An Outbreak of Febrile Gastroenteritis Associated with Delicatessen Meat Contaminated with *Listeria monocytogenes*

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In June 2001, the Los Angeles County Department of Health Services/Public Health conducted a cohort study of an outbreak of acute febrile gastroenteritis among 16 of 44 healthy attendees of a catered party. The median age of the attendees who became ill was 15.5 years. Symptoms included body aches (in 88% of attendees), fever (81%), headache (81%), diarrhea (63%), and vomiting (56%). Illness was associated with ingestion of precooked, sliced turkey (*P* < 0.000004). Six stool specimens yielded *Listeria monocytogenes*. Leftover turkey yielded *L. monocytogenes*, 1.6 × 10³ cfu/g. All isolates were serotype 1/2a and had matching molecular fingerprints. Clusters of suspect cases were identified among attendees at 2 other catered events, but no additional cases were confirmed. This is only the third reported outbreak of *L. monocytogenes*-associated gastroenteritis in the United States. In cases of febrile gastroenteritis for which routine cultures for enteric pathogens are negative, clinicians should suspect listeriosis and should consider asking laboratories to retain stool specimens to expedite testing for *Listeria* organisms.

The Los Angeles County Department of Health Services/Public Health (DHS) received, on 6 June 2001, a report of a cluster of cases of diarrheal illness among attendees of a birthday party that had been catered by a local delicatessen 3 days earlier. Approximately 60 individuals attended the party, and 28 reported illness. Because of the temporal association between symptoms and attendance at the party, and because of the involvement of a commercial establishment, the DHS performed an investigation.

*Listeria monocytogenes*, an emerging pathogen since the late 1970s, causes ~2500 cases of serious illness and 500 deaths per year in the United States [1–4]. With its ability to survive and multiply in human macrophages, *L. monocytogenes* most commonly presents as severe systemic illness (e.g., sepsis, meningitis, and encephalitis) in persons with impaired cell-mediated immunity, such as infants, elderly individuals, immunocompromised persons, and pregnant women [5–7].

Since Schlech et al. [8] reported the first outbreak of invasive *L. monocytogenes* illness to be epidemiologically linked to the ingestion of contaminated coleslaw in 1982, other foods have also been associated with such outbreaks; these foods include soft cheese, raw milk, hot dogs, delicatessen meats, seafood, and fresh vegetables [9–12]. Although not always confirmed, a less common foodborne febrile gastrointestinal syndrome in healthy persons has also been reported, with onset of fever, muscle aches, headache, and diarrhea occurring 9–48 h after exposure [13–21]. The outbreak reported in the present study is only the third reported foodborne outbreak of *L. monocytogenes*-associated gastrointestinal illness in the United States.
States, and it is the first such outbreak attributable to the ingestion of contaminated delicatessen meat.

MATERIALS AND METHODS

Investigations of foodborne outbreaks in Los Angeles County involve the collaboration of 3 DHS agencies: Acute Communicable Disease Control (ACDC), Environmental Health Services (EHS), and Public Health Laboratories (PHL). ACDC conducted a cohort investigation of birthday party attendees by use of a telephone questionnaire. Delicatessen employees also were interviewed. Case-finding consisted of contacting other at-risk customers and events identified through a search of delicatessen invoices from 15 May to 7 June. Identified customers were contacted by facsimile or by mail, with follow-up done by telephone. Enhanced surveillance for listeriosis also was done, with alerts sent to district public health nurses and hospital infection-control practitioners.

Any birthday party attendee with ≥1 systemic symptom (fever, body aches, or headache) and ≥1 gastrointestinal symptom (diarrhea, vomiting, cramps, or nausea) was considered to have a “presumptive case.” Any other customer of the delicatessen during the study period (i.e., non–birthday party attendee) who had ≥1 of the aforementioned systemic symptoms and ≥1 of the aforementioned gastrointestinal symptoms was considered to have a “suspect case.” Any birthday party attendee or other customer of the delicatessen during the study period who had a blood or stool culture that was positive for the outbreak strain of *L. monocytogenes* was considered to have a “confirmed case.” Univariate and stratified analysis of foods that were possible vehicles for transmission of infection was done using Epi Info 6.0 (Centers for Disease Control and Prevention [CDC]; Atlanta).

