Outbreak of cryptosporidiosis among young children attending a day-care centre in Durban


Summary

During an outbreak of an enteric illness occurring among infants and toddlers in a day-care centre in Durban, Cryptosporidium was detected in 51 (73%) of 70 children. Two (10%) of 20 staff members were also found to have cryptosporidiosis. Symptoms occurred in all but 4 of the Cryptosporidium-positive infants and toddlers and lasted for 1 - 33 days. Oocyst excretion often persisted after cessation of symptoms and continued for up to 50 days in some children. Transmission is considered to have occurred predominantly by person-to-person spread. Measures to prevent transmission of enteric-type diseases were implemented and coincided with cessation of the outbreak.

The intestinal parasite, Cryptosporidium, has long been recognised as a cause of gastro-enteritis in animals.1-2 The first case of human infection was reported in 1976.3 Since then, infections in humans have been reported from many parts of the world and Cryptosporidium is now recognised as a significant cause of intractable diarrhoea in immunocompromised patients, especially those with the acquired immunodeficiency syndrome (AIDS),4-5 and may also cause self-limiting diarrhoeal illness in apparently immunocompetent patients, especially children.6-7 In recent years Cryptosporidium-associated diarrhoea has been increasingly recognised in South Africa, especially in infants.8-10

While initial reports suggested that cases of human cryptosporidiosis were largely sporadic and community-acquired and that the infection was primarily a zoonosis, it has become increasingly evident that human-to-human spread occurs frequently. More recently hospital-acquired cryptosporidiosis and outbreaks in closed communities have been reported.11,12

An outbreak of diarrhoeal disease in infants and toddlers attending a day-care centre for white children in Durban is reported.

Patients and methods

The day-care centre provides day-time care for healthy children from 6 months to 6 years of age. Depending on the age of the child, children in this centre are separated into an infant and toddler group (6 months - 3 years), who are accommodated on the top floor of a two-storey building, and a pre-primary group (over 3 years of age) who occupy the bottom floor of the building and utilise the playgrounds. These two groups of children have no contact with each other.

The outbreak of cryptosporidiosis occurred during January 1987 when a number of children in the infant and toddler group developed diarrhoea (Fig. 1). Cryptosporidium was the only enteric pathogen detected in the initial cases. This finding prompted us to screen for faecal excretion of Cryptosporidium oocysts: (i) all infants and toddlers; (ii) staff caring for this group; and (iii) any symptomatic contacts of positive cases. During the outbreak, stool samples were collected by staff or parents and submitted to the Regional Public Health Laboratory within 24 hours of collection.

Fig. 1. Diagrammatic representation of the outbreak.

All stool specimens received were screened microscopically for oocysts of Cryptosporidium by the auramine acid-fast method; all positive specimens were confirmed by the modified Ziehl-Neelsen stain.13 Stool specimens were also examined for other parasites and for bacterial enteric pathogens including Salmonella, Shigella, Campylobacter, Vibrio cholerae and enteropathogenic Escherichia coli by routine microbiological techniques.

Stool samples were received at least once from all 70 children in the infant and toddler group, from all of 20 staff members and 2 of 110 children in the pre-primary group, who were family contacts of Cryptosporidium-positive infants who developed symptoms.

During the outbreak, all symptomatic children with diarrhoea were excluded from the centre until clinically well. Stool specimens were obtained weekly from most positive cases for examination for Cryptosporidium oocysts until specimens became negative.

Surveillance continued until no further symptomatic cases were reported. The infection control measures applied during the outbreak included hand-washing, especially after nappy changes and contact with infected children, and exclusion of symptomatic children.
Information regarding symptoms and the duration thereof was obtained from parents of the children by the full-time nursing sister employed by the day-care centre.

Results

The outbreak is depicted in Fig. 1. The first case of cryptosporidiosis was detected on 10 January 1987, followed by another case on 21 January 1987 and 9 new cases in the following week. The outbreak lasted 14 weeks during which 51 (73%) of the infant and toddler group were affected.

Table I summarises the prevalence of cryptosporidiosis in the infant and toddler group. At least one stool specimen was examined from each of these children. In the age group 6 - 12 months, 8 (100%) of 9 children had oocysts of Cryptosporidium in their stools. In the age group 13 - 24 months and 25 - 36 months, 24 of 30 children (80%) and 19 of 32 children (63%) respectively were found to have oocysts of Cryptosporidium in their stools. The overall prevalence of cryptosporidiosis in these infants and toddlers was 73%. Two children were found to be excreting Giardia lamblia cysts in addition to oocysts of Cryptosporidium. No ova, cysts or larvae of other intestinal parasites were detected. Of 40 initial stools examined for other bacterial enteropathogens, none were positive for Salmonella, Shigella, Campylobacter, Vibrio cholerae or enteropathogenic E. coli.

