not stated, 2.

Inquiries from practitioners at the time of writing—Aug. 25, 1945—show that there has been no recrudescence of the epidemic, but that sporadic cases are still occurring, sometimes in groups of two or three. Several practitioners thought there had been two or three waves of infection during April, May, and June.

4. *Does this appear to be a new type of infection?*—Yes, 13; cannot say, 1; unanswered, 1; had seen similar outbreak, but not so severe or lasting so long, 1.

5. *General symptoms and duration of the disease.*—A large majority stressed the sudden onset of profuse watery diarrhoea, sometimes with colic and often preceded by nausea and vomiting. Occasionally there was slight pyrexia, usually clearing up in 2 to 5 days but sometimes lasting 10 to 12 days. A few cases had relapses. Profuse watery diarrhoea was the outstanding symptom in nearly all cases—stools 5 to 20 a day. Two practitioners stated that they had occasional mild cases with nausea and vomiting without diarrhoea. Only one practitioner mentioned giddiness in a few cases after severe attacks.

6. *Can you express any opinion as to whether this type of gastro-enteritis is different from the usual cases of bacillary dysentery which have been in evidence for some years?*—Fourteen replied, "Yes": mainly on account of sudden onset, nausea and vomiting being much commoner, and also because of a profuse watery stool, occasionally with mucus but very rarely blood.

7. *Age incidence.*—All ages affected, 9; mainly adult, 6; not stated, 1.

8. *Does it usually spread to other members of the family?*—Yes, 13; very rarely, 1; usually no, 1; no, 1.

The general impression was that it occasionally spread to all members of the household, usually at intervals of 2 to 4 days, but sometimes as long as 7 days. As a rule it did not spread to all members, but picked out a portion of them. As stated above, six of the practitioners considered that adults were definitely more often affected than children. It was admitted that many of the adults who attended the surgeries came for sick notes. This may be the explanation, as affected adults would therefore be more in evidence than children.

9. *Any other observations that strike you.*—No respiratory symptoms mentioned. No mention of fatal cases. Most practitioners agreed that the epidemic began insidiously with sporadic cases.

The number of new cases seen by each practitioner varied from 3 to 4 a day in some practices to as many as 15 to 20 daily in others while the epidemic was at its height—mainly during May and June. Four of the practitioners who replied to the questionnaire had themselves been infected. Inquiries were made at the maternity and child welfare clinics, day nurseries, and school clinics for evidence of increased incidence of diarrhoea and vomiting.

The maternity and child welfare clinics reported no increase of diarrhoea and vomiting in the babies attending. The day nurseries, which are kept under careful observation for outbreaks of dysentery, also reported no increased incidence during the period of the epidemic, although a few cases occurred among the adult staff. The impression at the school clinics was that there had been a slight increase in the incidence of gastro-enteritis.

Commentary

One may gather from this inquiry that the outbreak was fairly extensive, as probably only a portion of the cases affected reported for treatment. From reports received we have good reason to believe that a similar type of diarrhoea and vomiting has been widespread over the country this spring and summer. A comprehensive field inquiry into this would be of interest. An interesting feature of the outbreak is the observation that 13 out of the 16 practitioners stressed the fact that they could not remember a similar epidemic of gastro-enteritis occurring in their practices, and considered it a new type of infection. We cannot recall a similar outbreak at the hospital or in the surrounding district during our period of residence here—over 17 years.

Epidemic nausea and vomiting occurring in an English boarding school was described by Miller and Raven (1936). They mention similar outbreaks in Denmark in 1935. Diarrhoea was not a feature in these cases. A more recent outbreak is

reported by Bradley (1943) in which some of the cases had diarrhoea as a symptom of minor importance. R. E. Smith (1938) mentions small attacks of epidemic vomiting and diarrhoea occurring at a public school; he states that cases tend to occur in the early morning, that they are of extremely short duration, and that vomiting is a more constant feature than diarrhoea.

The only description we have found of an outbreak in this country closely resembling the present one is that of A. H. D. Smith and Davies (1941) of gastro-enteritis at a large Army training centre. The disease appears to be common and widespread in the United States. Reimann *et al.* (1945) give a very full account of the disease as it occurs in America, with a comprehensive bibliography of outbreaks in other countries, and state that the transfer of infection to human volunteers by inhalation of filtered nasopharyngeal washings and faecal filtrates from patients has given encouraging results. Their clinical and epidemiological descriptions correspond closely with ours. We quote the following extracts from their paper:

"This disease affects all ages, and its mortality is *nil*. Published epidemiological and clinical descriptions are similar. Sporadic cases are noted in the community for weeks or months, and eventually large outbreaks occur. No age group is immune, but children of school age and young adults seem mostly affected. Epidemics occur at all seasons of the year, but especially in the autumn; and in different groups from 15.1 to 100% of persons are involved. Incubation period has been estimated from 30 hours to 7 days, usually two days.

