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ROTAVIRUS ENTERITIS IN THE WEST MIDLANDS DURING 1974

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Summary During 1974 in the West Midlands of England, 38% of children less than 6 years old with enteritis were excreting rotaviruses. Children aged from 6 months to 3 years were those most commonly infected. Rotavirus infections were most common during winter with only a few sporadic cases during summer. A possible pathogen was detected in 59% of patients examined.

Introduction

ROTAVIRUSES (reovirus-like particles) are an important aetiological agent of acute gastroenteritis or febrile diarrhoea of infants and young children.¹⁻¹³ Reported studies of such gastroenteritis have been based on either a limited number of cases or covered a period of only a few months, although there is no doubt about the worldwide distribution of the agent. Lately a comprehensive 12-month survey in Melbourne, Australia,¹³ substantiated our earlier finding⁸ that, although children under 3 years old are chiefly affected,

infection in children up to 6 years of age may be severe enough to warrant admission to hospital. This survey found that such virus infections reached a peak in June—the middle of the Australian winter—thus supporting the suggestion of Middleton et al.⁴ that rotaviruses are found mainly during the winter months.

This survey was undertaken to ascertain the seasonality and to reappraise the age-distribution of rotaviruses in the West Midlands, which may be representative of the U.K. as a whole.

Patients and Methods

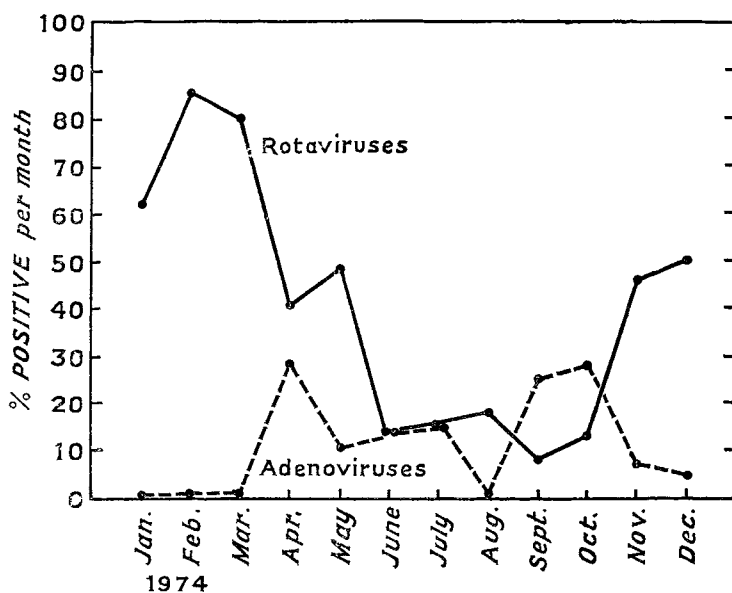
Two hundred and fifty-eight patients under 6 years of age were studied. All patients had gastroenteritis or febrile diarrhoea, as previously described,⁸ which started during 1974. The study of a well-defined outbreak of rotavirus enteritis in a long-stay children's ward¹⁴ demonstrated that, while the virus may persist in faeces for 2 to 3 weeks, it is often no longer detectable, by the method used in the Birmingham laboratory, 8 or 9 days after onset of disease. We did not include any patients whose faeces were first collected more than 7 days after onset of disease.

Most of the patients had been admitted to the communicable-diseases unit at East Birmingham Hospital or to the isolation unit at Copthorne Hospital, Shrewsbury; the remainder were either inpatients at other hospitals in the Birmingham region or under the care of their general practitioner. Since the East Birmingham Hospital admits patients with communicable diseases from the whole of Birmingham and its surrounding districts (a population of about two and a half million), a reasonable cross-section of the child population of the region was thus obtained.

Faeces from these patients were prepared for electron microscopy (E.M.) as previously described,¹⁵ except that high-speed centrifugation was at 30,000 r.p.m. for 30 minutes instead of 50,000 r.p.m. for 1 hour; this was adequate for sedimenting rotaviruses. Routine virus isolation was attempted in primary or secondary rhesus-monkey-kidney and HEp₂ cells; human-embryo-kidney cultures were used when available. Isolation of viruses in suckling mice was not attempted. The specimens were examined for *Salmonella* spp., *Shigella* spp., and enteropathic serotypes of *Escherichia coli* by the Public Health Laboratory, East Birmingham Hospital, the Shrewsbury laboratory, or by other hospital laboratories which sent the specimens to us for examination.