During the outbreak of diarrhoea among the infants and toddlers, 2 children in the pre-primary group developed diarrhoal illnesses and were found to have Cryptosporidium in their stools. Both these children were family contacts of infected cases in the infant and toddler group. Despite these 2 cases of cryptosporidiosis in the pre-primary group, none of the other children in this age group were symptomatic. The stools of asymptomatic pre-primary children were not examined.

In addition, 2 staff members were found to be excreting Cryptosporidium oocysts (Table II). One was a child minder who worked exclusively with the infants and toddlers and her work included the changing of nappies. She remained asymptomatic. The other staff member, who during the routine screening of staff was found to be negative for Cryptosporidium, subsequently developed diarrhoea and was found to be excreting Cryptosporidium oocysts. Her duties included washing of dishes in the kitchen and attending to the laundry of the infants and toddlers.

In the infant and toddler group, symptoms occurred in 47 (92%) of 51 children found to be excreting Cryptosporidium oocysts (Table III). Thus only 4 (8%) of the children found to excrete Cryptosporidium oocysts were asymptomatic. None of the infants and toddlers who were negative for Cryptosporidium were symptomatic. This relationship between oocyst excretion and symptoms is highly significant (P < 0.01).

The symptoms and their frequency of occurrence in the infant and toddler group are listed in Table IV. Diarrhoea was the commonest symptom, occurring in 89% of cases, followed by vomiting (55%), cough (36%), anorexia (21%) and fever (13%). Symptoms lasted from 1 to 33 days. The mean duration of illness was 13 days. The mean duration of oocyst excretion was 7 days (range 0-52 days). The relationship between the period of oocyst excretion and symptomatic periods revealed various patterns: (i) excretion of oocysts coinciding with the symptomatic period; (ii) oocyst excretion preceding symptoms, but never by more than 4 days; (iii) no excretion of oocysts during the symptomatic period and often occurring only 2-8 days after cessation of symptoms; (iv) a short duration of oocyst excretion after recovery (usually less than 7 days); and (v) a long duration of oocyst excretion after recovery, but rarely more than 50 days.

All children affected in this outbreak recovered, although 2 were hospitalised for rehydration.

Discussion

Cryptosporidium is a protozoan parasite of the gastro-intestinal tract that is being increasingly recognised as an agent causing gastro-intestinal disease in humans. Recently, outbreaks of cryptosporidiosis have been recognised in day-care centres in developed countries. In Britain, an outbreak lasting 6 weeks occurred in 7 of 58 children (18%) attending a centre with most cases among the 2 - 3-year age group. In 7 day-care centres in the USA that have reported outbreaks of crypto-

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**Table I. Prevalence of Cryptosporidium in Infants and Toddlers**

| Age group (mo.) | No. in group | No. positive (%)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6 - 12</td>
<td>8</td>
<td>8 (100)</td>
</tr>
<tr>
<td>13 - 24</td>
<td>30</td>
<td>24 (80)</td>
</tr>
<tr>
<td>25 - 36</td>
<td>32</td>
<td>19 (63)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>70</strong></td>
<td><strong>51 (73)</strong></td>
</tr>
</tbody>
</table>

**Table II. Prevalence of Cryptosporidium in Staff Members**

<table>
<thead>
<tr>
<th>Duties</th>
<th>No.</th>
<th>No. of cases positive (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child-minder</td>
<td>16</td>
<td>1 (6)</td>
</tr>
<tr>
<td>Food-handler</td>
<td>4</td>
<td>1 (25)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td><strong>2 (10)</strong></td>
</tr>
</tbody>
</table>

**Table III. Relationship of Cases of Cryptosporidiosis with and without Symptoms**

<table>
<thead>
<tr>
<th>Age group (mo.)</th>
<th>No. in group</th>
<th>Negative for Cryptosporidium, no symptoms</th>
<th>Positive for Cryptosporidium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No symptoms</td>
<td>Symptoms</td>
</tr>
<tr>
<td>6 - 12</td>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13 - 24</td>
<td>30</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>25 - 36</td>
<td>32</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>70</strong></td>
<td><strong>19 (27%)</strong></td>
<td><strong>47 (67%)</strong></td>
</tr>
</tbody>
</table>

Of 51 children with cryptosporidiosis 47 (92%) were symptomatic.
sporidiosis, the proportion of children infected has ranged from 17% to 60%. A study in Pennsylvania revealed Cryptosporidium in 65% of 17 symptomatic children and 11% of 28 asymptomatic children in a centre where an outbreak of a diarrhoeal illness was reported. The overall prevalence rate of Cryptosporidium in the infant and toddler age group in the Durban centre was 73%. This prevalence, to our knowledge, is the highest that has yet been reported. This is also the first such outbreak of cryptosporidiosis reported in South Africa.

