Communicable Diseases

Cryptosporidiosis in an urban community

D A HUNT, R SHANNON, S R PALMER, A E JEPHCOTT

Abstract

Over three months *Cryptosporidium* oocysts were identified in faecal samples from 43 (5%) of 867 patients presenting to their general practitioners with gastrointestinal symptoms. *Cryptosporidium* was the second most common enteric pathogen identified. Of the 867 patients, 329 were children aged under 5, of whom 24 (7%) excreted *Cryptosporidium*. A characteristic clinical presentation of infection with *Cryptosporidium* was recognised—namely, mild gastroenteritis with four to six watery, mucoid, and offensive motions a day, which lasted for one to two weeks. The source of infection was not identified, but direct contact with farm animals was not a feature and no association with a common water supply could be established.

Introduction

The protozoan parasite *Cryptosporidium*, which has been recognised as an important pathogen in immunocompromised patients¹ and as giving rise to a particularly severe opportunist infection in those with acquired immune deficiency syndrome,² is now being reported with increasing frequency as a cause of self limiting gastroenteritis in immunologically normal people.^{3,4} Current *et al* described an outbreak in the United States in 12 otherwise healthy adults infected from calves,⁵ and cryptosporidiosis has been described as an emerging zoonosis.⁶ None of 14 patients reported on from Finland, however, had had direct contact with farm animals, whereas 13 had a history of recent travel abroad.³ Reports from Australia indicated a high prevalence of infection in city dwellers with diarrhoea,⁷ and Casemore and Jackson suggested that *Cryptosporidium* may be a common cause of sporadic diarrhoea in children in the United Kingdom.⁸

From October 1983 to January 1984 we examined for *Cryptosporidium* oocysts faeces from patients with diarrhoea submitted to the Bristol Public Health Laboratory by general practitioners. We report our findings.

Methods

We looked for cryptosporidium oocysts in faecal smears fixed with alcohol and stained by a modified Ziehl-Neelsen method.⁸ Slides were exposed to cold carbolfuchsin stain for at least one hour. They were then washed and decolourised with 3% acid alcohol for 15 seconds, washed well in running water, and counterstained with malachite green. The prolonged treatment with carbolfuchsin was found to be necessary to ensure reliable staining of the oocysts. Stools from all patients with gastrointestinal symptoms were examined in this way in addition to the routine investigation for *Salmonella*, *Shigella*, *Campylobacter*, *Aeromonas*, *Escherichia coli* and *Giardia*. During the first two months of the study stools from patients aged under 10 were also examined for viruses by electron microscopy. The presence of cryptosporidium oocysts in stools from 24 patients was independently confirmed by two other experienced laboratories.

One of us (DAH) interviewed 39 patients (three of whom came to light through contact tracing), their parents, or their nursery school teachers between 19 December 1983 and 31 January 1984. Seven patients could not be interviewed. Follow up stool samples and samples from household contacts were requested.

Results

Table I shows that during 24 October 1983 to 31 January 1984 cryptosporidium oocysts were found in stool samples from 43 (5%) of 867 people from whom samples were submitted routinely by general practitioners in the

TABLE I—Faecal pathogens identified in people with gastrointestinal symptoms from 24 October 1983 to 31 January 1984

Age of patients (years)	No. (%) with <i>Cryptosporidium</i>	No. (%) with <i>Salmonella</i>	No. (%) with <i>Shigella</i>	No. (%) with <i>Campylobacter</i>	No. (%) with <i>Giardia</i>
<1 (n=78)	6 (7.7)	3 (3.8)		3 (3.8)	
1-4 (n=251)	18 (7.2)	4 (1.6)	1 (0.4)	8 (3.2)	5 (2.0)
5-9 (n=49)	2 (4.1)	3 (6.1)			1 (2.0)
10-14 (n=16)	1 (6.3)	2 (12.5)		2 (12.5)	
15-24 (n=128)	8 (6.3)	6 (4.7)		11 (8.6)	2 (1.6)
25+ (n=278)	8 (2.9)	16 (5.8)	5 (1.8)	17 (6.1)	8 (2.9)
Unknown (n=67)		3 (4.5)	1 (1.5)	8 (11.9)	1 (1.5)
Total (n=867)	43 (5.0)	37 (4.3)	7 (0.8)	49 (5.7)	17 (2.0)

Control of Infection Unit, Central Clinic, Bristol BS2 0JD

D A HUNT, MA, MB, senior registrar in community medicine

Public Health Laboratory, Bristol BS2 8EL

R SHANNON, FIMLS, MPHIL, senior chief medical laboratory scientific officer

A E JEPHCOTT, MD, FRCPATH, director

Public Health Laboratory Service Communicable Disease Surveillance Centre and

Public Health Laboratory, Cardiff CF4 4XW

S R PALMER, MB, MFCM, consultant epidemiologist

Correspondence to: Dr D A Hunt, Cheltenham and District Health Authority, Burlington House, Lypiatt Road, Cheltenham GL50 2QN.