Results

Rotaviruses were found in ninety-nine (38%) of the two hundred and fifty-eight patients examined during the year. Four of these patients were also infected by a pathogenic *E. coli* serotype, three by an adenovirus, one by *S. typhimurium*, and one by an unidentified agent. Adenoviruses, many of which could not be isolated in cell-culture, although present in great numbers in faeces (up to 10¹¹ virions per ml. approximately), were detected on 32 occasions and, as well as occurring in the presence of rotavirus, also occurred in three cases together with enteroviruses, in two with enteropathic *E. coli*, and in one with *S. morbificans-bovis*. One patient was excreting both *S. st. paul* and *E. coli* O55. There was no predominant serotype in the adenovirus, enterovirus, salmonella, or enteropathic *E. coli* groups. Excluding six poliovirus isolations from the study, because they were almost certainly non-pathogenic vaccine strains, agents of



Monthly distribution of rotavirus and adenovirus infections in 1974 in children aged less than 6 years.

pathogenic potential were detected in a hundred and fifty-two (59%) patients (table 1).

Table II shows the frequency of rotavirus according to the age of the patient. Children aged between 6 months and 3 years were those most commonly infected, the highest frequency (62%) occurring in those between 2 and 3 years old. The youngest patient excreting rotavirus was only 16 days old.

The proportion of patients with gastroenteritis excreting rotaviruses or adenoviruses is shown in the accompanying figure. Rotavirus infections were very common from the start of the year until May, with the highest frequency (80%) occurring during February and March. Towards the end of May the frequency decreased rapidly, only a few sporadic cases being recorded until the end of October. The frequency of rotavirus infection then rapidly increased to 50% of the total during November and December. Adenoviruses were not detected during the first quarter of the year, but from April onwards they were found in a small percentage of cases, with the highest percentage (28%) occurring in October. The April figure of 28% is misleading since five of the seven cases recorded that month were from a well-defined ward outbreak, which was described in detail elsewhere.¹⁴ As the frequency of all other pathogens, including bacteria, was insignificantly small, no analysis was attempted.

TABLE I—TOTAL ISOLATIONS DURING 1974

Organism	Patients examined		
	Rotavirus +ve	Rotavirus -ve	Total
Adenovirus* ..	3	29	32 (12%)
Coxsackie virus ..	0	3	3
Echovirus ..	0	4	4
Poliovirus ..	0	6	6
Enteropathic <i>E. coli</i> †	4	13	17 (8%)
<i>Shigella</i> spp. ..	0	4	4
<i>Salmonella</i> spp. ..	1	7	8 (3%)
Unidentified agent	1	0	1
Total ..	99	159	258

* Detected by E.M. and/or cell-culture isolation.

† 226 children less than 3 years old examined for enteropathic *E. coli*.

TABLE II—FREQUENCY OF ROTAVIRUSES ACCORDING TO PATIENT'S AGE

	Age-group					
	Up to 6 mo.	6 mo. -1 yr.	1-2 yr.	2-3 yr.	3-6 yr.	0-6 yr.
Rotavirus +ve ..	21 (25%)	23 (43%)	30 (48%)	16 (62%)	9 (28%)	99 (38%)
Rotavirus -ve ..	62	31	33	10	23	159
Total ..	83	54	63	26	32	258

There were no deaths during this study, nor is there any evidence of any patient being admitted with a second episode of rotavirus enteritis, although twelve of the patients in this study had a history of more than one episode of acute enteritis; there is only one reported case of a patient having a second episode of rotavirus enteritis.¹³ There is evidence that seven children were infected by rotavirus whilst they were in hospital; five of these were patients in a long-stay children's orthopaedic ward in which an outbreak occurred.¹⁴

Discussion

These results confirm the importance of rotaviruses as a major cause of gastroenteritis in young children, especially in those aged between 6 months and 3 years. Since babies under 6 months are obviously susceptible to rotaviruses, it is surprising that infection should be less common in them than in the 6-month to 3-year age-group. This may be due either to reduced exposure to rotaviruses because their main contact is with their parents, who are unlikely to be excreting rotaviruses, or to the apparent number of cases of enteritis in the group being increased by the inclusion of those with diarrhoea of non-infectious origin—e.g., "feeding problems". Or, perhaps, antibody of maternal origin may give some protection.

