An outbreak of *Escherichia coli* O157 associated with a children's paddling pool

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SUMMARY

In May 1992, a small, circumscribed community outbreak of infection due to verotoxin-producing *Escherichia coli* O157 phage type 49 occurred in a semi-rural area of south-east Scotland. On the basis of stool cultures, six cases were identified, one of whom was asymptomatic. One child developed the haemolytic uraemic syndrome. Although the source of infection of the index case was not established nor could the extent of person-to-person spread be fully determined, the clinical, microbiological and epidemiological evidence available indicated that a children's paddling pool served as the focal point in the transmission of infection causing the outbreak.

INTRODUCTION

The clinical and public health importance of infection by verotoxin-producing strains of *Escherichia coli* (VTEC), in particular serotype O157.H7, have become increasingly recognized internationally since the early 1980s. The bovine source of infection has been frequently identified and outbreaks involving foodborne [1–4], waterborne [5, 6] and person-to-person [7, 8] transmission have been reported including several affecting children's day-care facilities [4, 7, 9].

We report a community outbreak of *E. coli* O157 infection, involving six persons, which occurred in south-east Scotland in May 1992, the focus of which was a collapsible children's paddling pool.

THE OUTBREAK

On 27 May 1992, *E. coli* O157 was isolated from the stool specimens of two children from the same locality in Borders Health Board area (population 103 400). The first child (CH), a 3-year-old male, had developed diarrhoea on 20

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May and was admitted to Borders General Hospital on 23 May, but subsequently transferred to the Royal Hospital for Sick Children, Edinburgh because of deteriorating renal function associated with the haemolytic uraemic syndrome (HUS). The second child (MB), a 3-year-old female from an adjacent village (2 miles away) developed bloody diarrhoea on 23 May and was admitted to Borders General Hospital on 27 May for observation.

METHODS

A case was defined as a person with at least one stool culture positive for *E. coli* O157, regardless of the presence or absence of symptoms. Other possible cases occurring in the district unconnected with the affected families were sought by alerting local general practitioners by telephone to the clinical significance of VTEC infection. Practitioners were encouraged to submit stool samples from any other patients regardless of age currently presenting with gastro-intestinal symptoms, to the Microbiology Department, Borders General Hospital.

Epidemiological information was obtained by semi-structured interviews undertaken by environmental health staff with the parents of cases, using the standard 'Food Poisoning' investigation form that is widely used throughout Scotland.

Contacts of cases were sought retrospectively from information obtained during interviews of parents.

INVESTIGATION OF THE OUTBREAK

Initial enquiries revealed that MB had visited CH's house on 20 May. Following extensive investigations undertaken by staff of the Environmental Services Department, Ettrick and Lauderdale District Council and Borders Health Board Control of Infection Nursing Officer, four additional cases of *E. coli* O157 infection (one asymptomatic) were identified among family and other contacts screened, who had had direct or indirect links with visits to the house of CH between 17 and 20 May. A further 13 contacts (family and friends), including several other children, none of whom had been in the paddling pool, were also screened. None had been unwell and all had negative stool cultures.

Food was considered as a possible source of the outbreak, but only low-risk foods (viz. biscuits, cake and juice diluted with water from an adequately treated public supply) provided by his mother who remained well throughout were consumed at CH's house on each of the 2 relevant days. No food was common to all the children affected.

The sequence of events relating to the outbreak (Fig. 1) suggested that the index case was SR, a 1-year-old female child who had diarrhoea on 10 May. Her sister (LR), aged 2 years, became unwell on 17 May during which day she spent some time at the house and garden of CH, mainly playing alongwith the other children present in a collapsible plastic paddling pool filled with water from the public mains supply, and on a chute. During her visit, although she was not known to have passed faeces into the pool water, she had to be taken to the toilet on several