"Epidemiologically the mild widespread disease with isolated cases and family and community groups involved, its apparent pandemicity, and seemingly short incubation period closely resemble the behaviour of the common cold or influenza, except for its spread over two or three months and absence of peaking. It is probably an air-borne infection, but hand-to-mouth or other means of transmission cannot be excluded, nor is it known whether it enters through the respiratory or alimentary tract."

We have little to add to this description and these conclusions concerning the disease. Examination of the stools from the hospital and practitioners for organisms and parasites and pus cells was completely negative. Stools were plated on desoxycholate citrate agar, MacConkey's agar, and in some cases on blood agar. When the hospital outbreak occurred a number of the stools which had been left in the refrigerator, and also some which were fresh the same morning, were sent to the Public Health Laboratory, Cambridge, for confirmatory examination, with negative results. Blood counts and serological tests were not done on any of the cases, nor was the vomit examined. No attempt was made to transmit the disease to volunteers.

We are unable to explain why the outbreak in the hospital was mainly confined to two maternity wards, the remaining adjacent maternity ward escaping completely. It may be argued that this was a different type of infection from the concurrent epidemic, but the identity of clinical symptoms and absence of detected infective agents in faeces, food, or water do not support this view.

Reimann states: "It is unknown at present whether or not the syndrome is related to severe epidemic diarrhoeal disease of the newborn. In most reports of the latter disease emphasis is placed on the absence of obvious infection in adults associated with the infants either before, during, or after an outbreak and on its high mortality." Similarly, in our cases the mildness of the outbreak among the newborn babies with concurrent infection among the mothers and staff definitely suggests that this is a different type of infection from the usual virulent type of neonatal diarrhoea.

The suggestion made by various authors (Reimann) that the disease is primarily an infection of the central nervous system is interesting. There were no definite nervous symptoms or sequelae in any of the hospital cases. In answer to the questionnaire only one practitioner mentioned giddiness as a sequel in a few of the severe cases. He suggested that this was cardiac in origin. Three others stated that mental depression after an attack was pronounced.

Summary

An outbreak of epidemic diarrhoea and vomiting of unknown origin is described.

Epidemiological data and previous published work suggest that the infection is due to a virus.

We cannot recall a similar epidemic in this area during the past 17 years.

We believe the outbreak has been widespread over the country.

A field inquiry to determine its extent would be of interest.

We wish to thank all the general practitioners who co-operated so well in supplying much of the data for this paper, also Miss Matthews, supervisor of the maternity department, for her assistance; Dr. J. L. Burn, medical officer of health for Salford, for assistance in making inquiries from the practitioners and at the various public health departments; and Dr. R. Cruickshank, pathologist, North-Western Group Laboratory, London, for valuable suggestions.

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TICK-BORNE RELAPSING FEVER IN CYPRUS

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The occurrence of several cases of relapsing fever in rapid succession after military exercises, in which the patients had passed the night in caves or dungeons, raised the possibility of the infection being conveyed by ticks. Further cases with a similar history have since come under our care. As tick-borne relapsing fever has not previously been reported in Cyprus, the details of these cases are described below.

Site of Infection

Infection occurred in caves and dungeons situated in the north and north-east of the island, of which the following is a description:

Cave A is partially subterranean, the mouth being screened by sandbags. It accommodated three men on guard. Its walls are soft and deeply and irregularly creviced. Ticks of the species described below were found in material scraped from the walls of the cave by Major J. Clark and ourselves. Dead ticks of this same species were found in spiders' webs attached to the roof of the cave. Cases 1, 2, and 3 slept in this cave 8 to 9 days before contracting relapsing fever.

Dungeon B is situated in the interior gallery system of extensive mediaeval fortified ramparts. Its walls are of hard masonry with many deep interstices in their surface. Scrapings from its walls were superficial and no ticks could be obtained. Cases 4 and 5 and probably Case 6 slept in this dungeon a few days before contracting the disease.

Cave C is artificially constructed in the side of an eminence composed of hard clay. Ticks could not be found in this cave, but considerable alterations had taken place in its structure before it was possible to make a search. Case 7 slept in this cave some 6 weeks before diagnosed as having relapsing fever.

Cave D is very similar to Cave A. It is situated about a quarter of a mile west of Cave A. A tick of the same species was found in scrapings from the roof of Cave D. Case 8 worked in a hut, the door of which is situated 10 yards from the mouth of Cave D. Case 9 slept in the open on several occasions in this area.

Cave E is within 12 yards of a trench in which Case 10 was digging shortly before he became ill. Identical ticks were found in this cave by Major J. Clark, who has kindly shown them to us.

Cave F is similar to Caves A and D. This cave is in a very inaccessible position and no ticks could be found during the somewhat cursory search possible in the time at our disposal. Cases 11 and 12 slept in this cave 9 days before reporting sick.

Vector of Infection

The ticks found in Caves A, D, and E were all of the same species—namely, *Ornithodoros tholozani** (see Fig.). This tick is a known vector of relapsing fever in other parts of the Levant, but has not so far been described in Cyprus. There is direct evidence of Cases 1, 2, 3, 8, 9, and 10, before contracting

* These ticks have been identified as such by Prof. Adler and Major Leeson.