Research Note

Chicken Salad as the Source of a Case of *Listeria monocytogenes* Infection in Connecticut

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ABSTRACT

Listeriosis is a severe infection with high morbidity and mortality. We report a fatal case of listeriosis in a patient with a history of Crohn’s disease who consumed chicken salad purchased from a retail food establishment before developing listeriosis. As part of the regulatory testing programs, the U.S. Department of Agriculture Food Safety and Inspection Service and the Florida Department of Agriculture and Consumer Affairs found that chicken products from a single food-production establishment were contaminated with *Listeria monocytogenes*, resulting in a product recall. The case patient’s *Listeria* isolate was subtyped by pulsed-field gel electrophoresis (PFGE) and matched the *Listeria* isolates from the recalled chicken products. Identification of the source of *Listeria* involved collaboration among two state public health laboratories and epidemiologists and state and federal regulatory agencies. PFGE typing can be used to reveal correlations between clusters of human illness and contaminated food products and to rapidly identify sources of *Listeria* infection to allow implementation of corrective actions at both the state and national levels.

We report a case of listeriosis in a person who consumed chicken salad from a retail establishment that subsequently yielded the same subtype of *Listeria monocytogenes* as was identified from the case patient. The purpose of this report is to describe the value of timely molecular testing and collaboration across state and federal agencies.

*L. monocytogenes* is a gram-positive bacterium that can cause meningitis or bacteremia among the elderly and persons with certain medical conditions, including persons being treated with immunosuppressive therapy, persons infected with HIV, and persons with other immunocompromising conditions (23). Pregnant women also are at increased risk for listeriosis, and early infection may lead to fetal death, preterm labor, and invasive listeriosis in the neonate. Although the incidence of listeriosis is low in the United States (0.27 cases per 100,000 persons annually (4)), listeriosis can cause severe morbidity and mortality. Hospitalization rates are near 90% in some studies, and reported case fatality rates range from 21 to 38% among nonperinatal cases, the highest fatality rate for infections with bacterial pathogens commonly transmitted through food (25, 28).

The majority of listeriosis cases are sporadic, but outbreaks associated with consumption of contaminated deli turkey meat, hot dogs, pasteurized milk, and Mexican-style cheese (queso fresco) have been reported (5, 9, 20, 24, 28). Several other investigations of sporadic cases and outbreaks have identified links between human cases and food products such as cheese (8, 15, 16), fish (2, 3, 6, 19, 26), rice salad (22), butter (14), chocolate milk (5, 21), pasteurized milk (7), pork tongue in jelly (12), hot dogs (18), rillettes (10), paté (17), and corn (1). These case reports and outbreak investigations illustrate the pervasive nature of *L. monocytogenes* and the range of food products in which the bacteria can survive and proliferate.

In 1987, the U.S. Department of Agriculture Food Safety and Inspection Service (FSIS) (27) initiated regulatory microbiological testing for *L. monocytogenes* in ready-to-eat (RTE) meat and poultry products, and in 1989, the ‘‘zero tolerance’’ policy for *L. monocytogenes* in RTE meat and poultry products was established.

*L. monocytogenes* may be present in RTE foods as the result of postprocessing contamination, i.e., contamination of product after a lethality treatment (such as cooking). The FSIS routinely samples RTE and postlethality-treated RTE meat and poultry products for *L. monocytogenes*. The FSIS also collects samples for *L. monocytogenes* testing from contact and noncontact food surfaces at establishments.

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producing postlethality-exposed RTE meat and poultry products. During foodborne illness investigations, the Outbreaks Section of the Eastern Laboratory (OSEL) at FSIS may assist with the testing of suspect or implicated products. Pulsed-field gel electrophoresis (PFGE) analysis is performed on isolates from food samples collected during routine sampling and during foodborne outbreak investigations and uploaded to PulseNet for comparison with clinical isolates.

In 2000, listeriosis was made a nationally notifiable condition by the Council of State and Territorial Epidemiologists (CSTE) and became reportable to the Centers for Disease Control and Prevention (CDC). Beginning in 2003, the CSTE recommended the use of a standardized case report form for interviewing all identified case patients with listeriosis, collection of clinical isolates by public health laboratories, and rapid *Listeria* subtyping with PFGE nationwide. In the following year, the *Listeria* Initiative was launched by the CDC as a tool to aid in investigations of listeriosis clusters by rapidly obtaining food exposure history using a standardized questionnaire. The questionnaire captures case demographic information, the date of collection and source of specimen that yielded the positive culture, hospitalization and outcome data, and a detailed history of foods considered high risk that were consumed during the 4 weeks before onset. Patients are interviewed soon after they are reported, which allows for more accurate recall and food consumption histories. All of the collected information is stored in a national database. The *Listeria* Initiative database is linked to PulseNet, the National Molecular Subtyping Network for Foodborne Disease Surveillance, established by the CDC in 1996. PulseNet uses standardized PFGE protocols for rapid comparison of DNA fingerprints from pathogens such as *L. monocytogenes* among different laboratories to enhance foodborne disease surveillance and to identify case clusters.

