INFANTILE ENTERITIS IN DUBLIN CAUSED BY *ESCHERICHIA COLI* O142

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EARLY in 1971 the services of the Microbiological Laboratory of the Federated Dublin Voluntary Hospitals were extended to include a 92-bed infants' hospital in South Central Dublin. This hospital served a community, most of whom belonged to the lower socio-economic group. The standard of housing was particularly low, overcrowding and poor sanitation being the major problem.

From the beginning of April 1971, faeces or rectal swabs were examined from all infants admitted to the hospital. An attempt was made to assess the occurrence and significance of pathogenic bacteria: *Salmonella*, *Shigella*, or enteropathogenic *Escherichia coli* (EEC). *E. coli* O142 had recently been described in outbreaks of infantile enteritis in Scotland (Rowe and Gross, 1971) and anti-serum for this type was included in the screening programme.

MATERIALS AND METHODS

Faecal specimens or rectal swabs with definite faecal staining were cultured by direct plating on deoxycholate-citrate agar and MacConkey agar, and by enrichment in selenite broth with subsequent plating on deoxycholate-citrate agar. Non-lactose-fermenting colonies on any of the plates were tested for urease activity by Christensen's (1946) method, and those giving a negative reaction were identified biochemically according to the tables of Cowan and Steel (1965). Strains of *Salmonella* and *Shigella* were identified serologically by slide agglutination and the salmonella species were sent for complete serological identification to the Salmonella and Shigella Reference Laboratory, Colindale.

The MacConkey-agar plates were examined for the presence of EEC by direct slide agglutination of five lactose-fermenting colonies from each plate against the following antisera: (i) polyvalent for *E. coli* O86:B7, O125:B15, O127:B8, O128:B12, O114:K90; (ii) polyvalent for *E. coli* O26:B6, O55:B5, O111:B4, O119:B14, O126:B16; (iii) monovalent for *E. coli* O142:K86.

Strains agglutinated by the polyvalent sera were tested with monovalent antisera, and all positive results were confirmed by tube-agglutination tests on heated suspensions. Strains identified serologically as EEC were then shown to have the biochemical reactions of *E. coli*, and were tested for antibiotic sensitivity by the disk-diffusion method on Diagnostic Sensitivity Test Agar (Oxoid CM261). Disks, made by Mast Laboratories, containing the following antibacterial agents were used: ampicillin 25 µg, trimethoprim-sulphamethoxazole 2.5 µg and 22.5 µg respectively, tetracycline 100 µg, sulphatriad 200 µg, nitrofurantoin 200 µg, streptomycin 25 µg, nalidixic acid 30 µg, cephaloridine 25 µg, chloramphenicol 25 µg, gentamicin 10 µg, kanamycin 30 µg, carbenicillin 100 µg, neomycin 30 µg, colistin 200 µg.

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All strains of *E. coli* O142 were sent to the Salmonella and Shigella Reference Laboratory, Colindale, for complete serotyping.

TABLE I

Organisms isolated from admission specimens of 460 babies less than 2 years of age

Bacteria isolated	Number of infants	
	with diarrhoea on admission	without diarrhoea on admission
<i>Salmonella</i>	6	1
<i>Shigella sonnei</i>	2	3
<i>Shigella flexneri</i>	0	0
Enteropathogenic <i>E. coli</i> type		
O26	2	5
O111	2	0
O119	2	0
O126	1	2
O127	1	1
O114	1	2
O55	1	0
O128	1	2
O86	1	2
O142	13	2
No pathogens	37	370
Total number of patients	70	390

TABLE II

Organisms isolated from 54 babies who developed an attack of diarrhoea after admission

Bacteria isolated	Number of infants from whom organism was isolated	
	on admission	during subsequent diarrhoea
<i>Salmonella stanleyville</i>	0	2
<i>Shigella sonnei</i>	0	1
<i>Shigella flexneri</i>	0	1
Enteropathogenic <i>E. coli</i> type		
O26	1	2
O55	0	6
O111	0	1
O114	1	0
O126	0	1
O128	1	0
O142	0	40
No pathogens	51	7

RESULTS

Bacteriology. Admission specimens from 460 patients under 2 yr of age were examined from April 1971 until October 1971. Of these patients, 70 (18 per cent.) presented with diarrhoea and vomiting, the most common single

causative organism being *E. coli* O142, which was isolated from 13 patients. These results are summarised in table I.

