EPIDEMIC DIARRHOEA AND VOMITING

BY

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Two small outbreaks of epidemic diarrhoea and vomiting which occurred in Cornwall during 1946 are described below; they supply presumptive evidence of the incubation period and mode of spread of the disease, and, further, that given favourable soil the condition can prove fatal. A review of the literature is included in an attempt to analyse the similarities and differences between "epidemic nausea and vomiting," "epidemic diarrhoea and vomiting," and "endemic diarrhoea and vomiting of newborn babies."

Observations

A mild form of diarrhoea and vomiting had been endemic in Cornwall throughout 1946; the first cases were noted in March, the disease reaching a peak in May and again in October. The first of these two epidemics broke out at the Redruth Public Assistance Institution in early June. The hospital block in which most of the cases occurred is a two-storied building standing alone. The top floor contains a ward for female bed-patients (A), a small ward for sick children (B), one for male bed-patients (C), and the nurses' kitchen and dining-rooms; the ground floor has wards for male (E) and female (D) up-patients. The children's nursery (F) and a ward for low-grade mental defectives (G) are in separate blocks, both a considerable distance from the hospital.

All the food in the institution, except that for the nurses, is prepared in a central cookhouse, which has been modernized and is in every way satisfactory; none of the six girls employed in the preparation of the food at any time suffered from diarrhoea or vomiting. The cookhouse for the nursing staff is on the top floor of the hospital block. A cook and a maid are employed, the maid being off duty with diarrhoea and vomiting from June 10 to 13. The water supply (mains) and the milk supply (accredited) were both investigated, with negative results.

The first case occurred on May 31 in Ward A; the subsequent 32 cases and the dates of their appearance are shown in Table I.

TABLE I.—Cases at Redruth

Ward	No. of Cases	Population at Risk	Attack Rate	Date of Occurrence
A: Women bed-patients	7	14	50%	May 31, June 3, 6, 8, 11, 13
B: Sick children ..	—	6	—	—
C: Men bed-patients ..	5	14	35%	June 1, 1, 1, 3, 6
D: Women up-patients	—	30	—	—
E: Men up-patients ..	1	30	3%	June 13
F: Children's nursery	—	12	—	—
G: Mental patients ..	8	24	33%	June 10, 10, 11, 11, 14, 14, 15, 15
H: Nursing staff ..	9	12	75%	June 7, 7, 10, 12, 15, 15, 15, 17
I: Domestic workers ..	3	—	—	June 7, 10, 14

It will be noted that the sick children's ward escaped infection in spite of its position between the two wards most seriously involved, that in each ward the interval between cases was approximately 72 hours, and that the mental ward was the only part of the institution other than the hospital block to be affected. A domestic worker who was employed in Ward A but slept in a side ward on the mental block developed the disease on June 7; the first case occurred among the mental patients on June 10.

Details of the clinical history of the epidemic are included in Table III. Briefly, the symptoms were mild, though diarrhoea in a few cases was prolonged and severe; definite prodromal symptoms were absent, the attack beginning with lower abdominal colic, followed within half an hour by forceful repeated vomiting. Alternatively the abdominal pain was absent, vomiting being the primary symptom and so sudden in its onset that the patient vomited over the table or bedclothes. Within a couple of hours diarrhoea supervened, with copious and frequent stools, 12 to 20 being passed in the first 24 hours. Mild pyrexia was present in 10% of cases, but with one exception the temperature was normal again within 24 hours. Relapses were not seen, but reinfection occurred in two instances after a lapse of six to eight weeks.

A second outbreak of epidemic diarrhoea and vomiting occurred during December at the County Mental Hospital, Bodmin. The hospital accommodates 1,524 patients. The epidemic was confined to the female block, a large two-story building split into four wards, each of 60 patients. The first cases occurred in Wards 1 and 3 on Dec. 4, and between that date and the occurrence of the last case on Dec. 12, 27 patients were affected (Table II). The clinical picture was identical with the Redruth outbreak, though, owing to the high average age of the patients, manifestations were more severe, three deaths occurring from dehydration and collapse in patients, all of whom were over 75 years of age. Details of the dates of onset of disease are given in Table II.