Although Cryptosporidium may be transmitted in animal faeces, it is also highly infectious and transmissible from person to person, especially among household contacts of infected persons, in hospital personnel and in children attending day-care centres. A waterborne outbreak of cryptosporidiosis has also recently been described. In the day-care centre environment it is possible that young children become infected either directly by hand-to-mouth transfer of oocysts in faeces from an infected individual or indirectly from faecally contaminated surfaces, furniture, toys, food, etc.

As has been shown in this and other studies, the prevalence of cryptosporidiosis is highest in infants and toddlers in whom indirect transmission probably plays an important role. Infants and toddlers are at increased risk of disease transmission because of certain behavioural characteristics such as close, repeated person-to-person contacts, lack of faecal continence before toilet training, frequent exploration of the environment with their hands and mouths and the requirement for frequent handling of children by staff. While the child-minder whose work included the changing of nappies in the infant and toddler group may have been the index case, this was impossible to determine retrospectively.

The severity of cryptosporidial infection appears to be determined by immune competence. In immunocompromised individuals, for example those with AIDS or hypogammaglobulinaemia, symptoms and oocyst excretion may persist for months whereas symptoms in the immunocompetent are usually relatively short-lived, and last for an average of 10-14 days. In the infants and toddlers infected with Cryptosporidium in this outbreak, symptoms occurred in 47 of 51 children (92%), while 4 (8%) were asymptomatic (Table III). Symptoms persisted for 1-33 days. Cryptosporidiosis was associated with watery diarrhoea in 42 (82%), vomiting in 26 (51%), fever in 6 (12%), anorexia in 10 (20%) and cough in 17 (33%) of 51 infected children (Table IV). Proneness to infection is inversely related to age (Table I) and infection is also more likely to be symptomatic in younger infants (Table II).

Workers in Finland18 have shown that the incubation period of cryptosporidiosis ranges from 1 to 12 days. The first case in this study occurred on 10 January, followed by another case on 21 January, and another 2 cases on 27 January (Fig. 1). Near the end of the outbreak 5 cases occurred on 26 February, followed by 1 case on 11 March and 2 cases on 23 March. The results of this study thus seem to support the work of Jokipii and Jokipii.

The observation that clearance of the parasite from stools may be delayed for 50 or more days after the resolution of the illness may be significant since such cases may provide a persistent source of infection of others. Although cryptosporidiosis is usually a self-limiting illness, its debilitating effects may be of sufficient severity, especially in young infants, to justify therapeutic intervention. However, no effective agent against Cryptosporidium is available at present and patients should be treated conservatively with fluids and electrolyte replacement as required.19

Thus, when an outbreak of cryptosporidiosis is suspected, implementation of measures for the prevention and control of enteric infections should be considered. All symptomatic children and staff and a sample of asymptomatic children and staff should have a stool sample examined for parasites. In this way, an assessment of the extent of the outbreak may be made. Notification of parents and public health officials will allow the earliest possible implementation of specific control measures. Because Cryptosporidium can spread directly by person-to-person transmission or indirectly by the hands of staff, environmental contamination or contaminated food, measures designed to minimise faecal-oral transmission may reduce spread of the infection. These measures should include hand-washing after nappy changes and contact with infected children as well as before food handling. Washing of children's hands at regular intervals may also be a worthwhile control measure. Because Cryptosporidium oocysts can survive for months if kept cool and moist, regular cleaning of environmental surfaces and toys may reduce opportunities for spread of this infection. It is worth while noting that oocysts of Cryptosporidium are relatively resistant to many phenolics, iodophores, quaternary ammonium compounds and hypochlorite. Risk of transmission of cryptosporidiosis in children requiring nappy changes may be reduced by using nappy changing areas designed to facilitate cleaning and hand-washing. The use of disposable nappies offers obvious advantages over re-usable ones by eliminating the need for excessive handling and washing. Exclusion of children who are ill with diarrhoea is generally recommended. The management of asymptomatic children in the day-care centre situation has been little addressed but, because these children should be considered potential sources of infection, cohorting of infected children within a centre would seem to be less ideal than temporary exclusion, which is to be preferred. Application of such measures in Durban cleared the outbreak. It is our belief that this was a cause-and-effect relationship. However, especially in view of the high overall attack rate, it is possible that the improvement was spontaneous and unrelated to the introduction of control measures.