Stool and leftover food specimens were requested from all ill party attendees and delicatessen employees. EHS inspected the kitchen facility of the delicatessen on multiple occasions. Environmental swab specimens were obtained from the kitchen for culture.

PHL tested stool specimens for *Salmonella*, *Shigella*, *Campylobacter*, and *Yersinia* species; *Escherichia coli* O157-H7; and Shiga-like toxin. Food specimens were tested for *Salmonella* and *Listeria* species, and environmental swab specimens were tested only for *Listeria* species. Stool specimens were analyzed for *Listeria* species in accordance with recommendations in the *Manual of Clinical Microbiology* and the *Compendium of Methods for the Microbiological Examination of Foods* [22, 23], whereas food specimens were analyzed in accordance with recommendations in the *Food and Drug Administration Bacteriological Analytical Manual* [24]. Molecular typing of *L. monocytogenes*–positive isolates was performed using 2 enzymes, according to the CDC’s PulseNet standardized protocol for molecular subtyping of *L. monocytogenes* by PFGE; results were then posted on the PulseNet listserv [25]. CDC laboratories performed serotyping of both food and stool isolates and determined the listeriolysin titers of available serum samples.

RESULTS

Of an estimated 60 individuals who attended the birthday party, 44 were interviewed (response rate, 73%). Of these 44 individuals, 16 met the criteria for the definition of having a presumptive case (attack rate, 36%). Three 6-foot submarine sandwiches were ordered and made on the same day that the birthday party occurred: “sandwich A” was half turkey and half vegetarian, with pepper jack cheese on both halves; “sandwich B” consisted of turkey and cheddar cheese throughout; and “sandwich C” was half roast beef and half ham, with Swiss cheese on both halves. All sandwiches included shredded lettuce and tomato; condiments, such as mustard and mayonnaise, were served separately. Potato salad and ice also were purchased from the delicatessen. Other food items available at the party included store-bought taquitos, watermelon, guacamole, chips, and soft drinks; strawberries from a local farm; cake from a bakery; and a home-prepared onion dip.

**Case characteristics.** The median age of birthday party attendees with presumptive and confirmed cases of febrile gastroenteritis was 15.5 years (range, 7–66 years); half were male. The median incubation period was 25 h (range, 6–49 h). Symptoms included body aches in 14 patients (88%); fever, in 13 (81%); headache, in 13 (81%); diarrhea, in 10 (63%); and vomiting, in 9 (56%). With regard to the characteristics of illness noted, there were no significant differences between persons with confirmed and presumptive cases (table 1). A complete blood count was performed for 1 person and revealed a hemoglobin count of 12.8 g/dL, a platelet count of 201,000 platelets/cm, and an elevated WBC count of 16,400 cells/cm, with 94% polys (absolute polys, 15,500 polys/μL) but with no bands.

**Food-specific analysis.** The 16 birthday party attendees with the reported cases had all eaten turkey: 15 had eaten turkey from sandwich A, and 1 had eaten turkey from sandwich B. Both sandwiches had been made using the same previously unopened package of whole, unsliced turkey breast. Eating from sandwich A was significantly associated with illness (relative risk [RR], 5.6; *P* < .002), whereas eating from either sandwich B (RR, 0.1; *P* < .01) or sandwich C (RR, 0.2; *P* < .01) was protective against illness. Consumption of turkey (RR, undefined; *P* = .000004, by Yates uncorrected test) or pepper jack cheese (RR, 6.3; *P* = .0002, by Fisher’s exact test) was associated with illness on univariate analysis (table 2). Consumption of turkey could account for 100% of cases, whereas consumption of pepper jack cheese could account for only 56% of cases. According
Table 1. Characteristics of illness in a cohort of birthday party attendees with confirmed and presumptive cases of Listeria monocytogenes–associated gastroenteritis from a foodborne outbreak, Los Angeles, 2001.