TABLE II.—Cases at Bodmin

Ward	No. of Cases	Population at Risk	Attack Rate	Date of Occurrence
1. Female	17	60	28%	Dec. 4, 6, 6, 7, 7, 7, 9, 9, 9, 10, 10, 12, 12, 12, 12, 12
2. "	Nil	60	—	—
3. "	10	60	16.6%	Dec. 5, 5, 6, 6, 6, 9, 9, 9, 12
4. "	Nil	60	—	—

The hygiene in the institution was carefully investigated and found to be satisfactory. A central cookhouse supplies food for the hospital, the water is main supply, and the milk comes from the home farm. Samples of milk and water were taken, but results were negative. Numerous samples of stool and nasal swabs were taken from patients in both epidemics, but apart from two specimens containing Morgan's bacillus, and one from which *B. dysenteriae* (Flexner) was isolated, no pathological organisms were found. Agglutination to typhoid and salmonella groups was likewise negative.

In each epidemic routine measures for the prevention of spread of alimentary and upper respiratory tract infections were taken—namely, immediate isolation of patients, adequate ventilation and bed-spacing, and the wearing of masks by the nursing staff. Such simple measures appear to have been rewarded by very good results.

Comments and Conclusions

Perusal of the dates given in Tables I and II leads to the conclusion that the incubation period in the two outbreaks described was 72 hours, with a minimum of 48 hours and a maximum of four days. In both of the epidemics a high attack rate occurred in one or two wards, whereas adjacent wards in the same block were unaffected, in spite of the fact that all were supplied with identical food and water; further, all samples of food, milk, and water proved satisfactory. One must conclude that the infection is air-borne and gains entry through either the upper respiratory tract or the gastro-intestinal tract—probably the latter, as

signs of involvement of the fauces are not frequent. The disease attacks all ages, and usually follows a mild course, though among the aged symptoms are more serious and the disease may prove fatal.

Literature and Discussion

The first recorded outbreak of epidemic nausea and vomiting in Britain occurred in 1936, when Miller and Raven (1936) described an epidemic in a girls' boarding-school in Thanet. Since this date at least four epidemics of a similar type have been recorded. In order to facilitate the comparison of the epidemiology and symptoms of these outbreaks I have tabulated the salient features (Table III).

themselves and the order of their predominance in different epidemics may be accounted for by the different age groups affected, the season of the year, and the well-known existence of closely related but slightly different strains of the organism. The endemic distribution with periodic exacerbations into mild widespread epidemics, the short incubation period, and the absence of sustained immunity strongly resemble the behaviour of the common cold or influenza, so that it seems probable that a virus will be found to be the causative organism. Reimann *et al.* (1945) were unable to transmit the disease to animals or to isolate a filtrable agent, but they obtained results strongly suggesting that the disease could be communicated