As most of these babies were not breast fed, like most infants admitted with other conditions to the hospitals in our areas, but received proprietary brands of dried milk, we do not know whether breast-feeding affords any protection.

In contrast to enteritis caused by enteropathic *E. coli* serotypes, which are regarded as important pathogens only in children under 3 years of age, rotavirus infections in 3-6-year-old children can be sufficiently severe to warrant admission to hospital. Over 6 years of age there is virtually no evidence of infection; during 1974 faeces from only ten patients, aged between 6 and 11 years, were referred for examination; in only one of these samples, from a 7-year-old boy, were rotaviruses found. Most children have antibodies to the rotavirus by 6 years of age¹⁶ and in such children immunity may well be life-long. It may be, however, that reinfection with rotavirus can occur with second and subsequent episodes being mild or sub-clinical owing to the presence of antibody. Another possible explanation for the apparent absence of rotavirus infection in children of more than 6-7 years is that infections in non-immune older children are sub-clinical. Sub-clinical infections occur with the virus of enzootic diarrhoea of infant mice (E.D.I.M.), which is now known to be a rotavirus.^{12,17} E.D.I.M.

causes diarrhoea in suckling mice up to 13 days old, whereas in older mice infection is subclinical.¹⁸

The variation in frequency during the year substantially supports earlier findings^{4,13} that rotavirus infections occur predominantly during the winter months. Studies extending over several years will be necessary to confirm this and to compare the frequency of infection from year to year.

Apart from rotavirus the only pathogenic viruses easily recognisable by E.M. are adenoviruses. Isolation of adenoviruses from faeces by cell-culture inoculation has long been regarded as easy, but lately^{10,14,22} adenoviruses which have defied all attempts at isolation have been demonstrated by E.M. It is not surprising, therefore, that our study revealed a considerable number of such strains. Conversely, there were some strains which were not detected by E.M. yet grew with ease in cell-culture. Those strains which did not grow in cell-culture may have been neutralised by the immune response of the gut, but as E.M. revealed neither virus-antibody complexes nor immunoglobulin-coated virions there is no evidence to support this hypothesis. Since these adenoviruses were often present in great numbers in the faeces, we feel sure that there must have been replication in the gut. Because we were unable to compare the adenovirus-positive group with matched controls we cannot be sure that the presence of the virus was connected with the patient's condition. The results nevertheless strongly suggest that adenoviruses cause some cases of gastroenteritis.

Fortunately, apparent double infections are rather uncommon; when both agents are present together it is impossible to say which agent has caused the disease. We have, however, encountered the occasional patient in whom one bout of symptoms closely followed another, with a small remission between. In such cases it is often possible to demonstrate a different pathogen in each episode. The second pathogen is often acquired in hospital. There is no evidence to suggest latent infection by rotaviruses; thus their presence indicates infection during the previous week or so. Chronic carriage of enteropathic bacteria is well known. It seems possible, however, that both infections could be contracted simultaneously by the ingestion of faeces or food contaminated with faeces. Since no effort was made to eliminate patients excreting enteropathic bacteria from our studies, the low frequency of salmonellæ, shigellæ, and enteropathic *E. coli* serotypes suggests that bacteria were responsible for only a small proportion of cases of gastroenteritis in young children in this part of the U.K. during the period of this survey.

However, many cases remain, especially during summer, in which no pathogen can be demonstrated. Group-A Coxsackie viruses, isolation of which was not attempted, may be responsible for some of those, but the available data¹⁹ suggest that the number is probably small. There is evidence implicating coronaviruses,^{20,21} and other causal viruses must remain to be discovered.

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STAPHYLOCOCCUS AUREUS TRANSMITTED IN TRANSPLANTED KIDNEYS

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Summary *Staphylococcus aureus* septicæmia developed shortly after transplantation in both recipients of transplanted kidneys from a donor who had received electrical burns. In each case the organism appeared initially in the urine. All staphylococci isolated were phage type 6/47/54/75. Transplant nephrectomy was necessary in both recipients because of complications of infection, and one recipient died. These results draw attention to the possible significance of *Staph. aureus* in the urine of recipients after transplantation and to the potential risk of transplanting kidneys from a burned donor.

Introduction

INFECTION is a major cause of morbidity and mortality in patients receiving renal transplants.^{1,2} The recipients are usually anæmic and in a state of poor nutrition as a result of chronic renal failure, and their resistance to infection is lowered still further by immunosuppressive therapy. In these patients bacteraemia is caused predominantly by gram-negative