<table>
<thead>
<tr>
<th>Characteristic of illness</th>
<th>Persons with confirmed cases (n = 6)</th>
<th>Persons with presumptive cases (n = 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incubation, median h</td>
<td>24 (10–49)</td>
<td>25 (6–35)</td>
</tr>
<tr>
<td>Duration, median days</td>
<td>7 (2–21)</td>
<td>2 (2–3)</td>
</tr>
<tr>
<td>Symptom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body aches</td>
<td>6 (100)</td>
<td>8 (80)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>5 (83)</td>
<td>6 (60)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>2 (33)</td>
<td>4 (40)</td>
</tr>
<tr>
<td>Fever</td>
<td>5(^a) (83)</td>
<td>8(^b) (80)</td>
</tr>
<tr>
<td>Chills</td>
<td>4 (67)</td>
<td>8 (80)</td>
</tr>
<tr>
<td>Nausea</td>
<td>2 (33)</td>
<td>8 (80)</td>
</tr>
<tr>
<td>Vomiting</td>
<td>2 (33)</td>
<td>7 (70)</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>5(^c) (83)</td>
<td>5(^d) (50)</td>
</tr>
<tr>
<td>Abdominal cramps</td>
<td>1 (17)</td>
<td>5 (50)</td>
</tr>
<tr>
<td>Provider visited</td>
<td>2 (33)</td>
<td>3 (30)</td>
</tr>
<tr>
<td>Antibiotics given</td>
<td>1(^e) (17)</td>
<td>1 (10)</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

**NOTE.** Data are no. (%) of persons, unless otherwise indicated.

\(^a\) Temperature range for persons with confirmed cases, 38.9°C–39.7°C (102°F–103.5°F) (n = 3).

\(^b\) Temperature range for persons with presumptive cases, 38.3°C–39.7°C (101°F–103.5°F) (n = 4).

\(^c\) Median no. of stools per 24-h period for persons with confirmed cases, 5 (range, 3–12).

\(^d\) Median no. of stools per 24-h period for persons with presumptive cases, 2 (range, 1–4).

\(^e\) Outbreak strain of L. monocytogenes cultured from a stool specimen 3 weeks after a 3-day course of ciprofloxacin was given.

To stratified analysis, with controlling for both exposures, only consumption of turkey remained statistically significant (P = .003). Furthermore, neither of the 2 persons who ate only the vegetarian portion of sandwich A, which also contained pepper jack cheese, became ill. None of the other food items, condiments, cakes, or drinks was associated with illness.

**Stool testing.** For 6 birthday party attendees, the results of initial, routine stool cultures were negative for enteric pathogens (Salmonella, Shigella, and Campylobacter species), and the results of subsequent stool cultures were negative for Yersinia enterocolitica and E. coli O157:H7. Four of these 6 persons were tested and were found to be negative for Shiga-like toxin. Because of the preponderance of systemic symptoms, we also tested for L. monocytogenes. Of the 16 persons with presumptive cases, 8 provided the requested stool specimen. Six stool isolates recovered from these 8 persons were confirmed to be L. monocytogenes; all isolates were serotype 1/2a and shared with the outbreak strain an indistinguishable PFGE pattern. Of the 2 persons with presumptive cases who tested negative for *Listeria* species, 1 had begun receiving empirical treatment with antibiotics before stool collection. For persons with confirmed cases, the median delay between onset of symptoms and collection of stool samples was 7 days (range, 1–34 days).

**Serological findings.** Serum levels of listeriolysin were determined for 2 party attendees who had presumptive cases, both of whom had begun receiving antibiotics for their illness and had initially received negative stool culture results. Both had borderline elevated serum levels at a dilution of 1:100. One of these presumptive cases was confirmed 3 weeks later by a second stool culture.