Bristol area. *Cryptosporidium* was the second most commonly detected pathogen overall after *Campylobacter* during the survey period, but in patients aged under 5 *Cryptosporidium* was as common as *Salmonella*, *Shigella*, *Campylobacter*, and *Giardia* combined. Of the 43 patients, 24 were children under 5 (table I). In the first two months of the study *Cryptosporidium* was identified in 29 patients, *Campylobacter* in 36, *Rotavirus* in 19, *Salmonella* in 16, and *Giardia* in 12. During this period 16 patients aged under 5 years were found to harbour *Cryptosporidium* compared with 17 with *Rotavirus*. Few stool samples were submitted from patients aged 5-14 during the three month study period, but the proportion in whom cryptosporidium oocysts were identified was similar to that found in the under 5s. The incidence in adults aged over 25 was half that in children ($p<0.05$).

CLINICAL FEATURES (table II)

In all patients loose or watery stools were noted. In the 29 children on whom clinical data were obtained, abdominal pain was reported in 11 (38%), vomiting in five (17%), and fever in six (21%). The duration of diarrhoea ranged from one day to more than eight weeks with a median of 12 days. The maximum number of stools a day ranged from one to more than 12 with a median of four. In the 10 adults interviewed, abdominal pain was reported by eight, vomiting by seven, fever by five, and headache by two. The duration of diarrhoea ranged from two to more than 20 days with a median of 14 days, and the maximum number of stools a day ranged from three to more than 12 with a median of six.

A prominent and distinctive feature emphasised by many patients was the offensiveness of the stools. Mucus or slime in stools was noted in 12 (41%) children and three (30%) adults. Blood in the stool was reported from one patient, a 3 year old girl, on one occasion only.

CASE REPORTS

Case 23—A 21 year old man was ill for two days with lassitude and headache followed by nausea, vomiting (five times), and a fever (38.9°C). On the third day of illness he developed watery diarrhoea containing some mucus. Fever subsided on days 4 and 5. He suffered three days of severe diarrhoea with five motions a day followed by loose stools for 11 days. Stool samples on days 13, 15, 26, and 28 were positive for cryptosporidium oocysts but were negative on days 41 and 59.

Case 26—A 24 year old woman suffered abdominal pain for four days with vomiting on day 4 and severe diarrhoea on days 5 and 7. A stool sample on day 8 contained oocysts.

Case 6—A 18 month old girl suffered intermittent diarrhoea for seven days with a maximum of four to five stools a day. She had been "off colour" with loss of appetite for a week before the onset of diarrhoea. A stool sample on the third day of diarrhoea contained oocysts.

CONTACTS

Contact with animals

None of the patients worked with live animals or had contact with farm animals. One 22 year old woman served in a butcher's shop. Twenty eight (72%) had some degree of contact with domestic pets either in their own homes or in the homes of relatives and friends.

Contacts in day nurseries

Two small clusters of patients were identified in day nurseries. In one nursery two children (table II, cases 5 and 15) in different classes using separate toilet facilities were affected three weeks apart for two days and one day respectively. Stool samples from 13 children and 13 staff were obtained 15 to 17 days after the onset of illness in case 15. None contained cryptosporidium oocysts. Stools from nine of the 12 other children and three of the four other staff were obtained 22 to 38 days after the illness in case 15, again with negative findings. No animals were kept at this day nursery.

In a second nursery four children were affected (table II, cases 7, 17, 20, and 25). Two (cases 17 and 20) lived in the same household and were ill 21 and 27 days after one of the others (case 7). Precise clinical details were not available. These three patients were in separate classes, but two (cases 7 and 20) shared toilet facilities. Stool samples from 33 children and 15 staff were obtained seven to 10 days after the onset of diarrhoea in case 20, and cryptosporidium oocysts were identified in the stool of one child in the same class as case 20. This child (case 25) had had an episode of mild diarrhoea at about the same time as case 20. Further samples were obtained from 17 of 25 other children and the one remaining staff member six to 24 days later, and all were negative. Stool samples from gerbils and hamsters kept at the nursery were negative.