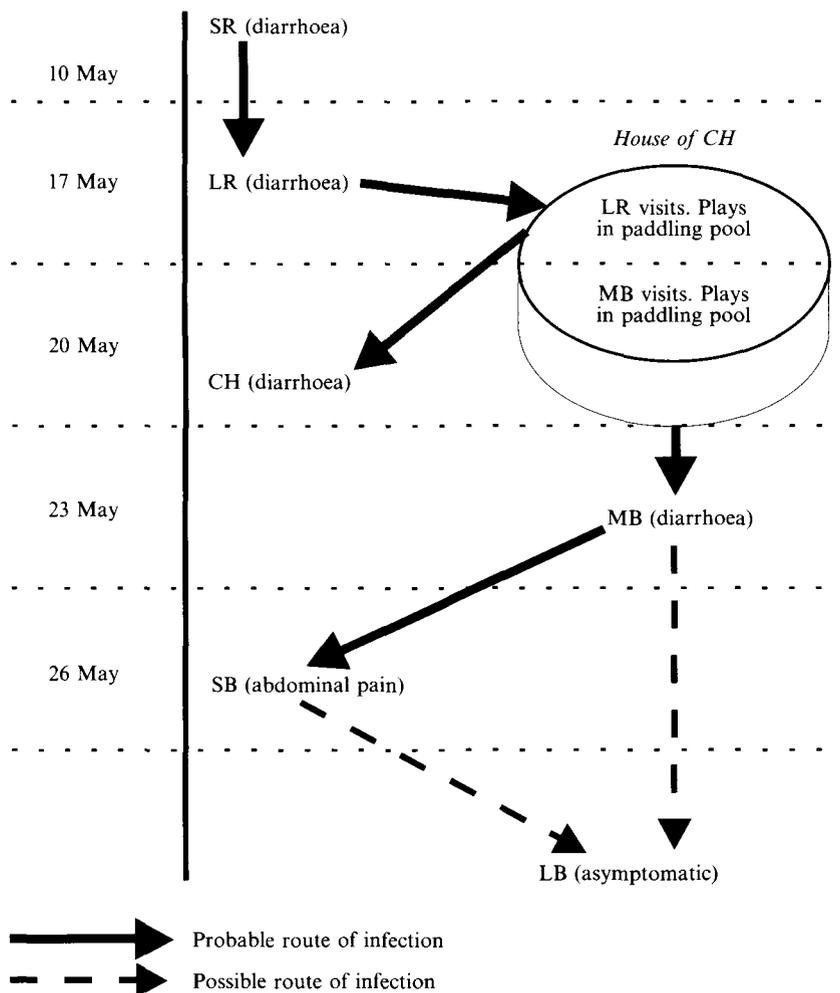Sequence of events and postulated routes of transmission.

Fig. 1. Sequence of events and postulated routes of transmission.

occasions because of diarrhoea. On 20 May, CH also developed diarrhoea, during which same day MB visited for the first time and played in the paddling pool. Three days later on 23 May, MB developed diarrhoea and on 26 May her mother (SB) complained of abdominal pain; stool cultures from SB and her other asymptomatic 4-month-old child (LB) were also positive for *E. coli* O157. All four of the clinically affected children, including the two admitted to hospital, made an uneventful recovery.

The only link, social or other, between the family of SR and LR and that of MB, was their mutual friendship with the family of CH, the point of contact of all three families being the paddling pool on 17 and 20 May respectively. There was no evidence to suggest that the outbreak might have originated at some other community locus such as a playgroup. No further cases were identified in the district.

MICROBIOLOGY

In addition to the routine examination of faeces using standard culture media for the detection of *Salmonella* sp., *Shigella* sp. and *Campylobacter* sp., and microscopy for *Cryptosporidium* sp., stool specimens from everyone involved in the outbreak were plated on to Sorbitol McConkey Agar (SMA) according to the department's selective screening protocol applicable to faeces which are diarrhoeal and from children under 5 years of age who are pyrexial. Isolates which were non-sorbitol fermenting and agglutinated with *E. coli* O157 antiserum (Difco) were identified biochemically as *E. coli*. All isolates of *E. coli* O157 from the outbreak were forwarded to the PHLS Laboratory of Enteric Pathogens, Colindale for phage typing and verification of verotoxin production; all six isolates were shown to belong to phage type 49 and to produce verotoxin.

DISCUSSION

Outbreaks due to a wide range of enteric infections such as giardiasis [10–12], cryptosporidiosis [13, 14], Norwalk gastroenteritis [15], hepatitis A [16] and enterovirus-like illness [17] have been reported in association with swimming pools and other communal water play areas. Experimental work following a major waterborne outbreak in Missouri, USA in 1991 has demonstrated the ready survival of *E. coli* O157 in water for a week at temperatures of 5 °C and 20 °C [6]. We believe that this is the first report of a community outbreak of *E. coli* O157 infection associated with a children's paddling pool.