**Case-finding.** Delicatessen invoices from 15 May 2001 to 7 June 2001 were reviewed, and 60 additional events for which suspect foods (sandwiches, meats, and cheeses) had been ordered from the delicatessen were identified. Attendees associated with each identified event were contacted and asked about gastrointestinal illness. Clusters of suspect cases were identified in association with 2 unrelated events, hereafter known as “events X and Y” (figure 1).

Of 220 questionnaires mailed out to attendees of event X, 48 were returned (response rate, 22%), including those from event X attendees with 8 suspect cases (attack rate, 17%). Five of these 8 persons had eaten food from the delicatessen on 3 June, the same day that the birthday party occurred. Four of these 5 ill persons, but only 2 of 16 persons who did not become ill, reported having eaten turkey on that day (RR, 10; P = .01, by Fisher’s exact test). Stool specimens obtained from 5 persons with suspect cases were cultured and were found to be negative for *Listeria* species; 4 of the 5 specimens were also negative for enteric pathogens, with 1 also testing negative for *E. coli* O157:H7. A serum listeriolysin level obtained for one person with a suspect case was positive at a 1:400 dilution.

Event Y involved 232 persons, 59 of whom returned questionnaires (response rate, 25%); 8 of those who returned a questionnaire had a suspect case (attack rate, 14%). Six of these 8 persons had eaten food from the delicatessen on 4 June, the day that catered sandwiches reportedly had been made using meat from the same package of turkey breast implicated as the source of the outbreak of febrile gastroenteritis among birthday party attendees. Five of these 6 persons but only 9 of 27 persons who did not become ill reported having eaten turkey on that day (RR, 6.8; P = .06, by Fisher’s exact test). Stool specimens obtained from 4 persons with suspect cases were cultured and were found to be negative for *Listeria* species, and 2 specimens also were found to be negative for enteric pathogens and *E. coli* O157:H7 on routine culture. A serum listeriolysin level obtained for one person with a suspect case was negative at <1:100 dilution.

For persons with suspect cases, the median delay between onset of symptoms and collection of stool specimens was 20
Table 2. Univariate analysis of possible food vehicles for an outbreak of *Listeria monocytogenes*–associated gastroenteritis among attendees of a catered birthday party.

<table>
<thead>
<tr>
<th>Food item</th>
<th>No. (%) of attendees</th>
<th>Relative risk (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who became ill (n = 16)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>16/16 (100)</td>
<td>Undefined</td>
<td>.000004&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Pepper jack cheese</td>
<td>9/12 (75)</td>
<td>6.3 (2.1–19)</td>
<td>.0002&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Lettuce</td>
<td>11/16 (69)</td>
<td>1.5 (0.7–3.5)</td>
<td>.3</td>
</tr>
<tr>
<td>Cake</td>
<td>10/16 (63)</td>
<td>0.9 (0.4–1.7)</td>
<td>.5</td>
</tr>
<tr>
<td>Taquitos</td>
<td>9/16 (56)</td>
<td>1.2 (0.6–2.7)</td>
<td>.6</td>
</tr>
<tr>
<td>Tortilla chips</td>
<td>9/16 (56)</td>
<td>1.4 (0.5–3.6)</td>
<td>.7</td>
</tr>
<tr>
<td>Chips</td>
<td>8/16 (50)</td>
<td>0.9 (0.4–1.9)</td>
<td>.7</td>
</tr>
<tr>
<td>Tomato</td>
<td>8/16 (50)</td>
<td>1.0 (0.5–2.0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Who did not become ill (n = 27)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> After stratification on the basis of pepper jack cheese consumption, turkey remained significantly associated with illness (P = .003).

<sup>b</sup> After stratification on the basis of turkey consumption, pepper jack cheese was no longer significantly associated with illness (P = .1).

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days (range, 16–25 days). Heightened surveillance for listeriosis during the ensuing months failed to identify any cases that were linked to this outbreak or that matched the outbreak strain. Posting the PFGE pattern of the outbreak strain on the CDC’s PulseNet listerv failed to identify other cases in other jurisdictions.