Household contacts

Stool samples were obtained from 24 household contacts of 10 index cases within 14 days of diagnosis. Four of these contacts from three households were excreting cryptosporidium oocysts in stools.

Case 21—This 2 year old boy had had diarrhoea for two weeks before diagnosis. Stool samples obtained on days 29 and 36 from his sisters aged 8 and 5 contained cryptosporidium oocysts. Neither sister had been unwell. Both parents had negative stools on day 29 even though the father had suffered from diarrhoea for the previous two days.

Case 29—The mother, father, and 3 year old brother (case 31) of this boy all had diarrhoeal illnesses, which began the same day, 11 days, and one day respectively after his. The mother was ill for 10 days but a stool sample on day 18 was negative. The father was ill for two days but a stool sample on day seven of his illness was also negative. The brother was ill for 12 days and was excreting oocysts on day 18 of his illness.

Case 35—This 5 year old girl was ill 12 days before her mother (case 30) with cough, vomiting, and loss of appetite. A second episode of mild diarrhoea and abdominal pain for one day developed 17 days after the onset

TABLE II—Clinical details of 39 patients with diarrhoea whose stools contained *Cryptosporidium* oocysts

Case No	Age	Sex	Duration of diarrhoea (days)	Maximum No of stools/day	Other symptoms	Days on which stools examined	Days on which oocysts found
1	10 months	M	Unknown	6-7		≥100	≥100
2	29 years	F	7-10	3-6	Anorexia	7, 79	7
3	11 months	M	2	Unknown	Abdominal pain, anorexia	3, 47	3
4	7 months	M	28	4	Anorexia	14, 53	14
5	20 months	M	2	2-3	Abdominal pain	1	1
6	18 months	F	7	4-5		3, 10	3
7	2 years	F	Unknown	Unknown		1, 53	1
8	1 year	M	7	5-6	Anorexia	3	3
9	3½ years	F	1	1		3	3
10	1 year	M	21-28, 14*	2-3	Abdominal pain	17	17
11	1 year	M	8	6	Fever, anorexia, abdominal pain	3, 4, 59	4
12	11 months	F	21	3-4	Anorexia	20, 54	20
13	5 years	M	2-3	Unknown	Abdominal pain, anorexia	≥ 30, 71	≥ 30
14	33 years	M	Unknown	5-6	Abdominal pain, fever, anorexia	15, 54	15
15	3 years	F	1	>3		1, 16	1
16	52 years	M	6	6-7	Abdominal pain, anorexia, nausea	6, 7	6, 7
17	28 months	F	Unknown	Unknown		1, 15	1
18	17 months	F	1, 5*	>12	Anorexia	13, 20, 30	13
19	7 years	F	4	2-3		10	10
20	18 months	F	>50	Unknown		60, 82, 89	60
21	2 years	M	14-21	6	Abdominal pain, vomiting, fever	14, 28, 39	14, 28
22	39 years	M	15	>6	Anorexia, vomiting	12, 28	12
23	21 years	M	>20	5	Headache, vomiting, abdominal pain	13, 15, 26	13, 15, 26, 28
					Fever	28, 41, 59	
24	24 years	M	21	>6	Abdominal pain, vomiting, fever	21	21
25	2 years	F	2-3	2		10, 29	10
26	24 years	F	2*	>12	Abdominal pain, vomiting	8, 19	8
27	11 months	M	21	8	Abdominal pain	9, 24	9
28	22 years	F	14	4-5	Abdominal pain, fever, vomiting	8, 13, 16	8, 13
29	17 months	M	>14*	5	Anorexia, vomiting	13, 14, 18	13, 14, 18
30	27 years	F	>11	3-4	Vomiting, headache, abdominal pain	8, 16, 23	8
31	3 years	M	12	Unknown		18	18
32	13 years	F	>21	>5	Anorexia	22, 29, 36	22
33	15 months	F	14-21	4-5	Vomiting, fever, abdominal pain	16, 22	16
34	20 months	M	10	4-5	Abdominal pain, fever, anorexia	5, 7, 9, 13	5, 7, 13
35	5 years	F	Unknown, 1*	4-5	Anorexia, vomiting	29, 39	29, 39
36	32 months	F	>14	1-2	Vomiting	10	10
37	21 years	M	21	10-12	Abdominal pain, fever, vomiting	27, 34	27
38	3 years	M	>56	1	Abdominal pain, fever, anorexia	≥ 56	≥ 56
39	3 years	F	14	4	Fever, abdominal pain	13, 18	13

*Two episodes.

of illness in the mother. Stool samples taken on the previous day and nine days later both contained oocysts.