The paddling pool link was elicited spontaneously and independently from each of the parents of the first two cases (CH and MB) identified, during interviews undertaken co-incidentally in Borders and Edinburgh, respectively. While there was no attempt scientifically to avoid any leading question relating to the pool in subsequent interviews, there were no inconsistencies between the information offered by the different sets of parents.

Person-to-person transmission of infection would appear to have been responsible for three cases (LR, SB, LB) in two of the affected families and cannot definitely be excluded as having caused the entire outbreak. Although some of the evidence pointing to the paddling pool as the focal point of the outbreak was circumstantial, nevertheless from the clinical, microbiological and epidemiological findings, it is our contention that the pool which had not been drained nor had disinfectant added at any time, was contaminated by LR during her visit on 17 May when she had diarrhoea, and acted thereafter as a source of infection for both CH and MB. In further support of this, cases of *E. coli* O157 phage type 49 infection identified in the district during this time were localized to three infected households whose only common link was the children (LR, CH, MB), all three of whom had played in the paddling pool over the 3-day period. No other children were reported to have been in the pool. The incubation periods of between 3 and 7 days were compatible with those reported by others in outbreaks of *E. coli* O157 infection attributed to foodborne [2, 18] and person-to-person [8] transmission.

The mainly rural Borders is served by a single district general hospital containing the area microbiology laboratory under the personal supervision of one

of us (M. I. B.) who, as consultant microbiologist, is responsible for scrutinizing all reports. Communication with local general practitioners throughout the Borders area is excellent. Several of the stool specimens submitted to the laboratory during the outbreak and the subsequent investigations were at the instigation of practitioners rather than the outbreak investigation team. There was, however, no noticeable increase in the number of stool specimens submitted to the laboratory during the weeks following the outbreak. No further cases of *E. coli* O157 infection were identified as a result of the increased awareness of practitioners. In subsequent weeks, although other cases were identified elsewhere in the Borders area, they were all of different phage types. A check of laboratory reports failed to reveal any other *E. coli* O157 infections occurring in the Borders in preceding weeks. Thus, we are reasonably confident that all symptomatic cases of *E. coli* O157 infection occurring in the district, and seeking medical attention during the period of the outbreak, were identified.

No food was common to all those affected in the outbreak and in the absence of other cases in the district unconnected with the paddling pool being identified, it was unlikely that a locally retailed food or other environmental source could have been responsible for introducing infection into all three households. Similarly, since one of the three families resided in another village, the likelihood of some other community locus being responsible for the outbreak is further reduced.

Although discussed at the Outbreak Control Team meeting on 29 May, no attempt could be made to isolate *E. coli* O157 from the paddling pool water as the father of CH eventually had drained and disposed of the pool 2–3 days before. However, a negative result would not have ruled out transmission of infection through the pool, while at the same time, a positive result would not have conclusively proved that transmission had occurred by this route. While playing in the paddling pool, the children were in and out of the water repeatedly, thus making it impossible to determine reliably the length of 'exposure' for each child. Such information might itself have been subject to recall bias and be unlikely to equate with the 'infecting dose'. Although it was possible that the association of the paddling pool with the outbreak could have arisen through ascertainment bias, we believe that this was unlikely. Due to the nature and presentation of the outbreak, and the small numbers involved, it was not considered appropriate to undertake any statistical analysis.

The source of infection of the apparent index case (SR) was never established. Phage type 49 has been one of the two most common strains of *E. coli* O157 identified in Scotland in recent years, and is not unique to the Borders area. SR's father worked in a local livestock auction mart, and while having indirect contact with bovines, did not have any known access to raw meats. Bacteriological screening of both parents was negative and serological examination (ELISA) failed to demonstrate lipopolysaccharide antibodies in either parent. Agriculture is a major feature in the economy of the Borders Health Board area and it is more than possible that infection had been acquired locally, either from contact with infected cattle or via contaminated butcher meat. Twelve months previously an outbreak of *E. coli* O157 infection of a different phage type affected two residential homes in other Borders towns with the same butcher meat supply [19].

Although the main perceived risk from children's paddling pools usually relates

to accidental drowning, a further hazard may be posed via faecal contamination. 'Contaminated' paddling pools re-used over a period of several days clearly pose a potential risk of transmission of infection. The infection control implications of this may extend to other types of water play such as those engaged in by young children attending nursery school and playgroups.

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