Our investigation has confirmed that cryptosporidiosis has the potential for spread among children, especially the very young, and that practical and relatively simple preventive infection control measures may be effective in limiting spread in closed groups such as in a day-care centre.

We thank Sister E. Jackson, sister-in-charge at the day-care centre, for the collection of stool specimens and clinical data.

REFERENCES

| TABLE IV. SYMPTOMS IN 47 SYMPTOMATIC INFANTS AND TODDLERS WITH CRYPTOSPORIDIOSIS |
|---------------------------------|------------------|------------------|
| Symptom                        | No. of children (%) |
| Diarrhoea                      | 42 (86)           |
| Vomiting                       | 26 (55)           |
| Fever                          | 6 (13)            |
| Anorexia                       | 10 (21)           |
| Cough                          | 17 (36)           |
Relationship between milk lactose tolerance and body mass in teenage Tswana schoolchildren

F. P. R. DE VILLIERS

Summary

The Tswana and other black races of southern Africa have a high prevalence of the adult type of primary lactose intolerance. It is possible that nutritional status may affect milk lactose absorption, so that lactose malabsorbers may be less well nourished than lactose absorbers. However, such a poor nutritional status may have caused, or have been caused by, the lactose malabsorption. It is also possible that another factor, such as chronic diarrhoea, may cause both poor nutrition and lactose intolerance.

A random sample of 92 Tswana pupils was taken from a school population of 486. Their heights and weights were measured, and the relative weight and body mass index (weight/height²) calculated for each subject. A milk tolerance test was administered to each subject to establish whether they were lactose tolerant or intolerant. There were 79 (85.5%) lactose intolerant subjects, 7 (7.5%) were probably intolerant and only 6 (6.5%) were lactose tolerant. The nutritional status of the lactose intolerant and tolerant subjects were compared. The two groups did not differ in nutritional status, as measured by their relative weights and body mass indices, and were nutritionally similar to a reference population of Tswana schoolchildren.

Lactose intolerance is very prevalent in most societies in the world; exceptions are Caucasian races and certain races with a long history of dairy farming, such as the Fulani in Nigeria and the Tuusi in Uganda. This disorder occurs as a result of the loss or decrease of lactase in the intestinal brush border after the onset of weaning, and is the adult type of primary lactose intolerance. Secondary lactose intolerance occurs commonly in childhood due to gastro-enteritis, with accompanying malnutrition, and is often transient. Other diseases such as gluten enteropathy and inflammatory bowel disease can also give rise to secondary lactose intolerance.

The black races of southern Africa, and specifically the Tswana from the Mankwe, Madikwe and Odi II magisterial districts of Bophuthatswana (adjacent to Rustenburg, western Transvaal), have a high prevalence of the adult-type primary lactose intolerance.

It is possible that nutritional status may affect lactose absorption. Lactose malabsorbers may be more likely to be chronically malnourished than lactose absorbers. This may be due to inefficient absorption of nutrients, if milk or milk-containing products form part of the diet of both groups.

Thus Woteki et al. note increased losses of nutrients in children with primary adult lactose intolerance. Taylor makes similar comments with respect to adults with the disorder and Bayless et al. having noted the same points, ask rhetorically: 'Is milk of definite nutritional value to those who are intolerant of lactose?' Similarly Simoons et al. feel that the nutritional loss of calories could be 'nutritionally significant for individuals... with marginal caloric intakes'. Therefore some authors feel that the distribution of milk or milk powder to populations with a high prevalence of lactose intolerance who need nutritional assistance is inappropriate and must be modified.

In contrast, Deboninge et al. feel that although marked malabsorption of lactose and mild malabsorption of protein occur in adults with primary adult lactose intolerance, the nutritional consequences of 'primary lactose deficiency in adults are probably minimal'.

Thus at least some experts conclude that lactose malabsorbers may be nutritionally disadvantaged compared with absorbers. An attempt was therefore made to assess the nutritional status of subjects whose lactose-absorption status was studied. Southern African blacks may suffer poorer nutritional conditions than the North American reference population. Therefore...