No stool samples obtained from a further 23 household contacts of eight cases obtained 14 to 49 days after diagnosis in the index cases contained *Cryptosporidium* oocysts.

Discussion

Cryptosporidium has been intensively studied since 1971 as a cause of disease in animals and particularly of scouring in calves.⁷ Naturally occurring infection has been reported in a wide range of animals including cats and poultry.⁷ The first report of cryptosporidiosis in man was in 1976, when *Cryptosporidium* oocysts were detected on rectal biopsy specimen from a 3 year old girl with severe self limiting enterocolitis.⁹ Subsequent reports focused on disease in immunologically deficient patients, particularly those with the acquired immune deficiency syndrome, in whom *Cryptosporidium* causes severe chronic life threatening diarrhoea.² Evidence is growing rapidly, however, to show that a high proportion of immunologically normal people with diarrhoea excrete *Cryptosporidium* oocysts.

Evidence that *Cryptosporidium* is a pathogen and not merely a commensal in man as well as animals comes from: histological studies in immunodeficient patients; the occurrence of outbreaks in people in direct contact with infected calves⁵; experimental transmission studies using human isolates to infect animals⁵; the occurrence of infection in a nurse in contact with an infected patient¹⁰; and from one striking case in which a researcher was accidentally exposed while administering infective oocysts to a rabbit (five days later he developed fever, anorexia, lethargy, abdominal cramps, and watery diarrhoea; *Cryptosporidium* oocysts were excreted in his stools and seroconversion was shown).¹¹ In the study reported here 18 out of 251 children aged 1 to 4 with diarrhoea had oocysts in their stools, compared with only one of 72 asymptomatic nursery school children also examined ($p=0.049$, Fisher's exact test), and even this one child (case 25) had been stated by the staff (before samples were taken) to have suffered a recent episode of diarrhoea.

The method of staining used in this study entailed long exposure to cold carbolfuchsin, and it has been argued that this may increase the incidence of false positive results due to uptake of stain by yeasts.¹² We, however, accepted as oocysts only objects of appropriate size (3-4 μ m) with characteristic morphology (thick walls with eccentric dots (remnants of zygotes) and vacuoles often discernible⁴). All the stool specimens sent for confirmation of diagnoses were reported by two experienced laboratories to contain *Cryptosporidium* oocysts.

The typical clinical features of infection in children were prolonged mild, foul smelling diarrhoea with mucus but no blood, accompanied sometimes by abdominal pain and vomiting. In adults symptoms were more severe, most patients reporting abdominal cramps and vomiting. The median duration of diarrhoea in adults was almost twice that in children, and this is probably partly accounted for by the different circumstances in which the diagnoses were made. Nursery children with mild symptoms are likely to have a stool examination, whereas the stools of adults are tested when they seek medical advice only if symptoms are severe or prolonged. The clinical picture of relatively mild but prolonged diarrhoea is more like that caused by *Giardia* than *Salmonella*. Jokipii *et al*, however, suggested that *Cryptosporidium* is less likely to produce bloating, anorexia, and weakness than *Giardia*, although more likely to cause abdominal pain.⁴ Further studies will show whether there is a distinctive clinical presentation in immunocompetent patients harbouring *Cryptosporidium*.

Our study confirms that the disease is self limiting in immunocompetent patients and that only symptomatic treatment and rehydration are necessary. No specific chemotherapy is known to be effective.¹³

The source of infection in our patients was unknown. None had had direct contact with farm animals, and contact with domestic pets was unexceptional. A zoonotic origin is possible, with transmission via food, milk, or water. No characteristic food history was obtained, and the geographic distribution of cases did not correlate with any particular water supply. The apparent maximum observed

incidence of infection in our survey, however, coincided with the ages of maximum milk consumption; no infection was seen in children under 10 months, below which age drinking of unboiled milk is less likely. Furthermore, although none of our patients consumed untreated milk it has been implied that cryptosporidia are killed only by temperatures above 65°C for 30 minutes,⁷ in which case they may be able to survive some pasteurisation procedures.

