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Staphylococcal food poisoning on a cruise ship

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SUMMARY

Two waves of vomiting and/or diarrhoea affected approximately 215 of the 715 passengers on a Caribbean cruise ship. The outbreak was independently associated with eating cream-filled pastries at two separate meals. *Staphylococcus aureus* phage type 85/+ was isolated from cases and pastry cooks, but not from controls. This is the first well-documented outbreak of staphylococcal food poisoning on a cruise ship.

INTRODUCTION

Although several etiologic agents and sources have been implicated as the cause of gastroenteritis outbreaks on cruise ships (Merson *et al.* 1975, 1976; Gunn *et al.* 1980; Snyder *et al.* 1984; Centers for Disease Control, 1976, 1986), staphylococcal food poisoning on a cruise ship has not previously been reported. We describe here an investigation of a large outbreak of acute gastroenteritis on a Caribbean cruise ship in 1983 in which staphylococcal contamination of cream pastries prepared on board was implicated as the cause of illness.

THE OUTBREAK

On 25 February 1983, a cruise ship company reported to the Centers for Disease Control (CDC) that 39 passengers had reported to the physician of one of its ships because of a gastrointestinal illness during its current cruise, with most becoming ill either shortly after midnight on 23 February or during the early evening of 24. February. According to the initial report, the illness was characterized by severe vomiting often accompanied by diarrhoea, no fever, and a duration of only a few hours. The ship's physician said that many of the ill passengers had eaten cream-filled cakes. *Staphylococcus aureus* or *Bacillus cereus* food poisoning was suspected. A medical epidemiologist and a quarantine inspector boarded the ship the evening of 25 February to meet the ship's captain and physician and begin an investigation.

METHODS

A case-control study was done by administering questionnaires on 25 February to all known patients (those who had reported to the ship's physician) and to every tenth person from the passenger list. A substantial proportion of persons in the systematic sample proved to have experienced gastroenteritis, so additional controls (and cases) were added by administering the questionnaires to a random sample of people attending breakfast on 26 February. The questionnaire was a standard form which included information on age, sex, time of onset, clinical symptoms, duration of illness, cabin number, dining table number, and water exposure. Ill persons and controls were also asked to indicate from menus which foods they had eaten at dinner on 22 February and lunch and dinner on 24 February. A case was defined as vomiting and/or diarrhoea (three or more loose or watery bowel movements) in a passenger or crew member on the evening or early morning of 22–23 February and/or on the evening of 24 February.

Food-handling procedures were observed, and refrigerator and food-holding temperatures were checked. Fourteen food samples including milk and cream ingredients used to prepare suspect dessert items, desserts prepared after the outbreak and cold cooked meats were obtained for culture. Seven environmental swabs from food preparation and storage surfaces and utensils in the bakery were taken. Rectal swabs were obtained from 13 ill and 9 well individuals. Swabs were taken from the anterior nares, rectum, and skin of 7 crew members from the galley bakery. All swabs were placed in Cary–Blair transport medium and shipped to CDC in Atlanta within 48 h.

Swabs from people and the environment were plated on blood agar and mannitol salt agar. Food specimens were cultured by blending a 10 g sample with 90 ml of physiological saline and then inoculating the blended sample onto blood and mannitol salt agars. Plates were examined for *S. aureus* and *B. cereus* colonies. One *S. aureus* isolate from each culture-positive patient was submitted for phage typing (Blair & Williams, 1961).

RESULTS

The overall attack rate of acute gastroenteritis meeting the case definition, estimated from the cooperating members of a 10% systematic sample of the 715 passengers, was 30% (17/56). Sixty-three cases were identified from the ship's medical log and from the sample of the remaining passengers. The epidemic curve had two sharp peaks, corresponding to the meals served 2 days apart (Fig. 1). All but 10 of the cases occurred during the first peak.

Illness in both peaks was associated with eating cream-filled dessert pastries (Table 1). Illness in the first peak was associated with eating pastries at dinner on 22 February, while illness in the second peak was associated with eating pastries at lunch on 24 February. Onion soup was also associated with illness on 22 February but only 58% of patients consumed this item, while 96% recalled eating the pastries at the same meal.

Although no samples of pastry were available for culture (because leftovers were routinely discarded), laboratory results from patients and food handlers were

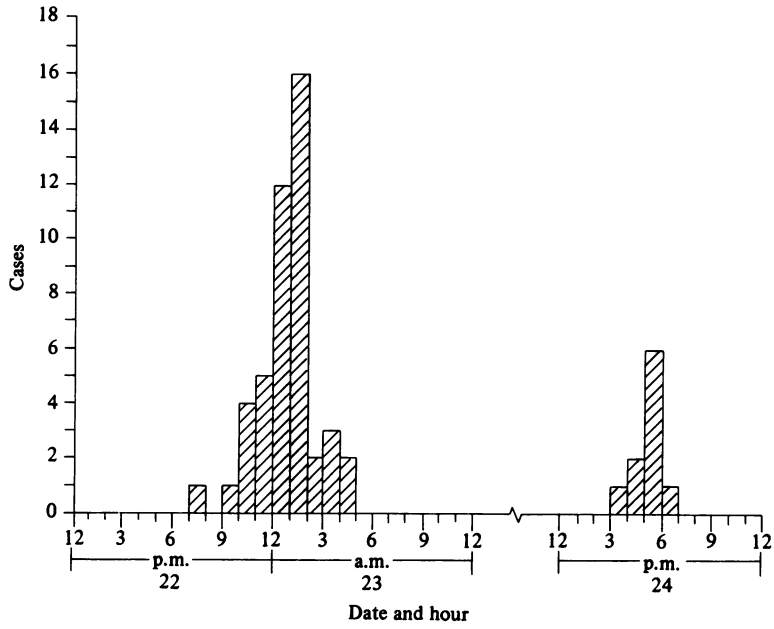

Fig. 1. Cases of acute gastroenteritis, by date and time of onset, Caribbean cruise ship outbreak, February, 1983