**MATERIALS AND METHODS**

In Connecticut, listeriosis is a physician and laboratory reportable condition. All cases of *L. monocytogenes* infection are reported to the Connecticut Department of Public Health through the Foodborne Diseases Active Surveillance Network (FoodNet) (4). Active laboratory-based surveillance is carried out statewide (Connecticut population of 3.5 million) in 30 hospital-based and two independent clinical laboratories.

FoodNet staff use the CSTE case report form to interview all Connecticut residents with culture-confirmed listeriosis. Interviews are conducted by telephone with the case patient or a surrogate. Surrogates are interviewed when the patient is hospitalized and unable to respond to questions, dies, or is a neonate or child. Surrogates may be the spouse of the case patient, an adult child, or a parent or guardian.

In addition to conducting surveillance for listeriosis in Connecticut, all isolates from clinical laboratories are sent to the Connecticut State Laboratory for verification and PFGE using the standard CDC PulseNet protocol (11). PFGE patterns are analyzed and compared with those in the local database using BioNumerics software (Applied Maths, Saint-Martins-Latem, Belgium) and then uploaded to and compared with patterns in the *Listeria* national database. Local database searches assess any previous occurrence of the patterns, and national searches seek pattern infections reported within the last 120 days. Search results are relayed to Department of Public Health and FoodNet epidemiologists. Isolates are pulsed in real time; pattern analysis and reporting are completed within three working days from culture receipt.

**RESULTS**

**Case results.** Two cases of listeriosis with matching PFGE patterns were reported in March 2008. One case was from Connecticut and the other was from a midwestern state.

A Connecticut man in his mid-60s was seen in the emergency department in March 2008 with a 4-day history of fever (up to 40.5°C), occipital headache, runny nose, chills, confusion, and lethargy. He was released from the emergency department to his home. Later that day, he was admitted to a hospital in Massachusetts with altered mental status. Previous medical history was unremarkable except for a diagnosis of Crohn’s disease, for which he was currently receiving a monoclonal antibody treatment directed against tumor necrosis factor alpha (29). Upon hospitalization, *L. monocytogenes* was isolated from the patient’s cerebrospinal fluid. On day 4 of hospitalization, the patient was transferred to the intensive care unit and put on mechanical ventilation. He died 9 days after hospital admission.

Follow-up of the Connecticut case patient was conducted by telephone interview with a surrogate. The case patient and his wife had traveled to Florida during the 4 weeks before his illness onset. They had eaten at numerous food service establishments but primarily bought groceries at one chain retail store, chain X. PFGE was performed on the patient’s *L. monocytogenes* isolate by the state public health laboratory in Massachusetts (where the patient was hospitalized). The molecular pattern was uploaded to the PulseNet *Listeria* database for comparison with other human and food isolates and forwarded to Connecticut for local comparison and reporting. The CDC *Listeria* database administrators named the PFGE *Apa*I pattern GX6A16.0207 and the PFGE *Apa*I pattern GX6A12.0337. The *Apa*I pattern represented 0.6% of all *Apa*I patterns in the *L. monocytogenes* database. The *Apa*I pattern represented 0.34% of all *Apa*I patterns in the database. Together, this combination represented 0.1% of all two-enzyme patterns in the PulseNet database.

One other human isolate in the *Listeria* PFGE database matched the pattern of that in the Connecticut case. This isolate had been recovered from a case patient older than 65 years who had not traveled outside his home state in the Midwest in the 4 weeks before illness onset. He presented to an emergency department in March 2008 with a history of shortness of breath that had worsened over 2 days, cough, diarrhea, and fever (40.5°C in the emergency department). He was admitted for respiratory failure and sepsis and died shortly after admission. He had a history of myelodysplasia and coronary artery disease. He had not been interviewed by local health department staff before his death, and no surrogate was available for interview.

**Food results.** Isolates of *L. monocytogenes* with a matching PFGE pattern were identified in two food items: a
chicken wrap sandwich made with chicken supplied by establishment A that was collected on 5 December 2007 by the Florida Department of Agriculture and Consumer Services (FLAG) as part of its regulatory testing and a chicken salad sample collected by the FSIS at establishment A in New York on 27 February 2008. The FSIS sampled product, which was collected as part of a risk-based verification sampling program, was recalled on 4 March 2008.