The occurrence of two small clusters of cases in day nurseries follows the pattern of infection with *Giardia* in the United Kingdom and with the high prevalence of carriage in household contacts could be explained by spread from person to person. Interpretation of the data is difficult, however, without a clearer idea of the incubation period and duration of shedding of oocysts. In the incident reported by Blagburn and Current the incubation period was five days.¹¹ Jokipii *et al* gave a range of four to 12 days but did not present data on which this estimate was based.⁴ The data presented by Current *et al* suggested that shedding of oocysts lasted only up to one week after onset of symptoms,⁵ but 17 (44%) of our patients were excreting oocysts in the stools two weeks or more after the onset of symptoms.

The high incidence of excretion of *Cryptosporidium* oocysts in general practice patients with diarrhoea in Bristol over three months has not been found in all other laboratories in the United Kingdom to date. There may be important geographical as well as seasonal variation in incidence, and we do not know if infection occurs primarily as sporadic cases or in outbreaks. We recommend that, because of the relatively simple diagnostic procedures and the possible importance of *Cryptosporidium* as a pathogen in man, it should be included with the enteric pathogens routinely sought in patients with diarrhoea.

We thank Mr D Ives of Bristol Water Works for information concerning the water supply to patients; Mr D Casemore, Public Health Laboratory, Rhyl, and Mr K Angus, Moredun Institute, Edinburgh, for confirming the identification of cryptosporidia; and the staff of the Bristol Public Health Laboratory for laboratory services rendered.

References

- 1 Pitlick SD, Fainstein V, Garza D, *et al*. Human cryptosporidiosis: spectrum of disease. Report of six cases and review of the literature. *Arch Intern Med* 1983;143:2269-75.
- 2 Centers for Disease Control. Cryptosporidiosis: assessment of chemotherapy of males with acquired immune deficiency syndrome (AIDS). *MMWR* 1982;31:589-92.
- 3 Angus KW. Cryptosporidiosis in man, domestic animals and birds: a review. *J R Soc Med* 1983;76:62-70.
- 4 Jokipii L, Pohjola S, Jokipii AMM. Cryptosporidium: a frequent finding in patients with gastrointestinal symptoms. *Lancet* 1983;ii:358-61.
- 5 Current WL, Reese NC, Ernst JV, Bailey WS, Heyman MB, Weinstein WM. Human cryptosporidiosis in immunocompetent and immunodeficient persons. *N Engl J Med* 1983;308:1252-7.
- 6 Schultz MG. Emerging zoonoses. *N Engl J Med* 1983;308:1285-6.
- 7 Tzipori S. Cryptosporidiosis in animals and humans. *Microbiol Rev* 1983;47:84-96.
- 8 Casemore DP, Jackson B. Sporadic cryptosporidiosis in children. *Lancet* 1983;ii:679.
- 9 Nime FA, Burek JD, Page DL, Holscher MA, Yardley JH. Acute enterocolitis in a human being infected with the protozoan *Cryptosporidium*. *Gastroenterology* 1976;70:592-8.
- 10 Baxby D, Hart CA, Taylor C. Human cryptosporidiosis: a possible case of hospital cross infection. *Br Med J* 1983;287:1760-1.
- 11 Blagburn BL, Current WL. Accidental infection of a researcher with human *Cryptosporidium*. *J Infect Dis* 1983;148:772-3.
- 12 Casemore DP, Armstrong M, Jackson B. Screening for *Cryptosporidium* in stools. *Lancet* 1984;i:734-5.
- 13 Anonymous. Cryptosporidiosis. *Lancet* 1984;ii:492-3.

(Accepted 17 July 1984)

Are there any definite indications for using sorbitol in medicine? Is it, for example, of value in managing diabetes? If used in concentrations of equal sweetness is sorbitol less likely to cause dental caries than sucrose?

Sorbitol is a sugar alcohol that is 60% as sweet as sucrose and is used as a bulk sweetener in many diabetic foods. Recently many dietitians have been recommending fructose as an alternative bulk sweetener for baking, since fructose does not have the same tendency as sorbitol to produce osmotic diarrhoea. The development of acceptable intense sweeteners such as aspartame may also reduce the need for sorbitol in future. In some individuals even small amounts of sorbitol may produce cramps, diarrhoea, and a bloated feeling.¹ Clinical trials of sorbitol chewing gum have shown it to be non-carcinogenic²; however, "chewing gum diarrhoea" may also occur if it is taken in large quantities.—D W M PEARSON, consultant physician, Aberdeen.

¹ Hyams JS. Sorbitol intolerance: an unappreciated cause of functional gastrointestinal complaints. *Gastroenterology* 1983;84:30-3.

² Glass RL. A two year clinical trial of sorbitol chewing gum. *Caries Res* 1983;17:365-8.