Diarrhoea occurring after admission to hospital was found in 54 (14 per cent.) of the 390 patients who were without diarrhoea on admission. Admission specimens of this group showed that one patient excreted *E. coli* O26, one

TABLE III

Isolation of pathogens from 54 babies who developed an attack of diarrhoea after admission to hospital

Case number	Pathogens found		Case number	Pathogens found	
	on admission	during subsequent diarrhoea		on admission	during subsequent diarrhoea
1	none	<i>E. coli</i> O142	27	none	<i>Sh. sonnei</i>
2	<i>E. coli</i> O26	<i>E. coli</i> O142	28	none	<i>E. coli</i> O55
3	<i>E. coli</i> O128	<i>E. coli</i> O55	29	none	<i>E. coli</i> O142
4	none	<i>E. coli</i> O55 and <i>Sh. flexneri</i> 6	30	none	<i>E. coli</i> O142
5	<i>E. coli</i> O114	<i>E. coli</i> O142	31	none	<i>E. coli</i> O142
6	none	<i>E. coli</i> O126	32	none	<i>E. coli</i> O142
7	none	<i>E. coli</i> O55	33	none	<i>E. coli</i> O142
8	none	<i>E. coli</i> O55	34	none	<i>E. coli</i> O142
9	none	<i>E. coli</i> O111 and O55 and O142	35	none	<i>E. coli</i> O142
10	none	<i>E. coli</i> O142 and O26	36	none	<i>E. coli</i> O142
11	none	<i>E. coli</i> O142 and <i>Salmonella stanleyville</i>	37	none	<i>E. coli</i> O142
12	none	<i>E. coli</i> O142	38	none	<i>E. coli</i> O142
13	none	<i>E. coli</i> O142	39	none	<i>E. coli</i> O142 and <i>Salmonella stanleyville</i>
14	none	<i>E. coli</i> O142	40	none	<i>E. coli</i> O142
15	none	<i>E. coli</i> O142	41	none	<i>E. coli</i> O142
16	none	<i>E. coli</i> O18	42	none	<i>E. coli</i> O142
17	none	<i>E. coli</i> O142	43	none	<i>E. coli</i> O142
18	none	<i>E. coli</i> O142	44	none	<i>E. coli</i> O142 and O26
19	none	<i>E. coli</i> O142	45	none	<i>E. coli</i> O142
20	none	<i>E. coli</i> O142	46	none	<i>E. coli</i> O142
21	none	<i>E. coli</i> O142	47	none	<i>E. coli</i> O142
22	none	<i>E. coli</i> O142	48	none	<i>E. coli</i> O142
23	none	<i>E. coli</i> O142	49	none	none
24	none	<i>E. coli</i> O142	50	none	none
25	none	<i>E. coli</i> O142	51	none	none
26	none	<i>E. coli</i> O142	52	none	none
			53	none	none
			54	none	none

excreted *E. coli* O114, and another excreted *E. coli* O128; these serotypes were not isolated at the time of the hospital-acquired diarrhoea, but *E. coli* O142 was isolated from two of these patients. Six other patients had multiple infections. In all, *E. coli* O142 was isolated from 40 of the 54 patients at the time of their hospital-acquired diarrhoea. These findings are summarised in table II, and the results for individual patients are shown in table III.

Fourteen patients who presented with diarrhoea recovered and subsequently developed a second attack while in hospital. This is referred to as a recurrence

of diarrhoea. Their bacteriological findings are shown in table IV. Twelve contacts of infected patients became symptomless excretors.

Further examination of *E. coli* O142 strains showed that they were all of serotype O142:K86:H6, resistant to ampicillin, tetracycline, sulphatriad, neomycin, kanamycin, and carbenicillin. Two of the strains were also resistant to trimethoprim-sulphamethoxazole. All strains were biochemically atypical in that they failed to produce indole in peptone-water cultures.

Symptoms. All cases occurred in infants under 1 year of age and more than half of them were less than 4 mth old; 63 per cent. of them were males.

TABLE IV

Pathogens isolated from 14 babies who were admitted with diarrhoea and had a recurrence of diarrhoea

Case no.	Pathogens found	
	on admission	during second attack
1	<i>E. coli</i> O142	<i>Salmonella stanleyville</i>
2	<i>E. coli</i> O142	<i>Salmonella typhimurium</i>
3	none	<i>E. coli</i> O142
4	none	<i>E. coli</i> O142
5	none	<i>E. coli</i> O142
6	<i>E. coli</i> O119	<i>E. coli</i> O142
7	<i>E. coli</i> O126	<i>E. coli</i> O142
8	<i>E. coli</i> O128	<i>E. coli</i> O142
9	<i>E. coli</i> O142	<i>E. coli</i> O111
10	<i>E. coli</i> O55	<i>E. coli</i> O142
11	<i>E. coli</i> O142	<i>Salmonella stanleyville</i>
12	<i>E. coli</i> O26	<i>E. coli</i> O142 and <i>Sh. sonnei</i>
13	none	<i>Salmonella stanleyville</i>
14	none	<i>E. coli</i> O26

Many patients were poorly nourished, coming from poor and overcrowded homes. Anaemia and respiratory-tract infections are among the commonest causes for admission to hospital. Cases were divided into three grades according to the severity of the symptoms.