**Inspection of the retail food establishment.** Investigation of the delicatessen’s kitchen revealed multiple health-code violations, including a general lack of cleanliness, inadequate sanitization, and a temperature of 11°C–12°C (51°F–54°F) in a large walk-in refrigerator (by comparison, California law requires commercial refrigeration units to have a temperature of ≤5°C [≤41°F]) [26].

**Environmental testing.** Thirty environmental swab specimens were obtained from the delicatessen’s kitchen and walk-in refrigerator after the delicatessen had been thoroughly cleaned. All swab specimens, including those from the meat slicer, knife holder, surfaces for food cutting and preparation, utensils, equipment, refrigerator racks, and drains, tested negative for *Listeria* organisms.

**Delicatessen employee information.** None of the 9 employees who completed questionnaires reported illness. Seven employees provided stool specimens, but only 2 specimens, including 1 from the sandwich maker, were tested for *Listeria* species; the results for both of these specimens were negative.

**Testing of food samples.** Four samples of home-refrigerated leftover portions of sandwich A, including 1 sample of turkey, 1 of pepper jack cheese, and 2 of turkey, pepper jack cheese, bun, tomato, and lettuce, all were negative for *Salmonella* organisms but grew the outbreak strain of *L. monocytogenes*. Quantitative testing was performed on a 1-g sample of sliced turkey obtained from the leftover sandwich 14 days after the event; this sample yielded *Listeria* species (1.6 × 10<sup>5</sup> cfu/g of food). For reference purposes, the US Food and Drug Administration (FDA) has established that the size of a single serving of delicatessen meat is 55 g [27]. Not enough pepper jack cheese from the leftover sandwich remained for quantitative testing to be done, nor were any unused portions of turkey or pepper jack cheese from the implicated packages at the delicatessen available for testing. Previously unopened pack-
ages of the same brand of pepper jack cheese and turkey breast were obtained from the delicatessen some days later; all tested negative for *Listeria* organisms.

**Tracing back to the source.** We identified the out-of-state plant that processed the turkey breast, but an investigation of that plant was not done. The US FDA did investigate processing plants that produced and distributed the pepper jack cheese; no health-code violations were identified, and no food or environmental samples were obtained for testing.

**DISCUSSION**

An outbreak of febrile gastroenteritis due to *L. monocytogenes* occurred among healthy attendees of a catered birthday party who consumed highly contaminated delicatessen meat. Systemic symptoms were prominent among persons in whom cases developed, but no invasive disease was identified. *L. monocytogenes* is a slow-growing organism under the most favorable conditions. Febrile gastrointestinal illness has been seen in healthy persons who have ingested a ready-to-eat food item that was contaminated and then was stored at a temperature of >4°C for a prolonged period, allowing for the rapid growth of *Listeria* organisms [15, 18]. We hypothesized that the source of contamination in this outbreak was a single package of processed turkey breast that was stored for an indeterminate number of days in a delicatessen walk-in refrigerator that, upon inspection, was found to have a temperature of 11°C–12°C. Although we traced the implicated food source to an out-of-state meat-processing plant, investigation of that plant was believed to be unfeasible because of both the absence of a lot number for the package of turkey breast implicated as the source of the outbreak and the apparently limited nature of the outbreak. Therefore, we were unable to verify that the package of meat was the source of the causative pathogen.

Extensive case-finding efforts involved investigating other events catered by this delicatessen during a 3-week period and revealed 2 clusters of persons who were ill with symptoms of febrile gastroenteritis. Although both clusters tended to be associated either with ingestion of turkey on the same day that the outbreak occurred or with ingestion of turkey obtained from the same package of turkey implicated as the source of the outbreak, no additional cases could be confirmed. The prolonged delay in processing stool specimens (which was nearly 3 times longer for persons with suspect cases than for those with presumptive cases), as well as the low rate of response from the customers with potential exposure who we contacted, may have hampered confirmation of suspect cases. Nevertheless, letters that instructed high-risk individuals to contact their doctor if they experienced a febrile illness during the next 2–6 weeks were sent to all persons who had potentially been exposed to *Listeria* species.