TABLE III.—*Details of Outbreaks on Record*

Nomenclature of Epidemic	Gray (1939)	Smith and Davies (1941)	Bradley (1943)	Sakula (1943)	Brown <i>et al.</i>		Reimann, Hodges, and Price (1945)	Cornwall Epidemics
	Epidemic Nausea and Vomiting	Acute Gastro-enteritis	Epidemic Nausea and Vomiting	Gastro-enteritis in newborn	Epidemic Diarrhoea and Vomiting		Epidemic Diarrhoea, Nausea, and Vomiting	Epidemic Diarrhoea and Vomiting
					Adults	Babies		
Season ..	Autumn	Autumn	Autumn	Autumn	Young adults	Spring Babies	Autumn	Spring, autumn
Age most affected	Children	Troops	Young adults	Babies, average age 13 days	adults	0-3 months	Children and young adults mostly	Adults
Endemic in population	Yes	Yes	Yes	No	Yes	—	Yes	Yes
Mode of transmission	"Presumably a droplet infection"	Probably direct contact	Communicable disease; portal of entry upper respiratory tract	? Feeding-bottles	—	—	Probably air-borne; hand-to-mouth spread cannot be excluded	Air-borne infection
Incubation period	At least 48 hrs.	1½-7 days	2-7 days	—	4 days	—	2 days; extremes 30 hrs.-7 days	3 days. Extremes 2-4 days
Prodromal symptoms	—	Shivering and malaise	Nausea	Nil	Nil	—	Nil	Nil
Initial symptom	Nausea and vomiting	Vomiting	Vomiting	Vomiting	Abdominal pain, diarrhoea	Diarrhoea	Abdominal discomfort, nausea, diarrhoea	Vomiting, abdominal pain
Nausea and anorexia	Prominent symptom	—	Present in 20%	—	Present in 8%	—	Present in 75%	Present in 9%
Abdominal pain	—	"Feeling of heaviness"	Epigastric pain fairly frequent; no colic	—	Lower abdominal pain with 50% colic	—	Abdominal discomfort in 43%	Lower abdomen and colic
Vomit ..	Yes; in 90%	Forceful in 75%	Projected; 51%	Severe	Yes; 47%	Yes; 18.2%	Yes; 48%	Yes; 50%
Diarrhoea ..	Rare in children, frequent in adults	Yes; 93%	Of minor importance; 23%	Severe	Yes; 100%	—	Yes; 85%	Yes; 94%
Vertigo ..	Common symptom "sea-sick"	—	Dizziness present	—	No	No	Yes; 7%	Rare; 4%
Headache ..	Frontal headache in a few cases	—	Frontal headache invariably present	—	Yes; 11%	—	Yes; 66% frontal	Frontal headache in 10%
Pyrexia ..	Mild pyrexia in 12% school-children	Mild pyrexia	Mild pyrexia, but seldom above 100° F. (37.8° C.)	Mild; only one case over 100° F.	Mild pyrexia in 34%	Nil	—	Mild pyrexia in 25%
Pulse ..	Occasional bradycardia	—	Bradycardia not met with	—	—	—	—	—
Collapse—dehydration	—	—	—	Yes	Two cases of collapse responded well	—	—	Collapse in elderly patients, 3 deaths
Fauces ..	—	Infected	Resemble early stage of streptococcal throat; swabs negative	—	Not infected	—	Infected in 20-30%	Not infected; swabs negative
Agglutinations	Nil	Nil	Nil	<i>Ps. pyocyanea</i> in 44%	Nil	—	Negative Nil	Negative Nil
Organisms isolated	—	—	—	Diarrhoea	Diarrhoea	Diarrhoea	Diarrhoea	Diarrhoea
Most prominent symptom	Vomit	Forceful vomit followed by diarrhoea	Forceful vomit	—	—	—	—	—
Severity of symptoms	Mild	Mild	Mild	15 deaths; 83% mortality	Mild	Mild	—	Mild, but severe in old age
Average duration	3 days	—	—	—	4-6 days	3 days	—	3 days
Relapses ..	—	—	A few cases. After one week	—	Nil	Nil	—	Nil
Babies affected	No	No	No	Yes	—	Yes	No	No

It will be seen that epidemics described under the headings of epidemic nausea and vomiting, acute gastro-enteritis, and epidemic diarrhoea and vomiting possess many points of similarity. They have seasonal incidence in spring and autumn, an incubation period of 48 to 72 hours, and symptoms are of an afebrile gastro-intestinal infection, mild in nature, lasting three or four days and attacking in the main children and young adults. With the exception of the outbreak at Bodmin, described above, no fatal cases have been reported.

It is highly probable that all these cases were caused by the same organism. The slight variations in the symptoms

to human volunteers by the inhalation of a fine mist of nasopharyngeal washings or stools from patients. The evidence that epidemic diarrhoea and vomiting of newborn babies is not caused by the same organism as that in adults is strong. Babies were involved in two of the six epidemics reviewed above. The first was an epidemic outbreak of diarrhoea and vomiting in a general hospital; the patients affected were for the most part adults, but the disease spread to two of the three babies' wards, 37 mothers and 22 babies contracting the disease. In their description of the epidemic Brown *et al.* (1945) state: "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." The second, described by Sakula (1943), is a typical outbreak of diarrhoea and vomiting occurring in newborn babies, with a case mortality of over 80%.

The clinical distinction between these two epidemics, both involving babies, is obvious. Further evidence against the association of the two diseases is supplied by the infant mortality rate for diarrhoea and vomiting in Cornwall. Throughout 1946 a widespread outbreak of diarrhoea and vomiting was prevalent among the adult population. Yet the infant mortality from diarrhoea and vomiting for 1946 is the lowest for some years, being 1.7 per 1,000 live births.

Summary

Two outbreaks of diarrhoea and vomiting occurring at two county institutions in Cornwall during 1946 are described. These outbreaks were part of a widespread epidemic among the surrounding population. With the exception of three deaths, all in aged patients, symptoms were mild and conformed to previous epidemics reported in the literature, a summary of which is included. Evidence obtained from these Cornish outbreaks points to an air-borne disease with an incubation period of 72 hours, the portal of entry being either the upper respiratory or the gastro-intestinal tract; the organism is probably a virus. The relation between epidemic diarrhoea and vomiting in adults and that which occurs in newborn babies is discussed; the evidence points to the two conditions having a separate aetiology.