Mild cases (grade I) had loose stools and occasional vomiting. There was no dehydration, and oral feeding was maintained. Eight infants with diarrhoea on admission and 43 with hospital-acquired infection were in this grade. Thirty-six of them had a respiratory-tract infection.

Moderately ill patients (grade II) had fluid motions and vomiting. There was mild dehydration; oral feeding was maintained. This was equivalent to grade I of Ironside, Tuxford and Heyworth (1970). Four admission cases and six hospital-acquired infections were in this group; four of them had a respiratory-tract infection.

Severely ill patients (grade III) had vomiting and diarrhoea with dehydration, which necessitated parenteral fluid replacement. This was grade II of Ironside *et al.* One six-week-old male was in this group, and he also had slightly raised

alanine and aspartate transaminases which returned to normal after symptoms subsided.

Antibacterial therapy before infection. Of the 49 patients who became infected with *E. coli* O142 in hospital, 39 were being treated with antibacterial agents at the time of infection or just before the onset of infection. Fifteen were receiving penicillin V, 13 ampicillin, four erythromycin, six trimethoprim-sulphamethoxazole (Bactrim), and one was receiving kanamycin.

Period of excretion. The period of excretion of *E. coli* O142 was determined in 52 cases. Twenty-eight excreted the organism for 5 days, 17 for 10 days, and the remaining seven for between 10 and 30 days. All 52 had received antibacterial therapy.

Cross-infection with E. coli O142. Cases occurred in three wards, two of which shared staff and kitchen facilities. Each patient was barrier nursed, but only one ward had cubicles. Undoubtedly cross-infection occurred within the wards and between them. One nurse who prepared feeds was found to excrete *E. coli* O111, but no carriers of *E. coli* O142 were found amongst the staff.

Numerous air samples and environmental swabs were examined and *E. coli* O142 was isolated from a locker top in one ward and a cot rail in another.

By mid-October the outbreak had subsided and no more new cases occurred within the hospital. An analysis of the hospital-acquired cases showed that the infection prolonged their stay in hospital on average by 10 days.

DISCUSSION

E. coli O142:K86:H6 was first isolated from infants with diarrhoea in Indonesia (Ørskov *et al.* 1960), later from an outbreak of diarrhoea amongst premature infants in a Mexican hospital (Olarie and Ramos-Alvarez, 1965), and recently from outbreaks in the British Isles (Rowe and Gross, 1971; Roberts *et al.*, 1971). In the present study, this serotype was isolated from 13 (18.6 per cent.) of 70 patients admitted with diarrhoea but only two (0.5 per cent.) of 390 admitted without diarrhoea. Among 68 cases of diarrhoea acquired after admission to hospital, *E. coli* O142 was found in 49 (72 per cent.). It is clear that this serotype was a cause of diarrhoeal disease in the community served by the hospital and was also the cause of a cross-infection outbreak within the hospital during the period of study.

Few of the infections in this outbreak were severe. It was significant that none of the babies had serious underlying illness or was premature—factors regarded as important in determining the outcome of infantile enteritis in recent years (Taylor, 1970).

Cross-infection was an important factor in the outbreak, despite barrier nursing. Once an EEC is introduced into a unit housing young infants, the spread of infection is difficult to prevent even with adequate cubicle accommodation. During an outbreak an admission policy is an essential safeguard; Taylor recommends that all babies should remain in isolation until bacteriological tests are complete. No such policy was in force during this survey.

SUMMARY

Faeces or rectal swabs were taken from 460 patients under the age of 2 yr on admission to a Dublin paediatric hospital. Of the 460, 70 had diarrhoea and 390 were without diarrhoea on admission. The results of bacteriological examination of the specimens gave an indication of the range of enteropathogenic organisms causing disease in the community served by the hospital.

Of the 390 patients admitted without diarrhoea, 54 subsequently developed it; and of the 70 admitted with diarrhoea, 14 developed a second attack after recovering from the first. Examination of specimens from the 68 infants who developed diarrhoea after admission to hospital indicated the degree and pattern of cross-infection within the hospital. The importance of *Escherichia coli* O142:K86:H6 as a cause of diarrhoea during the survey was clearly demonstrated.

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