Upon receipt of the PFGE results, which indicated that the case patient’s *L. monocytogenes* strain had the same PFGE pattern as another human isolate and the isolates from the two food products, the wife of the Connecticut case patient was recontacted to obtain additional details of the items he had consumed from the retail food establishments. She had retained credit card receipts from purchases made at the food establishments, including the one retail store from chain X. The receipts indicated the name of the store, location, date of purchase, and specific items purchased from the deli counter. Of interest was the homestyle chicken salad purchased at the deli counter because one of the products with a matching *L. monocytogenes* PFGE pattern had been chicken salad produced at establishment A.

**Traceback investigation.** Based on the information recorded by the interviewer, FSIS and FLAG investigators visited the retail store from chain X on 23 April 2008 and subsequently determined that the retail store had purchased homestyle chicken salad produced by establishment A on 23 April 2008. FLAG investigators went to the grocery store and obtained unopened samples of the homestyle chicken salad produced by establishment A. These samples were tested by the FLAG Bureau of Food Laboratories and were positive for *L. monocytogenes*. The PFGE patterns of the isolates from these positive samples were indistinguishable from the pattern of the isolate from the case patient. Additional unopened homestyle chicken salad products were collected by the FSIS investigators at the corporate office of retail store chain X. Testing conducted by the OSEL indicated that these products were positive for *L. monocytogenes* on 2 May 2008 and yielded results of 0.43 and 0.93 most probable number per ml. On 3 May 2008, establishment A voluntarily recalled approximately 286,320 lb (129,989 kg) of fresh (produced in April 2008) and frozen meat and poultry products produced between October 2007 and April 2008. These products were recalled based on product testing, traceback investigations, and findings at establishment A. On 6 May 2008, PulseNet confirmed that the isolates from the unopened homestyle chicken salad products collected from the corporate office of chain X by FSIS investigators were indistinguishable from the outbreak strain (Fig. 1). The FSIS conducted a comprehensive food safety assessment of establishment A to evaluate the design and execution of its food safety system. Establishment A reevaluated its hazard analysis and critical control point plan by examining hazards that are reasonably likely to occur and sanitation standard operating procedures designed to prevent direct contamination and adulteration of product. Establishment A implemented corrective actions, which included deep cleaning of the facility, and continued to monitor its operations to prevent recurrence of contamination. The FSIS investigators collected follow-up environmental and product samples at the establishment, and all of these samples were negative for *L. monocytogenes*.

**DISCUSSION**

*L. monocytogenes* infection can cause serious foodborne illness that often results in death. This case report indicates the importance of prompt identification and interviews of listeriosis case patients using a standardized case report form and the importance of real-time molecular subtyping for finding relationships between human illness and food sources. The rapid actions taken by health and regulatory agencies likely prevented further illnesses associated with these contaminated foods.

The quick processing and response of the neighboring state public health laboratory coupled with the timely local and national comparisons performed by the Connecticut State Public Health Laboratory allowed for the rapid identification of one other human isolate and several food product isolates collected since 2005 that had *AscI* and *ApaI* patterns consistent with those of the patient’s isolate.

The use of various laboratory *Listeria* subtyping techniques has facilitated the linking of human listeriosis cases and food products. For example, McLauchlin et al. (17) used phage typing to identify common serovars in human cases and cheese. Jeffers and colleagues (13) used ribotyping and PCR restriction fragment length polymorphism in humans and animals, and Proctor et al. (21) used PFGE to link human cases to chocolate milk in a large outbreak investigation. In this report, PFGE was used to identify a molecular subtype pattern that was found during routine and targeted food testing, which led to the identification of a likely source for human listeriosis. This microbiologic link was a key component in this investigation because a common limitation in case investigations is recall bias due to the length of time between exposure and interview of the case patient or surrogate.

PulseNet has enhanced our ability to quickly share PFGE patterns of bacterial isolates from foods and humans for comparison prospectively and, as the need arises, on a national level. The federal FSIS and state FLAG were able
to coordinate traceback activities and testing so that the implicated product could be quickly recalled once identified. Rapid identification of RTE food items contaminated with *L. monocytogenes* will result in product recalls or alerts regardless of the association with human illness. However, use of PFGE to find correlations between clusters of illness cases in humans and isolates from contaminated food enhances the ability to identify the food vehicle responsible for outbreaks, which may otherwise be missed. In this case, it also led to identification and implementation of corrective actions at a food production establishment that had a chronic problem with *Listeria* contamination of finished chicken salad both before and after the two fatal cases occurred and that likely would have continued to produce contaminated products.

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