Table 1. *Association of illness with foods eaten at two meals on a cruise ship, 22 and 24 February, 1983*

	Dinner, 22 February				
	Case		Control		
Food	Ate	Did not eat	Ate	Did not eat	*P* value*
Napoleon cream pastry	51	2	26	21	0·001
Onion soup	31	22	15	33	0·01
Sirloin steak	26	27	24	24	N.S.
Escargot	23	30	27	21	N.S.
Frog legs	19	34	13	35	N.S.
	Lunch, 24 February				
	Case		Control		
Food	Ate	Did not eat	Ate	Did not eat	*P* value*
Florentine merengata cake	7	3	5	43	0·001
Caesar's salad	3	7	15	33	N.S.
Spring vegetable soup	3	7	14	34	N.S.
Papaya nectar	3	7	2	46	N.S.

* Chi-square test.

consistent with the epidemiologic findings incriminating cream pastry dessert. Enterotoxigenic strains of *S. aureus* phage type 85/+ were isolated from stools of 5 (38%) of the 13 patients cultured and from none of 9 controls. Enterotoxin-producing strains of the same staphylococcal phage type were grown from a perirectal swab and a swab of a scabbed-over forearm lesion from 2 of the 7 crew

members who made pastry, including the chief pastry chef. Two of the 5 patients whose cultures were positive for *S. aureus* phage type 85/+ were from the first cluster of cases and 3 were from the second group. Staphylococci of different phage types were isolated from 1 food handler and 2 other patients. *B. cereus* was not detected in specimens from patients, controls, or food handlers. All food samples and environmental swabs were negative for *S. aureus* and *B. cereus*.

Investigation of the ship's pastry kitchen did not reveal any improper food handling in the preparation of pastry items. Refrigeration temperatures were adequate, and the food handlers were free of pustular lesions. Since the pastry was prepared in large quantities in several steps by several food handlers, opportunities could have been present for the introduction of staphylococci into the pastry, with adequate time at warm temperature for production of enterotoxin.

The median incubation period was 5 h with a range of 1–8 h. The predominant symptoms of the 63 ill persons were vomiting (94%), diarrhoea (79%), and abdominal cramps (63%); headache (29%) and subjective (undocumented) fever (13%) were much less common. Most patients reported that symptoms lasted 1 day or less and usually subsided within 12 h, although 32% of patients indicated illness lasted at least 2 days. This high percentage with illness of relatively long duration may reflect the fact that the majority of our cases were ascertained because individuals had consulted the ship's physician and thus may have been more severely ill. Patients visiting the ship's surgeon represented less than 20% of the 215 estimated overall number of cases of acute gastroenteritis.

DISCUSSION

This report described the first well-documented outbreak of staphylococcal food poisoning on a cruise ship sailing from the United States. Outbreaks of acute gastrointestinal illness on passenger cruise vessels have been associated with several bacteria, including salmonella, shigella, enterotoxigenic *Escherichia coli*, invasive *E. coli* and *Vibrio parahaemolyticus* (Merson *et al.* 1975, 1976; Snyder *et al.* 1984; Centers for Disease Control, 1976). A viral aetiology (Norwalk virus) was documented during outbreaks on three cruise ships (Gunn *et al.* 1980; Centers for Disease Control, 1986). About one-half of all outbreaks investigated by CDC since 1970 have been of unknown aetiology; most of these may well have been caused by viruses.

Despite the apparent rarity of staphylococcal food poisoning on cruise ships, staphylococcus remains the second most common etiologic agent (after salmonella) of foodborne outbreaks in the United States. On the other hand, the number of outbreaks linked to milk products and cream-filled pastries, once notorious vehicles for staphylococcal contamination, has decreased considerably in the last decade (Bryan, 1976; Holmberg & Blake, 1984).

This outbreak shows again the value of phage typing in the investigation of staphylococcal intoxication (Holmberg & Blake, 1984). The phage types of *S. aureus* from various sources supported the epidemiologic evidence on the probable source of the outbreak despite the inability to culture the implicated food item.

In our inspection of the sanitation practices in the kitchen of this ship, we did

not find specific deficiencies that were likely to be responsible for contamination of the cream pastry and subsequent growth of the staphylococci. However, the inspection was conducted after the ship's personnel knew that an outbreak had occurred and that cream-filled pastries were suspected, so any deficiencies in food-handling practices may have already been corrected. The elaboration of staphylococcal enterotoxin requires inoculation of the food with an enterotoxigenic strain of *S. aureus*, often by a food-handler, and incubation at temperatures above 6·7 °C (44 °F) (Holmberg & Blake, 1984). The warm temperatures necessary for elaboration of sufficient enterotoxin to cause illness could have been achieved by failure to refrigerate the food, by use of a refrigerator that was not sufficiently cold, or by storing the food in large quantities that would not cool quickly.

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