Another limitation of our study was our difficulty in confirming more of the presumptive cases from the outbreak at the birthday party. This was due to both the apparent unwillingness of adolescents with presumptive cases to provide stool specimens and the use of prescribed antibiotics by some persons before stool samples could be collected.

In sliced turkey refrigerated at 4°C, *L. monocytogenes* has been estimated to grow by 2 logs in 14 days [28]. With *L. monocytogenes*, 1.6 × 10⁷ cfu/g, noted in turkey 14 days after the birthday event, the turkey would have been highly contaminated with *Listeria* organisms at the time of the birthday party (~1 × 10⁷ cfu/g), thus excluding the possibility of contamination at that time. If the source of contamination had been the delicatessen (for example, from the meat slicer or kitchen counter), we would have expected a more generalized outbreak that would have affected more customers than just the attendees at one party and that would have involved more food items than just the turkey.

If *Listeria* organisms had indeed contaminated the kitchen, they should have been potentially culturable, because delicatessen staff had been routinely following inadequate cleaning and disinfection procedures up to the time of inspection [29]. That environmental sampling of the kitchen failed to demonstrate *Listeria* contamination may have been due to the fact that swab specimens were obtained 10 days after the event and only after a thorough cleaning of the kitchen had been attempted. Also, because only 30 samples were obtained, we may have missed an area of contamination; one investigator found *L. monocytogenes* in only 2 of 64 environmental samples obtained in that outbreak [15].

A serum listeriolysin assay, although perhaps useful in past outbreaks, proved unhelpful in confirming presumptive cases in this outbreak [15]. In all, we were able to obtain serum samples from only 4 persons (2 with presumptive cases and 2 with suspect cases). It is unclear whether more-definitive results would have been obtained by a more thorough serological survey of persons with confirmed and presumptive cases.

*L. monocytogenes* serotype 1/2a is one of a limited number of common serotypes associated with foodborne outbreaks of classic listeriosis [4]. Of the 6 prior reported outbreaks of gastrointestinal listeriosis, 3 were associated with serotype 4 or 4b [13, 18, 19], 2 were associated with serotype 1/2b [14, 15], and 1 was associated with 1/2a [17]. Serotyping is less discriminating than is molecular typing that uses PFGE, and it may prove to be a less useful tool than PFGE in future investigations of *L. monocytogenes* outbreaks [30, 31].

**RECOMMENDATIONS**

Physicians should obtain stool and/or blood specimens from their febrile patients with diarrhea; they also should avoid using
antibiotics for such patients unless it is justified and only after cultures are obtained [32]. Because Listeria organisms, as has been suggested, are often underdiagnosed as a cause of febrile gastroenteritis, clinicians and health officers should think of Listeria species when signs and symptoms are consistent with the diagnosis and when routine cultures are negative for enteric pathogens [1, 19].

In the outbreak described in the present article, it was somewhat serendipitous that our own laboratory had held onto the stool specimens from persons with presumptive cases until the results of enteric cultures are known, so that further testing for Listeria organisms, other pathogens, and toxins can be done, if so desired. Also, with ~20% of the population at risk for developing systemic listeriosis when infected, clinicians should counsel their high-risk patients to avoid soft cheeses and delicatessen counter food and to cook leftover food and ready-to-eat foods (including cold-cut meats) until they are steaming hot [9, 32]. The general public should be made aware that delicatessen meat and ready-to-eat food, when mishandled, may pose a risk for gastrointestinal listeriosis in otherwise healthy persons. As has been recommended for pasteurized dairy products [15], consumers should store delicatessen meat and ready-to-eat food at a temperature ≤4°C (≤40°F), and these products should be consumed before their expiration dates [33].

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