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FATAL POISONING BY "LETHANE" INSECTICIDE

BY

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The following case is recorded in the belief that it is the first example of fatal poisoning by lethane insecticide.

Case Report

A woman of 35 was found unconscious in a chair, breathing heavily. She had vomited and there was an empty bottle of "semprolia" lethane insecticide near by. It was subsequently discovered that she was a widow and had been ailing with abdominal symptoms for some time and, being too ill to work, was nearly destitute. She was immediately transferred to hospital, but on arrival was found to be dead.

The relevant necropsy findings were as follows. The face was more pink than usual. The right side of the heart was dilated and the internal organs were moderately congested. The mouth and oesophagus were healthy. The stomach contained a little oily fluid with a strong odour of oil of citronella like that of the bottle found by her. There were numerous pin-point petechiae running together into clusters, mainly along the lesser curvature of the stomach but spreading out on to the adjacent walls. There were similar but less severe petechiae in the duodenum. The appendix was the seat of a well-localized abscess containing approximately 5 ml. of pus; this was presumably the cause of the abdominal symptoms. The liver was acutely congested and had the same odour as the stomach contents. There was an excess of frothy mucus in the trachea and

major bronchi and some oedema of the right lung. In addition both lungs showed extensive petechiae running together to form ecchymoses under the pleurae of the lower parts. All other organs appeared healthy.

Microscopically the liver contained a trace of fat and had collections of inflammatory cells in most of the portal tracts. Other organs showed no definite abnormality. The central nervous system was examined particularly for evidence of nerve-cell damage, and some swelling of the cells and loss of Nissl granules was noted, especially just lateral to the fourth ventricle; but as the necropsy was carried out 16 hours after death it was not possible to be certain that these were not autolytic changes.

Comment

The empty bottle found near the patient was of 55-ml. capacity. It had contained an insecticidal hair-oil, the composition of which was given on the label as: lethane 384 special, 49%; light petroleum, 49%; oil of citronella, 2%. Lethane 384 special consists of 12.5% of lethane 384 (N-butyl carbitol thiocyanate), 37.5% of lauryl thiocyanate, and 50% light petroleum. A 55-ml. bottle would therefore contain 3.5 ml. of N-butyl carbitol thiocyanate and 10.3 ml. of lauryl thiocyanate. The patient was judged to be about 8 st. (50 kg.), and, assuming that she took the whole contents of the bottle, the dose would be 0.07 ml./kg. of lethane 384 and 0.206 ml./kg. of lauryl thiocyanate.

Cameron *et al.* (1939), who studied the toxicity of these two drugs in rats, rabbits, and guinea-pigs by subcutaneous and intraperitoneal injection, found that the minimal lethal dose of lethane 384 was between 0.025 and 0.2 ml./kg. and of lauryl thiocyanate between 0.08 and 10 ml./kg. In the case of both drugs, therefore, the maximum dose which could have been taken by the patient lay within the range of lethal doses observed by Cameron. In fact, the effective dose taken was less than that stated above, because some was lost by vomiting, and, further, we were unable to discover whether the bottle was full. Even if the effective dose was as little as one-half of the maximum possible, the lethal dose for each drug still lies within the ranges observed by Cameron.

Cameron failed to observe any characteristic post-mortem lesions in his experimental animals, but concluded from clinical observation that death was due to respiratory failure, probably nervous in origin. We have similarly failed to find any characteristic lesion. The dilated right heart, congested viscera, and pleural petechiae suggest that death was due to respiratory failure. The petechiae in the stomach were presumably due to simple irritation, and the inflammatory changes in the liver were almost certainly secondary to the appendix abscess.

The particular preparation which proved fatal in this case can be bought at any chemist's shop and is not labelled "poison." It is marked with the words "For external use only" in print measuring 20 letters to the inch, followed by the words "Not to be taken" in print measuring 24 letters to the inch.

In view of the toxicity of lethane insecticide as evidenced by the present case it seems highly desirable that such preparations should be clearly labelled "Poison."

REFERENCE

- Cameron, G. R., Doniger, C. R., and Hughes, A. W. McK. (1939). *J. Path. Bact.*, 49, 363.

The Ministry of Food expects to be in a position to distribute small quantities of imported citric acid, and proposes to allocate supplies direct to such importers as can establish their claim to having engaged in this trade in the years immediately preceding the war. Importers who wish to participate in this scheme should apply for full details to the Ministry of Food, Miscellaneous Food Products Division, 39, Portman Square, London, W.1.